الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY

United Arab Emirates

Air Accident Investigation Sector

Serious Incident
–Final Report–

AAIS Case Nº: AIFN/0010/2018

Runway Confusion
Takeoff from Wrong Runway

Operator:	Air Arabia
Make and Model:	Airbus A320-214
Nationality and Registration:	The United Arab Emirates, A6-ANV
Place of Occurrence:	Sharjah International Airport
State of Occurrence:	The United Arab Emirates
Date of Occurrence:	18 September 2018

This Investigation was conducted by the Air Accident Investigation Sector of the United Arab Emirates pursuant to Civil Aviation Law No. 20 of 1991, in compliance with Air Accident and Incident Investigation Regulation, and in conformance with the requirements of Annex 13 to the Convention on International Civil Aviation.

This Investigation was conducted independently and without prejudice. The sole objective of the investigation is to prevent future aircraft accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

The Air Accident Investigation Sector issued this Final Report in accordance with national and international standards and best practice. Consultation with applicable stakeholders, and consideration of their comments, took place prior to the publication of this Report.

The Final Report is publicly available at:

http://www.gcaa.gov.ae/en/epublication/pages/investigationReport.aspx

The Air Accident Investigation Sector
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Occurrence Brief

Occurrence File Number	:	AIFN/0010/2018
Occurrence Category	:	Serious Incident
Name of the Operator	:	Air Arabia
Manufacturer	:	Airbus Industries
Aircraft Model	:	Airbus A320-214
Engines	:	Two, CFM56-5B4
Nationality	:	The United Arab Emirates
Registration	:	A6-ANV
Manufacturer Serial Number	:	5984
Type of Flight	:	Scheduled Passenger
Flight Number	:	ABY111
State of Occurrence	:	The United Arab Emirates
Place of Occurrence	:	Sharjah International Airport
Date and Time	:	18 September 2018, 1225 UTC
Total Crewmembers	:	6 (two flight and four cabin crewmembers)
Total Passengers	:	42
Injuries to Passengers and Crew	:	0

Investigation Process

The Air Accident Investigation Sector of the United Arab Emirates (AAIS) was notified about the occurrence by a phone call from the operator to the Duty Investigator (DI) Hotline number +971 50 641 4667.

After the assessment, the AAIS classified the occurrence as a ‘serious incident’.

Accredited representative was assigned by the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation civile (BEA) of France as being the State of Design and Manufacture of the aircraft. The BEA accredited representative was assisted by advisers from Airbus. In addition, the operator assigned a technical expert to assist the investigator-in-charge.

The scope of this investigation is limited to the relevant flight operations, related aircraft systems, relevant human factors, and air navigation.

Notes:

[1] Whenever the following words are mentioned in this Report with the first letter capitalized, it shall mean:

- (Aircraft) – the aircraft involved in this serious incident
- (Commander) – the commander of the flight
- (Copilot) – the copilot of the flight
- (Incident) – this investigated serious incident
- (Investigation) – the investigation into the circumstances of this serious incident
- (Report) – this investigation Final Report.

2 Photos and figures used in this Report are taken from different sources and are adjusted from the original for the sole purpose of improving the clarity of the Report. Modifications to images used in this Report are limited to cropping, magnification, file compression, or enhancement of color, brightness, contrast or insertion of text boxes, arrows or lines.

3 Unless otherwise mentioned, all times in this Report are UTC. Local time in the United Arab Emirates is UTC plus 4 hours.

Abbreviations

A/THR	Auto thrust
AAIS	The Air Accident Investigation Sector of the United Arab Emirates
ACARS	Aircraft Communications Addressing and Reporting System
AIFN	Accident/Incident File Number
ASR	Air safety report
ATC	Air traffic control
ATIS	Air traffic information system
ATPL	Air transport pilot license
CAS	Calibrated airspeed
CAR	Civil Aviation Regulations
CAVOK	Ceiling and visibility okay
CRM	Crew resource management
EFIS	Electronic flight instrument system
E/WD	Engine warning display
FCOM	Flight crew operating manual
FCTM	Flight crew technique manual
FCU	Flight control unit
FDR	Flight data recorder
FFS	Full flight simulator
FLX/MCT	Flexible temperature/maximum continuous thrust
FMA	Flight mode annunciator
hPa	hectopascal
IOE	Initial online experience
LTC	Line training captain
MCDU	Multi-purpose control and display unit
MPL	Multi-crew pilot license
OFP	Operational flight plan
PF	Pilot flying
PFD	Primary flight display
PM	Pilot monitoring
QNH	Atmospheric pressure (Q) at nautical height
RMP	Radio management panel

RT	Radio telephony
RWY	Runway mode in FMA
OMSJ	Sharjah International Airport
OOSL	Salalah International Airport
SO	Second officer
SOP	Standard operating procedure
TRE	Type rating examiner
TRI	Type rating instructor
TOGA	Takeoff/go-around
UAE	The United Arab Emirates
UTC	Universal time coordinated

Synopsis

On 18 September 2018, an Air Arabia Airbus A320 Aircraft, registration A6-ANV, operating scheduled passenger flight ABY111, departed the gate at Sharjah International Airport (OMSJ), the United Arab Emirates, to Salalah International Airport (OOSA), Sultanate of Oman. The flight had 48 persons onboard, consisting of two flight crewmembers, four cabin crewmembers, and 42 passengers. After obtaining air traffic control clearance for takeoff, the Aircraft took off from runway 12 instead of runway 30.

The Copilot, under training, was the pilot flying (PF) and occupied the right cockpit seat. The Commander on the flight was a training captain and occupied the left seat.

As part of the Copilot's training, the Commander had briefed that a rolling takeoff would be conducted. The responsibility for engine start was the Commander's. The Copilot taxied the Aircraft whereas the Commander was on the radio communications.

Tower air traffic control gave clearance for an intersection takeoff from taxiway Bravo 14 for runway 30, which required a left turn for the correct runway. Thereafter, the *before takeoff checklist* 'below the line' items were completed by the flight crew.

Instead of steering the Aircraft left following runway 30 lead-on lines from Bravo 14 intersection, the Copilot steered the Aircraft right for runway 12. The Copilot called out that RWY was not showing on the flight mode annunciation (FMA) after the thrust levers were moved to the FLX/MCT detent. As the Aircraft accelerated through 57 knots, the Commander realized that the Aircraft was on the wrong runway and immediately took over control. His decision to continue the takeoff was based on his perception that there was insufficient available runway for rejecting the takeoff. The Commander advanced the thrust levers to TOGA detent and nine seconds after, changed the Aircraft flap setting from 1+F to flap 2 position. The Aircraft lifted off 20 to 40 meters beyond the end of runway 12. No. 3 main wheel tire received cuts when it struck one approach light during the liftoff.

Tower controller did not detect that the Aircraft had turned unto runway 12 and only noticed when the Aircraft was about eight seconds before liftoff.

The Commander handed over controls to the Copilot and the flight continued uneventfully to the planned destination.

Safety recommendations in this Report are addressed to the Operator and the air navigation service provider who developed safety actions for risk mitigation.

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1. Factual Information

1.1 History of the Flight

On 18 September 2018, Air Arabia Airbus A320 Aircraft, registration A6-ANV, was scheduled to operate commercial flight ABY111 from Sharjah International Airport (OMSJ), the United Arab Emirates, to Salalah International Airport (OOSA), Sultanate of Oman. The flight occupants were the Commander, who was a training captain, the Copilot, whose designation was a second officer under training, 4 cabin crewmembers, and 42 passengers.

The flight crew were off duty for 33 hours before the flight. They arrived at the Operator's dispatch at approximately 1120 UTC.

The flight preparation went normally, and there was no evidence of rushing the *before start* checklist. The take-off mass was well below the maximum.

The flight documents, including the weather report, operational flight plan (OFP), and departure procedures, were checked and discussed between both flight crewmembers before the flight.

The Copilot was the pilot flying (PF), and it was her first flight to OOSA. The Commander stated that he briefed the Copilot that the taxi would be on a single engine with the second engine start during the taxi. The Commander briefed the Copilot for intersection and rolling takeoff as part of her training subjects. The responsibility for engine start and air traffic communications was the Commander's, whereas the Copilot was responsible for taxiing the Aircraft.

The Aircraft take-off mass was 56.7 tons, center of gravity 27.36%, and the fuel on-board 10,100 kg. The Aircraft configuration for takeoff was flap setting of 1+F using engine thrust setting at FLX/MCT (Flex temperature of 67 degrees Celsius). The OFP 'take-off data' speeds were: 122 knots V_1; 127 knots V_R; and 129 knots V_2. The flight crew entered all relevant flight performance data, including the runway in use 'runway 30', in the Aircraft flight management system (FMS) through the multipurpose control and display unit (MCDU).

According to the Operator's procedure, the flight crew were provided with OFP that included the calculated speeds, but it did not include the accelerate-stop distance required to safely stop the Aircraft in case of rejected takeoff. The OFP stated in the matrix of data that for a takeoff on runway 30 at Bravo 14 intersection, the take-off distance available would be 3,050 meters, which was about 1,000 meters shorter that the runway length.

The pushback clearance was given to face east for runway 30. During the pushback from the parking stand, the left engine (No. 1) was started by the Commander. At 1220:22, the ground air traffic control (ATC) granted taxi clearance which stated: "taxi runway three-zero, Bravo one-four, taxi Alpha and Alpha 14 at the holding point contact Tower."

At 1220:55, the taxi commenced. At 1221:43, during the taxi, the right engine (No. 2) start was completed by the Commander and the Aircraft reached Bravo 14 runway 12/30 holding point at 1223.52. The parking brake was set, and the flight crew completed the *before takeoff checklist* 'down to the line'.

At 1224:21, the Commander communicated with the Tower stating: "Good afternoon, Arabia triple-one Bravo fourteen ready for departure." The Commander read back the Tower clearance stating: "Clear for takeoff, Bravo fourteen, Runway three zero Arabia triple one. Thank you." The crew did not inform the Tower about the planned rolling takeoff. The Copilot then asked the Commander for completion of the *before takeoff checklist* 'below the line' check items.

At 1224:35, the flight data recorder (FDR) confirmed that autobrake MAX deceleration rate was selected, and at 1224:39, the Aircraft parking brake was selected OFF. Shortly after, the Aircraft started moving towards runway 12/30 on idle thrust.

At 1225:32, the Copilot increased both engines' thrust above idle power and started a right turn from heading 30 degrees towards runway 12. The Commander stated that when the Aircraft entered runway 12 his sight was directed inside the cockpit completing the items of the *before takeoff checklist.* The Copilot advanced the thrust levers while the Aircraft aligned on runway 12. Tower controller was unaware that the crew had mistakenly turned onto runway 12 instead of runway 30.

At 1225:40, flight ABQ213, A320 aircraft, completed taxiing and stopped at taxiway Bravo 20, holding point for runway 30, waiting for take-off clearance.

At 1225:51, at 20 knots ground speed, the Copilot applied a nose down sidestick input of positive 8 degrees and within three seconds had advanced both thrust levers to FLX/MCT position. The Copilot stated that while the ground speed was increasing, she was busy with the monitoring the engine power and line-up. She then noticed and called out that the flight mode annunciator (FMA) was showing NAV instead of RWY.

At 1225:57, 31 knots ground speed, both engines thrust reached 87% N1, and the Aircraft accelerated from 1 to 4 meters per second.

As per the Commander’s statement, he was busy completing the *before takeoff checklist* and did not realize that the Aircraft had turned right onto runway 12 instead of runway 30. He shortly realized that the Aircraft was on the wrong runway but decided to continue the takeoff believing that the remaining take-off runway available was insufficient to reject the takeoff. The Commander stated: “I saw the end of runway coming.” He immediately advanced both engine thrust levers to the takeoff/go-around (TOGA) position. The FDR data indicated that this action occurred at 1226:01, 57 knots calibrated airspeed (CAS), and 63 knots ground speed, and 730 meters remaining runway. The Copilot was still applying a nose down sidestick input of 6 degrees.

At 1226:03, 67 knots CAS (72 knots ground speed), both engines attained TOGA engine thrust, 94.4% N1 speed.

At 1226:09, 106 knots CAS (114 knots ground speed), Tower contacted the flight crew upon noticing the Aircraft rolling at the wrong runway. There was no response from the flight crew.

At 1226:10, 109 knots CAS (120 knots groundspeed), the Commander moved the slat/flap levers to Flap 2 position (CONF2), and accordingly the slats and flaps began to extend.

At 1226:12, 122 knots CAS (130 knots ground speed) the Commander initiated a nose-up sidestick input of 8.3 degrees that subsequently increased to 9.2 degrees. FDR data recorded the nose landing gear lifted off at this time with a positive increase in Aircraft pitch angle passing 1.9 degrees. Simultaneously, the Copilot was still applying a sidestick nose down of 3 degrees and maintained at this position.

At 1226:14, 127 knots CAS (140 knots ground speed), the slats and flaps reached the selected Flap 2 position.

The Aircraft pitch-up angle increased up to 9.1 degrees, and at 1226:16, CAS passing 132 knots, the Aircraft lifted off from runway-end safety area at about 30 meters beyond the end of runway 12.

At 1226:17, following liftoff, the Aircraft pitch angle decreased to positive 7.7 degrees. Nose-up input of 8.3 degrees was applied again on the Commander's sidestick, and the Aircraft pitch angle began to increase thereafter.

Unknown to the flight crew, during the liftoff, the No. 3 main gear wheel tire struck and damaged a runway approach light.

At 1226:23, the Aircraft radio altitude passing 140 ft and 12.3 degrees pitch-up angle, Tower radioed the flight crew for the second time.

At 1226:26, while the Aircraft was at 260 ft above ground level, the Commander responded to Tower. Thereafter, the flight continued uneventfully with the Copilot as the pilot flying.

In his interview, the Commander stated that after landing at OOSA, the Operator control center informed the crew about the incident and discussed returning to OMSJ in a scheduled flight. He also added that he did not observe Aircraft structural damage or marks on the wheels during the walk-around in OOSA. Accordingly, he decided to return to OMSJ.

The return flight was uneventful, with the Commander as the pilot flying.

1.2 Injuries to Persons

There were no injuries to the flight crew, cabin crew, or the passengers because of the Incident

Table 1. Injuries to persons

Injuries	Flight Crew	Cabin Crew	Other Crewmembers Onboard	Passengers	Total Onboard	Others
Fatal	0	0	0	0	0	0
Serious	0	0	0	0	0	0
Minor	0	0	0	0	0	0
None	2	4	0	42	48	0
Total	2	4	0	42	48	0

1.3 Damage to Aircraft

The Aircraft was intact. The No. 3 main wheel tire on the right main landing gear struck a runway approach light located at the runway-end safety area, which resulted in cuts to the inboard sidewall and tread (figure 1). The tire remained inflated during the flight. As per the Commander's statement, he could not notice any cuts on the tire as the cut was on the lower invisible part of the tire.

Figure 1. Damaged No. 3 main wheel tire

1.4 Other Damage

The No. 3 main wheel tire struck the runway 30 approach light. The support post of the approach light was made of steel and was bolted to the runway surface with a height of 70 centimeters. The base of the light support structure was completely detached, and the light assembly was broken (figure 2). The damaged approach light was located on the runway end safety area (RESA) (figure 3).

Figure 2. Damaged runway 30 approach light

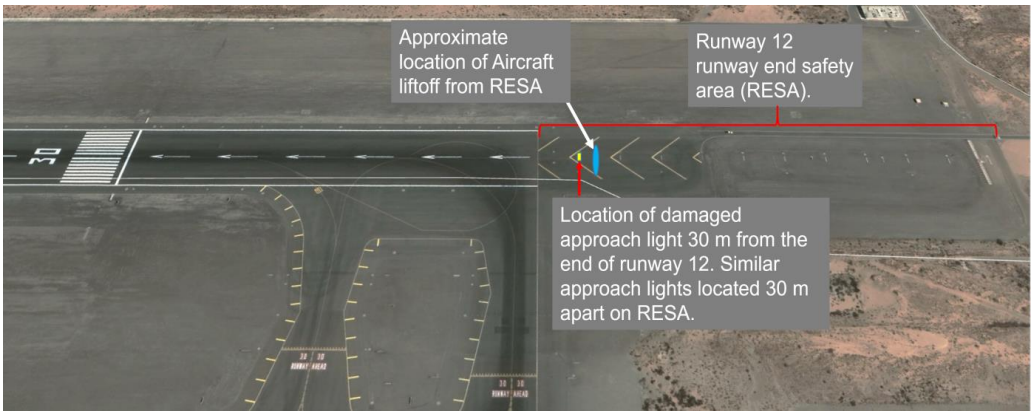


Figure 3. Location of the damaged runway 30 approach light on the runway end safety area (RESA)

1.5 Personnel Information

1.5.1 Flight crew information

The Commander was a qualified training captain with 22,184 total flight hours. He held a valid class 1 medical certificate. He stated that he was fit for duty on the day of the Incident. Besides his simulator sessions for rejected takeoffs, the Investigation was unable to confirm if the Commander had performed any A320 rejected takeoff during his career.

The Copilot joined the Operator as a second officer trainee pilot under a designated training program called *initial online experience (IOE)*. The Copilot held a valid multi-crew pilot license (MPL), a valid class 1 medical certificate. She stated that she was fit for duty on the day of the Incident.

The Copilot's training program was designed to train new joiners on full flight simulators (FFS) with no turbo-jet engine aircraft experience. As a part of her training, she was required to complete 100 sectors of line flying during the five stages of the MPL training program.

The Copilot was on stage five of the training program after successfully completing stage four as part of the second officer's training to remove the restrictions related to proper handling techniques for:

- Taxi techniques
- Speed control
- Altitude and thrust coordination, instrument scan
- Descent profiles and stabilized approaches
- Landing techniques (including crosswind)
- PM [pilot monitoring] duties
- Situational awareness and forward planning.

Accordingly, the Copilot was released to perform the duties of the pilot flying without the supervision of a cover pilot[1].

The Commander and the Copilot were together on a four-day pairing and had operated four uneventful sectors together on 16 and 17 September. The Copilot was the pilot flying for the two departures from OMSJ, and both were intersection takeoff at Bravo 6 for runway 12. The Investigation did not find negative observations or comments about the Copilot's performance by previous instructors.

Table 2 illustrates the flight crew information.

Table 2. Crew information

	Commander	Copilot
Age	51	34
Type of license	ATPL-A	MPL
Valid to	24 Aug 2021	24 June 2026
Rating	IR/MPA/A320	IR/MPA/A320
Total flying time (hours)	22184	159.88
Total on this type (hours)	15536	159.88
Total last 90 days (hours)	220.01	157.97
Total on type last 90 days (hours)	220.01	157.97
Total last 7 days (hours)	21.57	19.19
Total on type last 7 days (hours)	21.57	19.19
Total last 24 hours (hours)	0	0
Last line check	10 September 2018	NA
Medical class	Class I	Class I
Valid to	12 August 2019	2 January 2019

[1] The Operator's *operation manual-part A* (*OM-A)* states: Cover Pilot "A pilot serving in any capacity other than the pilot-in-command, who is onboard the aircraft for the main purpose of replacing the trainee pilot during his inability to operate or succeeding the commander in the event of his incapacitation." … "A cover pilot may be any crew qualified to operate from at least one of the pilot seats of the aircraft type"

1.5.2 Air traffic controller

The air traffic controller held a valid air traffic control license with 'aerodrome controller' rating, and class 1 medical certificate with level-6 English proficiency.

The roster of the air traffic controller showed that his duty on the Incident day was on the afternoon shift after three days of day-duty. As per the controller's statement, he was fit for duty and, was responsible for managing simultaneously both the Ground and Tower frequencies at the time of the Incident.

The controller stated that he was busy with multi-tasks at the time, granting take-off clearance to ABY111. He was monitoring Air Blue flight, ABQ213 to ensure that the aircraft was holding short of runway 30 at Bravo 20 holding point; visually scanning runway 30 approach path and the departure end of runway 30; and checking the strip markings on the flight progress strips.

The controller was relieved from duty after the Incident, in accordance with Sharjah Air Navigation Services policy contained in the *operations manual of air traffic services*.

1.6 Aircraft Information

The Airbus A320 is a medium-range, civil transport aircraft. It is equipped with two high bypass CFM56-5B4 turbofan engines mounted under the wings. Figure 4 illustrates the Aircraft dimensions.

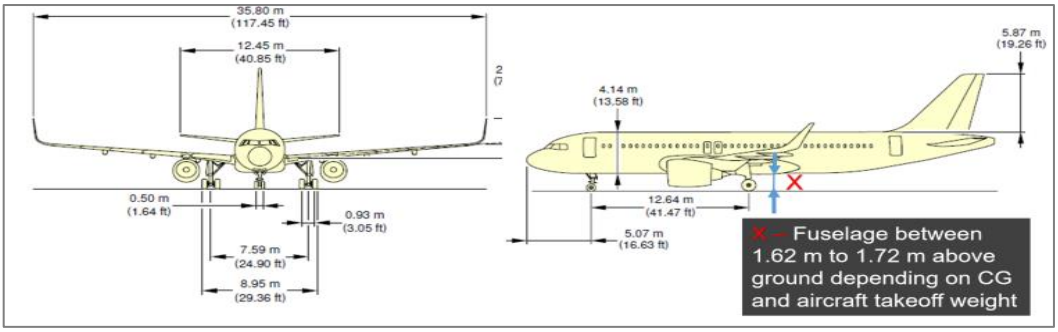


Figure 4. Airbus A320 dimensions

1.6.1 Aircraft data

Table 4 provides general Aircraft data at the time of the Incident.

Table 3. Aircraft data	
Manufacturer:	Airbus Industries
Model:	A320-214
MSN:	5984
Date of manufacture:	February 2014
Nationality and registration mark:	The United Arab Emirates, A6-ANV
Certificate of airworthiness	
Number: Issue date: Valid to:	ARC-AA-ANV-5 31 January 2018 19 February 2019
Certificate of registration	

Number: Issue date: Valid to:	UAE-COR-0664 30 March 2015 Open
Date of delivery:	21 February 2014
Last major inspection and date:	A-Check, 12 September 2018

1.6.2 Engines data

Table 5 illustrates the engines data at the time of the Incident.

Table 4. Engine data

	Left (No.1) engine	Right (No.2) engine
Manufacturer/model	CFM International/ CFM56-5B4	
Date installed	6 March 2018	13 February 2014
Time since new (hours)	25,026:47	21,788:38
Cycles since new	9,514	8,183
Time (hours)/cycles since last inspection (hours)	2,663:26/1,045	1,024:57/406

1.6.3 Flight mode annunciator

The flight mode annunciator (FMA) is divided into five columns and is an integral part of the cockpit's primary flight display (PFD). Each column describes the automation mode applied by the aircraft computers based on the selection made by the flight crew via the flight control unit (FCU) and the data inserted in the MCDU.

As per the Aircraft's manufacturer *flight crew operating manual (FCOM*), during line-up on the runway for takeoff, the lateral mode column indicates RWY in green color as illustrated in figure 5, provided the following conditions are fulfilled:

- The conditions required for SRS mode engagement are:
  - V_2 is inserted in the MCDU PERF TAKEOFF page
  - Slats are extended
  - The aircraft has been on ground for 30 seconds
- The aircraft is receiving a LOC signal and LOC deviation is less than ½ dot;
- The aircraft heading is within 20 degrees of the ILS related course; and
- The ILS course is identical to the runway heading of the origin airport as selected for the active flight plan, if any.

1.6.4 Autobrake system

As per the *FCOM*, the aircraft autobrake system is to:

- Reduce the braking distance in case of an aborted takeoff; and
- Establish and maintain a selected deceleration rate during landing, thereby improving passenger comfort and reducing crew workload.

The flight crew can select the autobrake deceleration rate of low, medium or maximum by a pushbutton. As per the standard operating procedure (SOP), the selection of maximum braking is required for takeoff at all times.

1.6.5 Thrust lever detent positions

The A320 thrust levers can be positioned in six detents along with the console panel. The six detents divide each of the thrust lever sectors into five segments. The positions are:

- **REV MAX:** Maximum reverse thrust
- **REV IDLE:** idle reverse thrust
- **FWD IDLE:** idle forward thrust
- **IDLE:** Idle thrust for both forward and reverse thrust
- **CL:** Maximum climb thrust
- **FLX/MCT:** Flex takeoff/maximum continuous thrust
- **TOGA:** Maximum takeoff or go-around thrust.

1.6.6 Flaps lever position

There are five flaps lever positions in the A320. Table 6 includes information related to the flap lever position, slats and flaps actual position, and the phase of flight for each of the flap lever position:

Table 5. Slats/flaps positions in Airbus A320

Lever Position	Slats Position	Flaps Position	Phase of Flight
0	0	0	Cruise
1 /1+F	18/18	0/10	Takeoff
2	22	15	Takeoff and Approach
3	22	20	Takeoff, Approach and Landing
Full	27	35	Landing

The positions of the flaps and slats are displayed on the engine warning displays (E/WD) which are centrally located in the cockpit.

1.6.7 Side stick priority

The two sidesticks on the A320 are not mechanically linked. Therefore, both sidesticks may be operated independently of each other. When both sticks moving simultaneously, the system sums up the signals of both pilots algebraically.

A priority pushbutton is provided on each stick to avoid both signals being added by the system. By pressing this button, a pilot may cancel the inputs of the other pilot. An audio signal will indicate which sidestick has priority and a red light comes on in front of the pilot whose stick is deactivated. A green light will come on in front of the pilot who has taken control if the other stick is not in the neutral position.

1.7 Meteorological Information

Sharjah International Airport meteorological terminal aviation routine weather report (METAR) for the departure stated:

> "Information Papa, Runway 30 in use, Wind 330/11, CAVOK, Temperature 38/ Dew point 21, QNH 1005 hPa NO SIG="

The METAR of the OMSJ at the time of the Incident stated that runway 30 was in use for takeoff, and the wind was blowing from direction 330 degrees at 11 knots. There were no clouds; visibility was more than 10 kilometers, ambient temperature was 38 degrees Celsius, and no significant change was expected.

At 1225, the time of takeoff for flight ABY111, the sun elevation was 25 degrees above the horizon at 260 degrees west. Sunset at OMSJ was at 1419, 272 degrees west.

1.8 Aids to Navigation

The Aircraft was equipped with the required navigational equipment. All ground and onboard navigation equipment were serviceable.

1.9 Communications

The communication between the flight crew and the air traffic control was audible and clear. The timings recorded by the air traffic communication audio recordings were similar to the Aircraft FDR timings.

At the time of the Incident, Tower and Ground control positions were managed by one controller. There were two aircraft each on the Tower and Ground frequency. The following was the communication between the flights and the OMSJ air traffic controller:

- At 1216:41, the ground gave clearance for pushback stating "Arabia triple-one push and start approved from stand six, face to the east." The Commander read back the Ground instructions correctly.
- At 1220:13, the Commander requested ground "Arabia triple one requesting taxi Bravo fourteen, thank you."
- At 1220:15, the Ground gave ABY111 clearance for taxi "Arabia triple-one runway three zero bravo one four taxi Alpha and Alpha one four at holding point contact Tower."
- At 1220:22 the Commander replied stating "Alpha Alpha one four at the holding point contact Tower Arabia triple one."
- At 1224:21, the Commander communicated with the Tower stating "Good afternoon Arabia triple one Bravo fourteen ready for departure."
- At 1224:24, Tower gave clearance for takeoff stating "Arabia triple one Sharjah Tower runway three zero, Bravo one four the wind three two zero at one zero, cleared for takeoff."
- At 1224:30, the Commander read back Tower clearance stating "Clear for takeoff Bravo fourteen Runway three zero Arabia triple one thank you."
- Ae 1224:36, Tower communicated with Air Blue ABQ213 stating "Air Blue two one three monitor Tower hold short of runway three zero."

- At 1224:40, ABQ213 confirmed to Tower that were holding short of runway 30.
- At 1226:02, another flight, ABY189, contacted Tower stating “Just to confirm Arabia one-eight-nine ahhh we can Alpha one four Bravo one four[?]”
- At 1226:09, Tower tried to contact ABY111 stating “Arabia triple one Tower.”
- At 1226:12, ABY189, radioed Tower stating “Yeah just to conform we have aircraft runway one two just to confirm we continue to Bravo one four [?]”
- At 1226:19, Tower instructed ABY189 to standby.
- At 1226:23, Tower communicated with ABY111 stating “Arabia triple one Sharjah Tower.”
- At 1226:27, the Commander replied to Tower stating “Arabia triple one go ahead sir.”
- At 1226:29, Tower stated to ABY111 “Yes sir triple one runway three zero is in use sir.”
- At 1226:33, the Commander responded to Tower stating “Arabia triple one we recognize that now.”
- At 1226:35, Tower stated to ABY111 “Say again.”
- At 1226:37, the Commander replied to Tower stating “We recognize that now sir [uh] we take off [unintelligible] runway. Now we level off at runway heading two thousand.”
- At 1227:30, Tower instructed ABY111 to contact Dubai Departure.

The *aeronautical information publications (AIP)* of the United Arab Emirates required departures from OMSJ to contact Dubai Departure as soon as possible after passing 500 ft with initial climb restricted to 2,000 ft until further instructions are received from Dubai Departure.

1.10 Aerodrome Information

1.10.1 Runway 12/30 and taxiway signage

Sharjah International Airport has one concrete runway 12/30 with a length of 4060 meters long, 60 meters wide, and 7.5 meters hard surface shoulder on each side. Runway 12 and runway 30 has a displaced threshold of 300 meters. Appendix B of this Report illustrates Sharjah Airport Chart.

The slope of runway 12 over the last 1,500 meters is positive 0.6 percent. The runways center lighting consists of bi-directional, 15 meters spacing with the first 3,130 meters white, next 600 meters alternate white/red, and the last 330 m red. At the end of runways 12 and 30, there is a runway-end safety area (RESA) of 240 meters by 60 meters consisting of asphalt material for the first 124 meters and road base material for the remainder. The landing approach lights fitted on the RESA are spaced 30 meters apart, with the last light 30 meters before the start of the runway. The runways have no arresting system installed.

Figure 7 illustrates that when runway 30 is used for intersection takeoff at Bravo 14, a left turn is required, with a take-off distance available of 3052 meters. The taxiway centerline that leads to runway 12 and runway 30 is marked with a continuous 150 millimeter wide yellow line in accordance with the requirements of the Civil Aviation Regulations *CAR Part IX - Aerodromes*. In case a right turn is made, the aircraft will be on runway 12 with the runway available of 1006 meters,

and immediately in sight will be runway 30 touchdown zone white bar markings as well as the aiming point with start of runway 30 threshold white markings approximately 650 meters from Bravo 14 runway intersection.

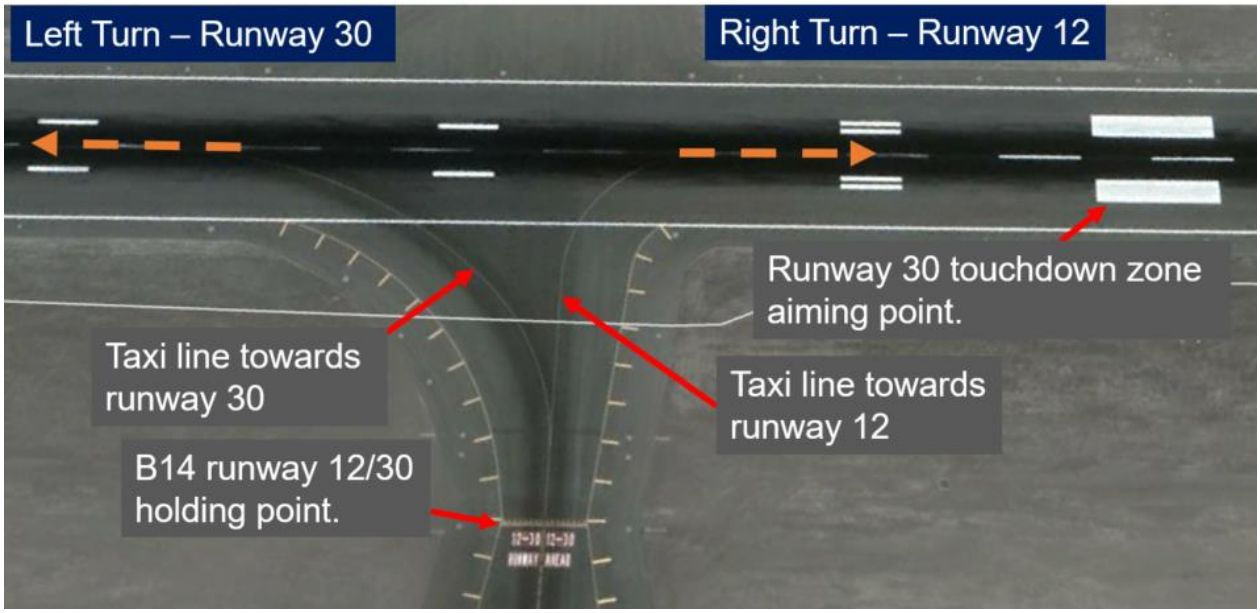


Figure 6. Taxiway Bravo 14 to runway 12/30 taxi lines

Figure 7. Taxiway Bravo 14 runway 12/30 holding point information signage

Additionally, for ABY111 Incident , the following was confirmed by the Investigation:

- Lead-on lights for runway 30 that were installed after stop-bar at Bravo 14 were OFF
- The uni-directional runway 30 edge lighting was at 30 percent setting
- The active runway, runway 30, in use was broadcasted on the air traffic information system (ATIS).

1.10.2 Air traffic control standby tower

The air traffic control standby tower was in operation during the time of Incident. Appendix B of this Report illustrates the location of the standby tower. The Investigation documented the following during the daylight visit to the standby tower air traffic control room:

- As illustrated in figure 9, a light pole at parking stand 24 obstructs the line of sight of the controller for aircraft at Bravo 14 runway holding point.
- From the assigned Tower and Ground positions, an A320 aircraft holding short of Bravo 14 stop bar, was not visible from the controller's seat.
- The controller's line of sight for taxiway Bravo 14 intersection with runway 12/30 extends approximately 1 kilometer.
- The height and location of the standby tower reduced the controller's visibility of runways, taxiways, and maneuvering areas. However, the controller's is able to move himself/herself to have a better view of aircraft at the holding point Bravo 14.
- Bravo 14 intersection with runway 12/30 was not monitored by the closed-circuit television (CCTV).
- There was no surface movement radar in the standby tower and none installed at Sharjah Airport.
- During taxi and take-off clearance, the controller stated the active runway in use.
- The controller accurately confirmed the readback by the flight crew.
- The controller had no provision to override a transmission from another flight crew.

Figure 8. Standby tower obstructed view of an Airbus A320 aircraft at Bravo 14 holding point

1.11 Flight Recorders

The Aircraft was equipped with a Honeywell Solid State FDR, part number 980-4700-042, and a Honeywell Solid State Cockpit Voice Recorder (CVR), part number 980-6022-001.

Both flight recorders were downloaded at Abu Dhabi Flight Recorders Laboratory. It was found that the CVR had been overwritten and contained no recorded information related to the Incident flight. The FDR data was valid.

At the request of the Investigation, the Aircraft manufacturer used the FDR data for analyzing the Aircraft's performance. The performance report received from the manufacturer revealed that the Commander did not take the side stick priority.

1.12 Wreckage and Impact Information

The Aircraft was intact.

1.13 Medical and Pathological Information

Post-Incident blood tests did not reveal any psychoactive materials that could have degraded the flight crew’s performance.

1.14 Fire

There was no evidence of fire.

1.15 Survival Aspects

None of the passengers or crew were injured.

1.16 Tests and Research

1.16.1 Rejecting take-off scenarios calculations

For flight ABY111, taking into consideration the dry runway surface, Aircraft take-off weight, Aircraft configuration and performance, and take-off wind conditions, the Investigation requested the Aircraft manufacturer to calculate if the Commander could have safely rejected the takeoff based on the following two scenarios:

- Applying maximum reverse thrust at the time when the Commander had selected TOGA thrust when the Aircraft CAS was 57 knots.
- Applying maximum reverse thrust instead of flap configuration 2 when the Commander selected flap 2 configuration with Aircraft CAS was 109 knots.

According to the Aircraft’s manufacturer calculation that at the time of the take-off initiation, the runway remaining was 984 meters. For both scenarios, it was possible to safely stop the Aircraft if maximum engine reverse thrust was used, automatically applying maximum braking. The calculated runway distance remaining were:

- For the first scenario, the Aircraft would have stopped 653 meters before the end of the runway.
- For the second scenario, the Aircraft would have stopped 45 meters before the end of the runway.

1.16.2 Simulator sessions at the Operator's flight simulator

The Investigation requested the Operator to perform simulator flight sessions using OMSJ airfield and runway visual cues, ABY111 flight plan data, and close to actual taxi speeds and taxi time to determine if it was possible to reject the takeoff. In addition, the simulator sessions were used to determine the time taken to perform the *before takeoff checklist* 'below the line' (see Appendix C to this Report) checks after take-off clearance was obtained at Bravo 14 runway holding point.

The Investigation concluded that the *before takeoff checklist* 'below the line' checks consisting of five check items took not more than 10 seconds to call and verify.

For the two simulator sessions, the Investigation determined that a rejected takeoff could have been safely performed based on the following:

- When the Commander realized that the Aircraft was on the wrong runway, the Aircraft CAS was between 57 to 63 knots. There was no body sensation of high speed based on the simulated external airfield and runway markings for OMSJ. By applying maximum engine reverse thrust, which would have automatically applied maximum autobrake, the simulator session determined that the Aircraft would have stopped some distance before runway 30 threshold.
- The second simulator session rejected takeoff was performed at 100 knots, as this speed, according to the Aircraft *flight crew techniques manual* (*FCTM)*, represents the high speed regime of the takeoff. Rejecting a takeoff at this speed as per the *FCOM* is a more serious matter, and a decision needs to be executed carefully. The simulator session determined that the Aircraft would have stopped close to runway 30 threshold using maximum engine reverse thrust and maximum autobrake.

1.17 Organizational and Management Information

1.17.1 The Operator

1.17.1.1 General

The Operator's fleet consisted of A320, with the main base at Sharjah International Airport.

During August and September 2018, Sharjah Airport departure records indicated that 85.5 percent of the Operators departures were from Bravo 14 intersection, and 14.5 percent of the departures were performed using the full length of runway 30 from Bravo 20. The ABY111 Incident flight was the first occurrence for the Operator.

From June 2018, only the Operator was permitted by the airport authority to perform intersection takeoffs.

The Operator's *operations manual-part A (OM-A)* stated that for the "Selection of Take-off Position. There are runways at various airports where takeoffs from intersections can increase operational efficiency without compromising safety. Flight crew are authorized to perform intersection takeoffs provided that the appropriate RTOW [regulated take-off weight] and TLR [take-off and landing report (performance)] performance data is available."

The Operator's *OM-A ─ Critical Phase of Flight*, stated:

> "…operations involving taxiing, take-off, landing and all flight operations below 10,000 feet, and any phase of flight [is] at the discretion of the Commander."

The Operator's *OM-A* policy sets a "Maximum taxi speed of 30 knots as specified in the Flight Crew Training [Technique] Manual". Additionally, prior to aircraft taxi, the OM-A ─ *General Taxi Guidance* stated that:

> "Prior to commencing taxi pilots should verbally agree between themselves on the taxi route, turns … etc. At all times, both pilots should have the taxi charts open and visible…"
>
> …
>
> "Crew shall ensure that no two heads are down at the same time, i.e. pilot flying shall monitor the taxi line and outside clearance at all times and if becomes necessary to shift his focus inside the aircraft, he should hand over control to the other pilot.

Before commencement of the take-off roll, the *OM-A ─ Line-up and Positive Runway Identification* stated: "…both pilots shall verify that the aircraft is lined up on the correct runway and closely as possible to the runway centerline by utilizing runway markings, ILS [instrument landing system] verification, etc."

For prevention of runway incursions, the *OM-A ─ Runway Incursions Policy* stated to the flight crew to perform "Takeoff and landing runway verification and crosscheck" and includes a list of other verifications, including the following statements:

> "During pre-flight/approach preparation all available information should be used to familiarize with so called "Hotspots", as indicated on the airport ground charts (AGC). Adequate communication and CRM [crew resource management] during taxi, proper knowledge of airport surface markings, lights and signs, proper preparation of expected taxi out/in routing, adequate taxi technique, adequate aircraft lighting, and continuous area screening will mitigate this risk of runway incursion."

1.17.1.2 Single engine taxi policy

The Operator allows single-engine taxi as per the policy stated in the *OM-A ─ One Engine Taxi Operations:*

> "One engine taxi is authorised except in some operational conditions, such as uphill slope, slippery taxiways, or high gross weight. The flight crew must exercise caution when taxiing on one engine to avoid generating excessive jet blast. Some countries may also impose additional restrictions to single engine taxi."

After the engine start, the *FCOM* restricts the flight crew from selecting a high engine power setting for two minutes to avoid a thermal shock to the engine.

1.17.1.3 Normal checklist and FMA callouts

The Operator's *Normal Checklist (*Appendix C to this Report), provides details on the checks required for each phase flight. The use of checklist was mandatory in flight, as it ensures that all necessary checks are completed in sequential order. The *OM-A ─ Use of Checklists*, stated:

> "
>
> …
>
> Strict adherence to checklist must be observed at all times and the crewmember's concerned must not call the next item until the current item is checked and the appropriate response is given.
>
> …

> As soon as a required checklist is complete, the crew member reading it will call " … Checklist Complete" (e.g. "Landing Checklist Complete")."

According to the *FCTM*, it was mandatory to monitor the FMA, announce the FMA, confirm the FMA, and understand the FMA. For FMA callouts, the *FCOM* stated:

> "Therefore, the PF should announce:
>
> - All armed modes with the associated color (e.g. blue, magenta): "G/S blue", "LOC blue".
> - All active modes without the associated color (e.g. green, white): "NAV", "ALT".
>
> The PM should check and respond, "CHECKED" to all FMA changes called out by the PF."

1.17.1.4 Take-off SOP

The *FCOM* SOP for *before takeoff* required the flight crew to check the "Approach Path…Cleared of Traffic" visually and use the aircraft traffic collision and avoidance system (TCAS) on the navigation display (ND). For *Takeoff Runway* confirmation, the *FCOM* stated:

> "Confirm that the line-up is performed on the intended runway. Useful aids are:
>
> - The runway markings,
> - The runway lights,
>
> Be careful that in low visibility, edge lights could be mixed up with the center line lights.
>
> - The ILS signal,
>
> If the runway is ILS equipped, the flight crew can press the ILS pb (or LS pb):
>
> The LOC deviation should be centered after line up.
>
> - The runway symbol on the ND,
> - The Runway Awareness and Advisory System."

In accordance with the *FCOM Takeoff* procedure, the pilot flying is required to announce 'Takeoff' and advance the thrust levers to 50% N1. The *FCOM* stated:

> "To counter the nose-up effect of setting engine takeoff thrust, apply half-forward sidestick until the airspeed reaches 80 knots. Then, release the sidestick gradually to reach neutral at 100 knots."

During the take-off roll, the pilot flying will monitor and call the FMA indications after the thrust levers are positioned at the FLX/MCT or TOGA detent. If the Copilot is the pilot flying, the commander will place his hands on the thrust levers until the aircraft has attained V_1 speed. Below 80 knots, the pilot monitoring is required to call 'Takeoff N1', 'Thrust Set' and monitor PFD and engine indications. On reaching 100 knots, the pilot monitoring has to call "One hundred knots" and the pilot flying shall cross-check and confirm the speed indicated on the PFD. The *FCOM* then stated:

> "…
>
> - Below 100 knots the Captain may decide to abort the takeoff, depending on the circumstances
> - Above 100 knots, rejecting the takeoff is a more serious matter."

1.17.1.5 Side stick priority

For control of side stick, the *FCOM* stated that only one pilot should fly the aircraft:

> "At all times, only one flight crewmember should fly the aircraft. However, if both flight crewmembers use their sidesticks simultaneously, their orders are algebraically added. The flight control laws limit the combined order to the equivalent of the full deflection of one sidestick. In this case the two green SIDE STICK PRIORITY lights on the glare shield come on and "DUAL INPUT" voice message is activated. A flight crewmember can deactivate the other sidestick and take full control, by pressing and keeping pressed the sidestick push button. To deactivate the other sidestick, the flight crewmember must press their sidestick push button for 40s. The other sidestick is permanently deactivated, until any flight crewmember presses their sidestick push button."

To transfer control, the *OM-A ─ PF/PNF Duties Transfer*, stated that flight crewmembers must use the following callouts:

> "To give control: The pilot calls out "YOU HAVE CONTROL". The other pilot accepts this transfer by calling "I HAVE CONTROL", before assuming PF duties.
>
> To take control: The pilot calls out "I HAVE CONTROL". The other pilot accepts this transfer by calling out "YOU HAVE CONTROL", before assuming PF duties."

1.17.1.6 Rejected takeoff

The *OM-A* policy gives the responsibility to the Commander to decide whether a takeoff is continued or rejected. The *OM-A* stated: "Rejected takeoff can be hazardous, even if correct procedures are followed." The *OM-A* listed several reasons why a takeoff may be rejected which included "Incorrect runway line-up technique". In addition, the *OM-A ─ Control of Aircraft*, stated:

> "**...** The decision to continue the take-off or to reject rests solely with the Captain.
>
> V_1 take-off reference speed is used when deciding whether to reject or continue.
>
> If a serious malfunction or other condition that renders the aircraft unsafe for flight is recognised before V_1, the take-off must be rejected."

The *FCTM Rejected Takeoff* signifies the potential hazards and discusses topics including Decision Making, Speed Considerations, Decision Callouts, and RTO [rejected takeoff] Technique". The *FCTM* stated:

> "
>
> "… The line-up technique is very important. The pilot should use the over steer technique to minimize field length loss and consequently, to maximize the acceleration-stop distance available."
>
> …
>
> **"SPEED CONSIDERATIONS**
>
> To assist in the decision making process, the takeoff is divided into low and high speeds regimes, with 100 kt being chosen as the dividing line. The speed of 100 kt is not critical but was chosen in order to help the Captain make the decision and to avoid unnecessary stops from high speed.
>
> ● **Below 100 kt:**
>
> The decision to reject the takeoff may be taken at the Captain's discretion, depending on the circumstances.

> The Captain should seriously consider discontinuing the takeoff, if any ECAM warning/caution is activated.
>
> **● Above 100 kt, and below V_1:**
>
> Rejecting the takeoff at these speeds is a more serious matter, particularly on slippery runways. It could lead to a hazardous situation, if the speed is approaching V_1. At these speeds, the Captain should be "go-minded" and very few situations should lead to the decision to reject the takeoff:
>
> …
>
> **● Above V_1:**
>
> Takeoff must be continued, because it may not be possible to stop the aircraft on the remaining runway.
>
> …
>
> **Decision Callouts**
>
> The decision to reject the takeoff and the stop action is the responsibility of the Captain and must be made prior to V_1 speed. It is therefore recommended that the Captain keeps his hand on the thrust levers until the aircraft reaches V_1, whether he is Pilot Flying (PF) or Pilot Monitoring (PM).
>
> - If a malfunction occurs before V_1, for which the Captain does not intend to reject the takeoff, he will announce his intention by calling "GO".
>
> - If a decision is made to reject the takeoff, the Captain calls "STOP". This call both confirms the decision to reject the takeoff and also states that the Captain now has control. It is the only time that hand-over of control is not accompanied by the phrase "I have control".”

The *OM-A — Flight Preparation Instructions*, under the heading of *Take-off* stated “… when determining the maximum permitted take-off weight …” that “The accelerate-stop distance must not exceed the accelerate-stop distance available” and defines “Accelerate-stop Distance Available” as: “The length of the take-off run available plus the length of stop-way, if such stop-way is declared available by the appropriate Authority and is capable of bearing the weight of the aircraft under the prevailing operating conditions.”

1.17.1.7 Incapacitation of flight crewmembers

The *OM-A* policy stated:

> “Incapacitation of a crew member is defined as any condition which affects the health of a crew member during the performance of duties which renders him incapable of performing the assigned duties.”

The incapacitation conditions stated in the *OM-A* addressed identification and actions required and assumed that the aircraft is already airborne above and below 1,000 ft above ground level (AGL) including approach. The *OM-A* did not address crew incapacitation during takeoff. Actions required in the *Event of Pilot Incapacitation* included:

> “
>
> - Assume control and announce “I Have Control”, return the aircraft to a safe flight path, use the take-over pb [pushbutton] and engage the autopilot;
>
> [The *FCTM* “Flight Crew Incapacitation” states: “If the incapacitated flight crewmember causes interference with the handling of the aircraft, press the sidestick pb for 40 seconds. The time required of 40 s includes the time necessary for AP deactivation (if AP engaged) and the time for offside sidestick deactivation.]

- Inform ATC and declare an emergency;

…

- Land as soon as practicable after considering all pertinent factors. …"

1.17.1.8 SOP for take-off speeds insertion

As per the Operator's SOP, the pilots are required to insert the speeds in the MCDU. The SOP do not state if the crew is required to be involved in calculating the take-off speeds.

1.17.2 Air navigation services

Sharjah Air Navigation Service (SANS) was contracted by the aerodrome operator to provide air traffic control services. At the time of the Incident, air traffic services were performed from the standby tower (ST) because the main airport tower was under maintenance.

Approximately two years before use of the standby tower, SANS had carried a safety case assessment and identified several hazards. SANS stated:

> "SANS has inspected this new facility and has identified aerodrome artificial light and the surveillance deficiencies, due to the ATC-ST [air traffic control standby tower] height and location, as significant safety hazard that must be mitigated prior to transfer of operations to the ATC-ST."

In summary, the following hazards were identified:

- ATC-ST Artificial lighting during nighttime operations
- ATC-ST Movement area surveillance
- ATC-ST Maneuvering area surveillance
- ATC-ST Maneuvering area surveillance Taxiway Bravo.

As part of mitigating risks of the identified hazards, a remote surface management system (RSMS) was installed. SANS stated:

> "Installation of an ATC [air traffic control] grade video camera system to provide surveillance of the main apron, maintenance area/apron and the runway, runway thresholds and associated taxiway hold points."

In addition, SANS stated:

> "The provision of a CCTV [closed-circuit television] camera system installed on the aerodrome for the ATC-ST will significantly reduce or eliminate the identified hazards."

SANS was confident of the mitigation taken, stating:

> "The CCTV system proposed for the ATC-ST (Standby Tower) will be a safety-critical component for ATC operations at Sharjah International Airport and will significantly enhance controller situational awareness."

The CCTV three cameras were installed at the following locations:

- Camera 1 – Departure end of runway 30
- Camera 2 – Stands 4-8 of the main apron area

- Camera 3 – Approach end (Bravo 20) holding position.

The Investigation was not presented with risk assessment of intersection takeoffs for runway 12/30 as SANS did not identify intersection takeoffs from Bravo 14 for runway 30 and Bravo 6 for runway 12 as hazards. In addition, intersections Bravo 14 and Bravo 6 were not identified as hot spots.

For the Incident flight ABY111, the following was presented to the Investigation by SANS based on the playback of RSMS CCTV information:

- At 1224:49, RSMS ATC CCTV camera 1 shows ABY111 crossing Bravo 14 stop bar and proceeding to the runway.
- At 1225:44, the Aircraft disappears from camera 1 view. SANS noted that it was not possible to determine which direction the Aircraft was turning due to camera 1 angle.
- At 1226:08, the Aircraft appears on camera 3 view departing from runway 12.
- At 1226:17, camera 3 shows the Aircraft airborne from runway 12.
- At 1227:12, the Aircraft disappears from camera 3 view.
- The ATC controller at the time of the Incident had positioned the three CCTV cameras showing the departure end of runway 30 with view of Bravo 6 and Bravo 7, the main apron with view of stands 4 to 8, and the approach end of runway 30 with view of holding point Bravo 20.

However, this Incident, requires SANS to explore the risk associated with intersection takeoff post this Incident and prepare a safety case study, if needed, to prevent similar incidents from occurring.

1.18 Additional Information

1.18.1 Runway awareness and advisory system (RAAS)

As per the manufacturer report:

> "The Smart Runway function includes a Runway Awareness and Advisory System (RAAS), which alerts the flight crew for attempted taxiway landings, taxiway take-off, short runway take-offs and landings and an incorrect take-off flap configuration."

According to the manufacturer, the system:

> "Offers improved situational awareness for the flight crew in order to help lower the probability of runway incursion incidents and accidents by providing timely aural messages to the flight crew during ground taxi, take-off (including rejected take-offs), final approach, and landing/roll-out operations."

The Aircraft was not equipped with the RAAS system.

1.18.2 Take-off surveillance and performance analysis

Even though it was not equipped, the Incident Aircraft was capable of retrofitting for installation of take-off surveillance (TOS2) system. When take-off thrust is set, this system provides:

(a) A wrong aircraft position with regard to the runway was inserted in the flight management system (FMS). In that case, the system triggers the amber ECAM caution 'NAV NOT ON FMS RUNWAY' if the take-off is on the wrong runway or taxiway; and

(b) A take-off distance is too short based on the take-off speeds of V_R. In that case the system triggers the red ECAM warning 'T.O RUNWAY TOO SHORT'.

For ABY111 flight, the Aircraft manufacturer concluded that the TOS2, the system would have triggered:

(a) The ECAM caution 'NAV NOT ON FMS RUNWAY' as the Aircraft lined up on the wrong runway 12; and

(b) The ECAM red warning 'T.O RUNWAY TOO SHORT' as the take-off runway available was 1,000 m after the Aircraft lined up on runway 12. The Aircraft manufacturer calculated that with the hypothesis of V_R at 127 knots, the take-off runway required was 1,145 m for the original Aircraft configuration of FLX/MCT engine thrust at flap 1+F position.

1.19 Useful or Effective Investigation Techniques

The Investigation was conducted in accordance with the legislation and *Air Accident and Incident Investigation Regulation* of the United Arab Emirates. This Report has been written in compliance with the AAIS-approved policies and procedures, and in accordance with the Standards and Recommended Practices of Annex 13 to the Convention on International Civil Aviation.

2. Analysis

2.1 General

The Commander and the trainee second officer Copilot were appropriately licensed and medically fit to operate the flight. The Investigation found no evidence that physical, physiological, or psychological conditions affected the flight crew performance.

The Aircraft was maintained in accordance with the maintenance program approved by the General Civil Aviation Authority of the United Arab Emirates (GCAA), and there were no technical anomalies prior to the Incident.

The dry environmental conditions prevailing during the afternoon daylight takeoff were within the Aircraft's operating limitations. Additionally, there was no significant weather affecting the Airport operations, and visibility was more than 10 kilometers.

The Aircraft was correctly configured for the takeoff with flap setting at 1+F, and engine thrust setting at FLX/MCT (Flex temperature of 67 degrees Celsius). The calculated take-off speeds were V_1: 122 knots; V_R: 127 knots; and V_2: 130 knots.

Sharjah International Airport (OMSJ) was the main base for the Operator. The Operator was allowed by the airport authority to perform intersection takeoffs. Intersection takeoff at OMSJ was considered a normal and safe operation for the Operator and was frequently used without any issues. Within the two months before the Incident, the majority of departures were intersection takeoffs from Bravo 14 for runway 30.

2.2 Flight Operations – Taxi and Take-off Execution

The performed takeoff was a “rolling takeoff”, which, as per the Commander’s and Copilot‘s statements, was planned and briefed. The Copilot stated that she called for the *before takeoff checklist* ‘below the line’ after Tower issued clearance for takeoff from runway 30. The Investigation was unable to confirm if the checklist ‘below the line’ was completed prior to the Aircraft parking brakes being selected OFF or after the Aircraft started moving from runway holding point Bravo 14.

Nine seconds after the Commander correctly read back ATC take-off clearance for departure from runway 30, autobrake MAX deceleration rate was set, the parking brake was selected OFF and shortly after the Aircraft started to move beyond Bravo 14 holding point. The Copilot started gradual increments of engine thrust beyond idle about 51 seconds after the parking brake was selected OFF. After another 22 seconds, with the Aircraft's ground speed increasing and passing 20 knots, the Copilot almost simultaneously applied a nose down sidestick input and advanced both thrust leavers to FLX/MCT detent. Because there was no need to stop the Aircraft on the runway, the Copilot continued to steer and align the Aircraft onto runway 12 centerline for the rolling takeoff.

When the Copilot noticed that the FMA was not indicating RWY, she realized that the Aircraft not aligned to the pre-selected runway which was entered to the flight management system (FMS). However, she announced the FMA modes but not RWY mode as it was blank.

After the callout by the Copilot, the Commander quickly decided to continue the takeoff and advanced both thrust levers to the takeoff/go-around (TOGA) detent position with the Aircraft speed passing 57 knots calibrated airspeed (CAS). Unknown to the flight crew, the remaining runway 12 available for an accelerate-stop was about 730 meters.

The Commander's perception that the Aircraft was approaching the threshold of runway 30, and his judgment that the liftoff may not be accomplished safely with the pre-set configuration, prompted him to move the flaps lever to flap 2 position while passing 109 knots CAS. That was about nine seconds from when the Commanded advanced the thrust levers to TOGA position. After two seconds, the Aircraft entered the displaced threshold area for runway 30.

By extending the flaps from position 1 to position 2, the Commander expected to shorten the take-off distance. The Aircraft eventually became airborne after traversing runway 12 stop-way area by about 30 meters with passing 132 knots CAS. The flight crew and air traffic controller were not aware that one of the approach lights of runway 30 was damaged by No. 3 main wheel tire during the Aircraft liftoff

From engine thrust lever movement to TOGA detent until liftoff, the Aircraft rolled along the runway for about 780 meters in 14, accelerating from 57 knots when the thrust leave was advanced to 132 knots when the Aircraft rotates.

Analyzing the FDR data, Aircraft taxi speeds, ATC transcript, and based on the simulator sessions conducted by the Investigation, the Investigation found that there was no departure time constraint imposed by ATC, and that the cockpit workload was normal as the crewmembers had sufficient time to complete the required checklist items and monitor the Aircraft position prior to takeoff. There were no cues that the crew had been affected by hurry-up syndrome to expedite the takeoff.

The Aircraft systems and engines were functioning as designed. However, the Aircraft was not equipped with the A320 industry-known software features that aid the flight crew to maintain situational awareness during taxi and takeoff. These awareness augmentation systems, such as runway awareness and advisory system (RAAS) and take-off surveillance (TOS2) system, provide aural and/or visual alerts in detecting and mitigating taxiway and runway confusion risks.

2.3 Flight Crew Performance

2.3.1 Copilot's training progression

Considering that this was a training flight with the trainee Copilot as the pilot flying, as well as the shorter taxi time of about three minutes from the pushback position for the intersection at Bravo 14 holding point when compared to Bravo 20 holding point, the Investigation believes that the Commander's decision to carry out a single-engine taxi followed by the second engine start during taxi could have potentially put the flight crewmembers under extra workload.

For better crew resource and workload management in the cockpit and the short taxi time anticipated, the Commander could have considered conducting a dual-engine start prior to commencement of the taxi as the economic benefit of conducting single-engine taxi procedure was probably negligible. Therefore, the Investigation recommends that the Operator improve its single-engine policy that takes into consideration taxi time to the runway holding point and the cockpit crew gradient.

The Copilot, a second officer under training, had successfully progressed through four of the five stages of the multi-pilot license (MPL) training program. As a result, the Copilot was permitted to assume the responsibilities of pilot flying without the need for a third pilot, known as a cover pilot, in the cockpit.

The training included taxiing and performing intersection and rolling takeoffs as part of a four-day pairing the Copilot with the Commander. For days 1 and 2 of the pairing, the Copilot, as the pilot flying, performed an uneventful single takeoff on each day from OMSJ runway 12 at Bravo 6 intersection. These two takeoffs were at the opposite end of the runway of the Incident flight

takeoff. The takeoffs required to steer the aircraft right from Bravo 6 intersection for alignment to runway 12.

However, the Incident training flight, which was on day 4 of the pairing, required the Copilot to steer the Aircraft to the left at the intersection Bravo 14 for alignment with runway 30. As per the Copilot's training records, this was her first intersection takeoff from Bravo 14 without the presence of the cover pilot. The Investigation was unable to determine if the Commander was aware that this was the first takeoff for the Copilot as a pilot flying from intersection Bravo 14.

Reviewing the training records revealed that the Copilot progression during the training was normal with no significant issues. However, the Investigation could not determine how many intersection takeoffs the Copilot had performed at OMSJ and if any was performed using intersection Bravo 14 for runway 30. Therefore, the Investigation could not verify if the Copilot training history specific to intersection takeoff was a factor in this Incident.

2.3.2 Flight crew briefing

The Investigation considers the departure briefing that was conducted before pushback and starts as a crucial action for enhancing the situational awareness of the flight crewmembers by highlighting the flight environment. In addition, the briefing could have cleared any ambiguity or resolved concerns raised by the Copilot during the briefing. The briefing could have established an opportunity for both crewmembers to plan ahead for the departure and determine their reactions to any emergency or abnormal situation.

The Operator classified taxiing and takeoff as 'critical phase of flight'. Accordingly, the SOP required the flight crew to carry out a briefing about the expected taxi route, taxi time, runway in use and runway alignment directions, and the scenario of a rejected takeoff. During the flight, and as an intersection rolling takeoff was planned from Bravo 14, more effective briefing was an opportunity for the flight crew to discuss the difference between a full-length takeoff and an intersection takeoff. Especially that there would not be visual cues for a threshold and '30' white markings like the full-length takeoff. This would have enhanced the flight crew's situational awareness and most likely formed a barrier to prevent confusion.

In addition, for the afternoon departure, had a thorough briefing been done, the flight crew would have most likely discussed the use of personal sunglasses and the cockpit sun visors because the sun was almost aligned with runway 30 at an elevation of 25 degrees above the horizon.

The lack of CVR recordings could not verify whether the flight crew's briefing of the taxi route for departure from runway 30 was carried out as per the *operation manual-part A* (*OM-A) — General Taxi Guidance*, and was appropriately applied or not. The Investigation believes that the confusion resulted from overlooking critical elements during flight preparation and take-off briefing. This may have potentially influenced the Copilot perception, judgment, and decision of steering the Aircraft correctly unto runway 30.

2.3.3 Runway confusion

The Commander stated that he was focused on completing the *before takeoff checklist,* and he was not aware that the Aircraft was mistakenly aligned with runway 12. Approximately 73 seconds elapsed from the time, the Aircraft moved from Bravo 14 until both engine thrust levers were advanced to the FLX/MCT detent, where the Aircraft had already aligned with runway 12.

The *before takeoff checklist* 'below the line' contained five check items that the ABY111 crew within 10 seconds should have accomplished. The Investigation believes that the Commander

was predominantly fixated inside the cockpit and did not effectively perform external peripheral view. He was probably preoccupied with something other than the *before takeoff checklist.*

Even though the Operator had specific risk mitigation in place including: General taxi guidance, line-up and positive runway identification, takeoff and landing runway verification and crosscheck, and the *before takeoff checklist* for both pilots to confirm the correct take-off runway; critical elements were lapsed by the flight crew which degraded their situation awareness.

The Operator had identified hazards of takeoff from incorrect runway, and appropriately developed mitigations. However, it is probable that the Commander did not scrutinize the trainee Copilot performance due to his confidence that she will carry a routinely successful intersection takeoff on runway 12 from Bravo 6 intersection as he witnessed earlier on days 1 and 2 of their four-day pairing.

The communications with Tower, the air traffic information system (ATIS), weather reports, and the operational flight plan (OFP) had all confirmed that runway 30 was in use, which should have been reached by a left turn from taxiway Bravo 14 holding point. The Investigation believes that the Copilot took the other direction referring to her previous experience for takeoffs from runway 12 by right turns from Bravo 6 intersection.

The external visual barriers that should have led to runway 30 were multiple:

- The illuminating lead-on lights towards runway 30 after the stop bar at Bravo 14 holding point.
- Bravo 14 holding point signage;
- Bravo 14 taxiway lead-on yellow centerline for runway 30; and
- The illuminating runway 30 uni-directional edge lighting.

Another cue to the flight crew that they had entered the wrong runway was the runway 30 white double touchdown zone markings and runway 30 aiming points, which would have been visible at such a short distance. All the above directional references were overlooked by the flight crew.

The Investigation could not determine how many intersection takeoffs the Commander had performed using Bravo 14 for runway 30 prior to the Incident, and when was his last takeoff using the same intersection. However, based on the two months' OMSJ intersection departure data prior to the Incident, 85.5 percent of the intersection departures were performed from Bravo 14. The Commander had, most likely, performed several intersection takeoffs from Bravo 14 for runway 30, and he should have been familiar with the taxiways and runway maps because OMSJ was his home base.

The Investigation concludes that because OMSJ was the home base of both flight crewmembers, it is possible that they performed the take-off checklist out of habit without assertive read and challenge communication. The three previous takeoffs conducted by the Copilot from runway 12 added to that habitual behavior.

2.3.4 Take-off decision

It took the Commander about six seconds to mentally process the information of the approximate position of the Aircraft on the runway, Aircraft speed, perception of remaining runway available, take control of the Aircraft, decide to continue the takeoff, and advance both thrust levers to TOGA detent.

A decision to take control of the Aircraft from the Copilot required the Commander to call "I have control" and then for the Copilot to transfer control by responding "You have control" and for the Copilot to then assume pilot monitoring functions. In addition, when the Commander mentally decided to continue the takeoff, he was required to make his intentions known with the callout 'Go'. The investigation believes that these callouts were not accomplished from the statements and interviews with the flight crew.

The Commander perceived that the remaining runway available was insufficient to reject the takeoff as indicated by his statement to the Investigation "I saw the end of runway coming." The Aircraft manufacturer's guidance and the Operator's policy for a rejected takeoff recognizes the risks involved with such a decision. This is why the manufacturer divided the take-off speeds into high-speed and low-speed regimes. The Commander applied the principle of 'go-minded' similar to the decision of continuing a takeoff at or beyond 100 knots

The Commander's decision was based on his perception of the runway available to stop the Aircraft. His immediate reaction to his realization that the takeoff was from the wrong runway was by advancing the thrust levers to TOGA. He misjudged that the remaining runway would have been sufficient to reject the take-off safely.

The nonstandard action by the Commander of moving the flap lever position from 1+F to Flap 2 position during the take-off roll would have required him to shift his attention from outside peripheral view during the take-off roll to the cockpit flap lever and engine and warning display (E/WD) to confirm that flaps/slats are moving to the selected position. This action could have caused lateral disruption in control of the Aircraft during takeoff due to the shift of sight. The Investigation believes that the Commander's efforts aimed at liftoff before reaching the end of the runway rather than rejecting takeoff at lower than 100 knots airspeed. That judgment and consequent decision were indications of a 'take-off minded' situation.

The Commander was aware of the 'High/Low rejected take-off speed' criteria, and was trained on rejected takeoff. There was no provision in the Operator's *flight crew operating manual (FCOM)* to provide the flight crew with information about the runway accelerate-stop distance, aircraft take-off weight, or aircraft take-off speeds. Therefore, a decision to reject a takeoff was left to the flight crew.

Had the Commander decided to reject the takeoff any time within the low-speed regime below 100 knots, and should he have applied maximum reverse engine thrust, which would automatically engage maximum autobrakes, the Aircraft would have safely stopped on runway 12. This was confirmed by the performance calculations provided by the Aircraft manufacturer and the simulated flight sessions.

The Investigation recommends that the Operator use this Incident to reinforce to the pilots the importance of full pre-flight briefing, including positive runway identification, familiarization with runway signage, markings, and distances, effective crew resource management during taxi and takeoff, and safeguarding the aircraft and occupants when making the decision to reject a takeoff at low and high speeds.

The Investigation recommends that the Operator improve the flight planning data by providing relevant runway accelerate-stop distances to the flight crew.

2.3.5 Crew performance

It is most likely that the late visual perception that the Aircraft was on the wrong runway surprised both flight crewmembers. The lack of cockpit voice recordings deprived the Investigation from the conversation data related to cockpit conversation, which could have provided cues of the crew's psychological condition and how it could have affected their performance. The only reference

for the crew reaction came from the Commander, who described the state of the Copilot as “startled and frozen.”

The Copilot’s degraded awareness led her to maintain a nose down pressure until rotation at 122 knots CAS. This action was not as per standard take-off technique. The standard procedure requires the pilot flying to apply nose down input immediately after commencing the take-off roll. Then the copilot must start releasing the nose down input gradually at 80 knots until it is completely released at 100 knots.

Similar to the actions by the Commander, the European Aviation Safety Agency (EASA) states “Startle and surprise effects can influence pilot performance in many detrimental ways. At the very least, these effects serve as a distraction which can disrupt normal operation and erode safety margins. On a more critical level, they can lead to inappropriate intuitive actions or hasty decision making.”[2]

Based on the FDR data, the Investigation found that the Commander had not applied the procedure of taking over side-stick controls.

From the time the Commander decided to continue the takeoff, and during the climb, the crew resource management was ineffective as the cockpit became a single-pilot operation. Based on the Investigation interviews, there were no inputs or monitoring tasks accomplished by the Copilot after the Commander took control. In such situation, and with a passive Copilot role, the Operator’s policy required the pilot flying to “Land as soon as practicable after considering all pertinent factors …”

Based on his conclusion that the Copilot cannot assume her responsibilities due to her affected mental state after takeoff, the Commander decided to continue the flight instead of returning to OMSJ.

The Commander’s decision to continue the training flight was not based on appropriate risk assessment of the situation of the degraded performance of the Copilot. The Investigation could not determine why the Commander did not report the Incident to the OMSJ Tower and inform the operation control center.

2.4 Aerodrome – Taxiway and Runway

Sharjah International Airport was in compliance with the requirements of the *Civil Aviation Regulations* concerning taxiway and runway markings, lighting, stop bars, and signage. The Investigation confirmed that the lead-on lights were functional and the centerline marking was visible from runway holding point Bravo 14 to runway 30, and if followed, would correctly lead to the planned take-off runway.

According to *Part IX* of the *Civil Aviation Regulations,* (Appendix 11, 11.4.1.5) “An intersection take-off sign shall be provided when there is an operational need to indicate the remaining Take-off Run Available (TORA) for intersection take-offs.” The Investigation was not provided with a study prepared by the airport for determining the operational need for intersection take-off sign indicating the TORA.

[2] Reference: EASA Startle Effect Management NLR-CR-2018-242

Although the Investigation could not confirm that whether or not the existence of TORA information at the intersection could have prevented entering the wrong runway, the Investigation believes that such information would have enhanced the flight crew situation awareness of the remaining runway available. Therefore, the Investigation recommends that the airport operator performs a risk assessment for fixing a sign illustrating the TORA at the intersection takeoff as stated in *CAR Part IX*.

2.5 Air Traffic Control

2.5.1 Standby tower

Sharjah Air Navigation Service (SANS) was the responsible organization for providing air navigation services and aerodrome monitoring services of aircraft and vehicle movements from the standby tower. The installed closed-circuit television (CCTV) was part of the surface management system (RSMS). In addition, monitors in the tower room were installed to aid the controllers in monitoring aircraft movement on the apron, taxiways, and runway.

The Investigation noted that monitoring of aircraft taxiing to Bravo 14 intersection and unto runway 12/30 was obstructed by a light pole which was located at the aircraft parking stand at a short distance from the tower. As Bravo 14 intersection with runway 12/30 was not covered by the CCTV, and Bravo 14 was about 1 kilometer from the tower, the controllers needed to physically move and sometimes use binoculars to visually watch a movement of aircraft or vehicle.

When SANS carried out a risk assessment for utilizing the standby tower, the intersection takeoffs were not registered as hazards, consequently, neither associative risk was analyzed, nor mitigations were considered.

The Investigation does not see that the surveillance deficiency at the standby tower was a factor in this Incident because the controller had other aids to monitor ABY111. However, the Investigation recommends that SANS perform a safety case assessment and mitigate risks associated with intersection take-off hazards.

2.5.2 Controllers communication and movement monitoring

The Investigation review of the air traffic controller’s communication with ABY111 was clear and unambiguous and was not a factor in this Incident. Similarly, the combined Tower and the Ground control did not affect the capability of the controller to respond to requests received from the flight crew of aircraft moving on the ground and flights in the vicinity, and provide accurate traffic information.

It took 80 seconds from the time the take-off clearance was issued to ABY111 until the Aircraft became out of CCTV Camera 1 coverage. Due to the angle of Camera 1, SANS had stated that it was not possible to know the direction in which the Aircraft's nose was turning. The controller was busy visual scanning the ground and airborne movements including some critical checks such as aircraft holding short of runway 30 at Bravo 20 holding point. Thereafter, there was a period of silence of about 82 seconds on Tower and Ground frequencies until ABY189 queried the controller about the runway in use.

The Investigation could not exactly identify the exact scanning technique applied by the controller in the 80 seconds after take-off clearance was given for ABY111 especially as the aircraft at the Bravo 20 holding point had already confirmed to Tower they had stopped and no other aircraft was on approach for runway 30. Due to the distance of Bravo 14 intersection as well as the known surveillance impediments at the standby tower, the scanning techniques employed by the controller has to be comprehensive so that they maintain situational awareness of aircraft on the taxiways and runway.

A number of factors probably affected the controller as to why he did not visually watch ABY111:

- The controller assumed that ABY111 flight crew read back of take-off clearance from runway 30 was based on action concurrent to that read back.
- The controller assumed that the flight crew are fully aware of the airport layout and intersection takeoffs as OMSJ is the base of the Operator.
- The controller was unaware that the flight crew had planned a rolling takeoff.
- The controller had a level of confidence that the flight crew were aware that runway 30 would have required a left turn from Bravo 14 intersection and would not have considered any possibility that the flight crew might have runway confusion.

The Investigation concludes that the controller's visual watching responsibility after giving take-off clearance was most likely affected by his confirmation bias of the aforementioned assumptions.

After this Incident, SANS had implemented the necessary safety actions to alleviate the issues surrounding controllers' scanning effectiveness.

3. Conclusions

3.1 General

From the available evidence, the following findings, causes, and contributing factors were determined with respect to this Incident. These shall not be read as apportioning blame or liability to any particular organization, or individual.

To serve the objective of this Investigation, the following sections are included in the Conclusions heading:

- **Findings.** Statements of all significant conditions, events or circumstances in this Incident. The findings are significant steps in the Incident sequence but they are not always causal nor do they indicate deficiencies.
- **Causes.** Actions, omissions, events, conditions, or a combination thereof, which led to the Incident.
- **Contributing factors.** Actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the Incident occurring, or mitigated the severity of the consequences of the Accident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2 Findings

3.2.1 Findings relevant to the Aircraft

(a) The Aircraft was certified, equipped, and maintained in accordance with the existing requirements of the *Civil Aviation Regulations* of the United Arab Emirates.

(b) The Aircraft records indicated that it was airworthy when dispatched for the flight.

(c) The No. 3 main wheel tire sustained cuts because of impact with an approach light during the Aircraft liftoff from runway 12.

3.2.2 Findings relevant to the flight crew

(a) The flight crewmembers were licensed and qualified for the flight in accordance with the existing requirements of the *Civil Aviation Regulations* of the United Arab Emirates.

(b) Both crewmembers were fit for duty.

(c) The Commander was a certified flight instructor.

(d) The Copilot was a second officer undergoing a multi-pilot license (MPL) training program.

(e) Both flight crewmembers conducted together 4-day pairing.

(f) In day 1 and day 2 of the pairing, the Copilot performed an intersection takeoff from Bravo 6 for runway 12 on each day.

(g) The takeoff from the incorrect runway occurred on day 4 of the pairing.

3.2.3 Findings relevant to the flight operations

(a) The Commander briefed the Copilot about conducting a single-engine taxi and a rolling takeoff.

(b) The Copilot was the pilot flying and was responsible for taxiing the Aircraft.

(c) The taxi conducted from the parking stand to holding Bravo 14 was a short taxi of about 3 minutes.

(d) The Commander did not notify the air traffic control about his intention to conduct a rolling takeoff.

(e) *Before takeoff checklist* was completed in the vicinity of runway 12/30 holding point Bravo 14.

(f) The Commander read back the Tower take-off clearance correctly with the confirmation of runway 30.

(g) The Copilot entered the runway following a taxi line for runway 12.

(h) Neither the Commander nor the Copilot confirmed runway 30 direction after take-off clearance was given by Tower.

(i) When the thrust levers were advanced to FLX/MCT, the Copilot called out that the flight mode annunciator (FMA) was not indicating RWY.

(j) The Commander realized that the Aircraft was on the wrong runway when the Aircraft CAS was at about 57 knots.

(k) The Commander took control of the Aircraft and decided to continue the takeoff.

(l) The Commander increased the engine thrust to takeoff/go-around (TOGA), and nine seconds later, he changed the flap configuration to Flaps 2.

(m) The Copilot was applying a nose down attitude on the sidestick up until the Aircraft rotated.

(n) The Commander did not attempt to use the sidestick priority.

(o) The Commander acted as the pilot flying and the pilot monitoring during take-off roll and climb.

(p) The Commander stated that the Copilot was “frozen and startled.”

(q) The Aircraft liftoff occurred at about 30 meters beyond the end of runway 12 from the runway safety area.

(r) The Commander did not notify the Operator about the Incident.

(s) The Commander continued the flight to the destination and returned the pilot flying duties to the Copilot.

(t) During the Aircraft liftoff from the runway safety area, one approach light for runway 30 was damaged.

(u) The cockpit voice recorder (CVR) recordings for the Incident were overwritten.

3.2.4 Findings relevant to air traffic control

(a) The air traffic controller was licensed and was medically fit.

(b) The controller did not detect that the Aircraft had turned right and had commenced the takeoff from runway 12.

(c) The controller became aware of the Aircraft taking off from the wrong runway about eight seconds before the Aircraft was airborne.

(d) The controller was responsible for both Tower and the Ground frequencies when the Incident occurred.

(e) The controller was relieved from duty after the Incident.

(f) The air traffic control operations were conducted from a standby tower located above the airport fire services.

(g) The view from the standby tower had surveillance deficiencies identified during the safety case assessment.

(h) As part of risk- mitigation for the identified hazards, a remote surface management system (RSMS) was installed, which included closed-circuit television (CCTV).

3.2.5 Findings relevant to Sharjah International Airport

(a) There was no study prepared by the airport for determining the operational need for intersection take-off sign indicating the take-off run available (TORA).

(b) The airport operator complied with the requirements of the *Civil Aviation Regulations* for the taxiways and runway 12/30 and installed the necessary markings, lighting, stop bars and signage.

(c) The lead-on lights were functional and centerline marking was visible from runway holding point Bravo 14 to runway 30 and if followed, would avoid runway confusion.

(d) The airport was not equipped with ground movement radar (GMR) system.

3.3 Causes

The Air Accident Investigation Sector of United Arab Emirates (AAIS) determines that the cause of the runway confusion was the Copilot steering the Aircraft right onto the wrong runway during a rolling takeoff.

Entry to the wrong runway was due to degraded situation awareness of the Aircraft direction by both flight crewmembers due to lack of external peripheral visual watch and runway confirmation.

3.4 Contributing Factors to the Serious Incident

A contributing factor to the Incident was that the air traffic controller did not monitor the Aircraft movement after take-off clearance was given.

4. Safety Recommendations

4.1 General

The safety recommendations listed in this Report are proposed according to paragraph 6.8 of *Annex 13 to the Convention on International Civil Aviation*, and are based on the conclusions listed in part 3 of this Report. The Air Accident Investigation Sector of the United Arab Emirates (AAIS) expects that all safety issues identified by the Investigation will be addressed by the receiving States and organizations.

4.2 Safety Actions

4.2.1 Safety Actions taken by the Aircraft Operator

Post-Incident, the Operator issued amendments to the standard operating procedure (SOP). The Operator instructed the pilots that they shall exercise extra caution when using an intersection and confirm the correct direction for line-up. For increased situation awareness, the following phraseology was introduced:

PF: “Lining up Left/Right for Runway XX.”

PM: “Affirm/Negative” after crosscheck.”

In addition, the Aircraft Operator made changes to the trainee pilot’s intersection takeoffs with lessons learnt from the Incident.

4.2.2 Safety Actions taken by Sharjah Air Navigation Service (SANS)

SANS addressed the issues relevant to controllers scanning and monitoring responsibilities and implemented additional training and procedural changes in the *operations manual.*

4.3 Final Report Safety Recommendations

4.3.1 Safety Recommendations addressed to the Operator

SR41/2021

Considering that this was a training flight with the trainee Copilot as the pilot flying, as well as the shorter taxi time of about three minutes from the pushback position for the intersection at Bravo 14 holding point when compared to Bravo 20 holding point, the Investigation believes that the Commander’s decision to carry out a single engine taxi followed by the second engine start during taxi, could have potentially put the flight crewmembers under extra workload.

For better crew resource and workload management in the cockpit and the short taxi time anticipated, the Commander could have considered conducting a dual engine start prior to commencement of the taxi as the economic benefit of conducting single engine taxi procedure was probably negligible.

The Operator is recommended to carry out risk assessment for single engine taxi considering the estimated taxi time, and operation environmental conditions to determine mitigation measures accordingly.

SR42/2021

The Aircraft systems and engines performed as designed. The Investigation noted that there were industry known aircraft systems and software aids available to improve flight crew situation awareness during the taxi and take-off phases of flight which were not installed on the Incident Aircraft. Examples of these awareness augmentation systems are runway awareness and advisory system (RAAS) and take-off surveillance (TOS2) system which provide cockpit aural and/or visual alerts in detecting and eliminating taxiway and runway confusion.

The Operator is recommended to establish a safety case to determine the possibility of enhancing A320 alert systems with the installation of taxiway and runway detection systems that will aid pilots' situation awareness.

SR43/2021

The Operator clearly identifies "Critical phase of flight" to include taxiing and takeoff. Thus, the flight crew briefing, if done in accordance to the SOP, both crewmembers would have briefed about the expected taxi route, taxi time, runway in use and runway alignment directions to be followed and rejected takeoff. As an intersection rolling takeoff was planned from Bravo 14, the briefing was an opportunity for the flight crew to discuss runway markings especially as there would not have been visual cues of a threshold and '30' white markings. This would have enhanced the flight crew situation awareness and most likely formed a barrier to reduce the likelihood of the Incident.

Even though the Operator had specific barriers in place including general taxi guidance, line-up and positive runway identification, takeoff and landing runway verification and crosscheck, and the *before takeoff checklist*, for both pilots to confirm the correct runway prior to entering as well as prior to takeoff; the critical elements were probably missed which resulted in both pilots having degraded situation awareness of the Aircraft position. The breach in these barriers allowed the Copilot to continue to steer the Aircraft following the taxi line leading to runway 12 centerline for the rolling takeoff.

The Commander perceived that the runway available was insufficient to reject the takeoff and reacted to his conclusion "I saw the end of runway coming." The Aircraft manufacturer guidance and the Operator's policy for a rejected takeoff recognized the risks involved with such a decision, thus the reason behind dividing the rejected takeoff into low and high speed regimes.

The Operator is recommended to use this Incident to reinforce to the pilots the significance of flight preparation briefing; positive runway identification; significance of knowing runway signage, markings and distances; effective crew resource management during taxi and takeoff; and safeguarding the aircraft and occupants when making the decision to reject a takeoff based on low and high speed regimes.

SR44/2021

The Operator did not have a procedure for providing the flight crew with information about the distance required to decelerate aircraft after a rejected takeoff considering the relevant flight parameter, weather, and runway condition. Instead, the take-off speeds are given readily in a matrix format which are included in the operational flight plan. If flight crewmembers are involved, this would likely increase the situational awareness of the flight crew and alert them about the distance required to stop on the runway before V_1. Which will most likely result in better decision-making. The Operator is recommended to

enhance take-off speeds calculations procedure for the flight crew by involving them in these calculations to ensure that they are fully aware of the performance requirements for stopping an aircraft on the runway.

SR45/2021

The Investigation believes that based on the statement from the Commander, the traits demonstrated by the Copilot reflects that she was mentally affected to continue her responsibilities as a pilot. Instead of returning to OMSJ, the Commander decided to continue the flight, and eventually returned the controls to the Copilot. The Investigation concludes that the Commander's decision to continue a training flight was not based on thorough analysis of the facts surrounding the flight and the mental condition of the Copilot.

It was noted that the Operator did not have in place a policy for handling situations where one or both flight crewmembers is affected by a sudden event to possibly degrade performance.

The Investigation recommends that the Operator to include in the *operation manual-part A (OM-A)* policy for crew resource management following degraded not categorized as incapacitation.

4.3.2 Safety Recommendations addressed to Sharjah Air Navigation Service (SANS)

SR46/2021

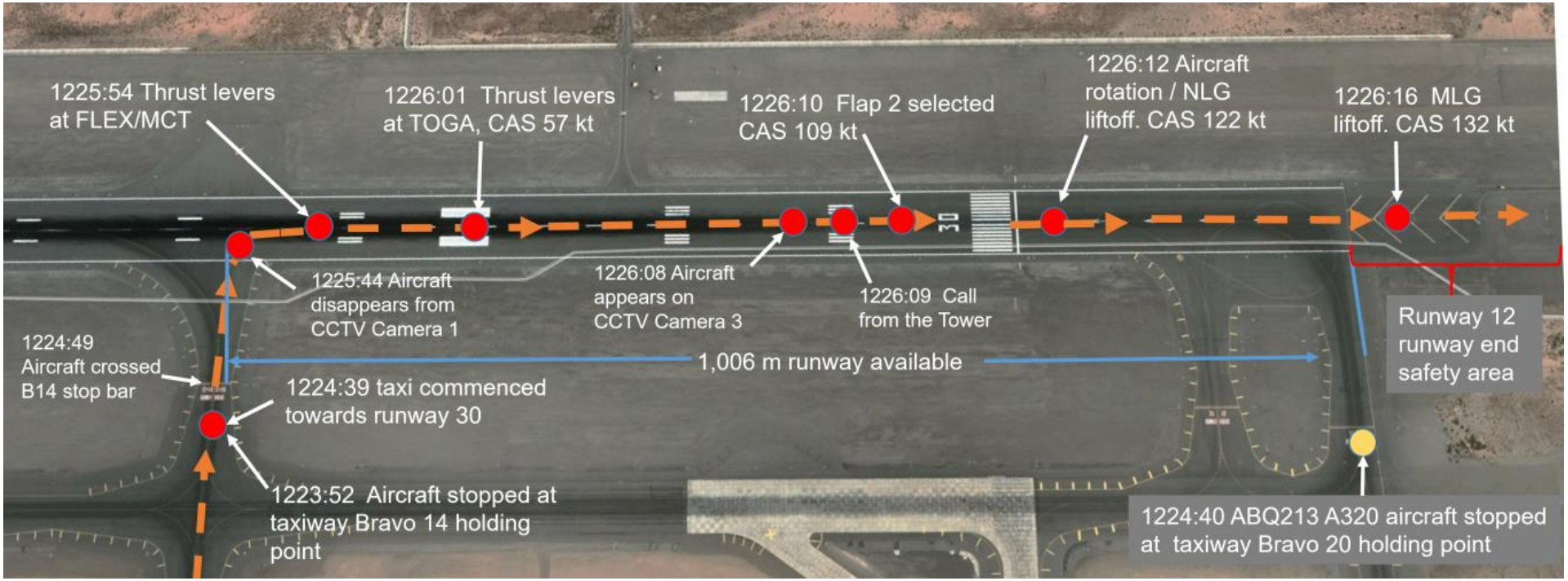
The Investigation noted that sighting the direction of an aircraft holding at Bravo 14 intersection was obstructed by a light pole located at the aircraft parking stand a short distance away from the standby tower. As the airport was not equipped with ground movement radar, the only means for monitoring Bravo 14 intersection was the visual watch. However, because of the obstruction of sighting Bravo 14 by the lighting pole, the controllers should change their body position in order to see an aircraft holding at Bravo 14. The controllers could also use binoculars because Bravo 14 was located about 1 km from Tower.

When SANS performed the safety case for use of the standby tower, the intersection takeoff was not identified as a hazard, consequently no associative risk assessment was performed.

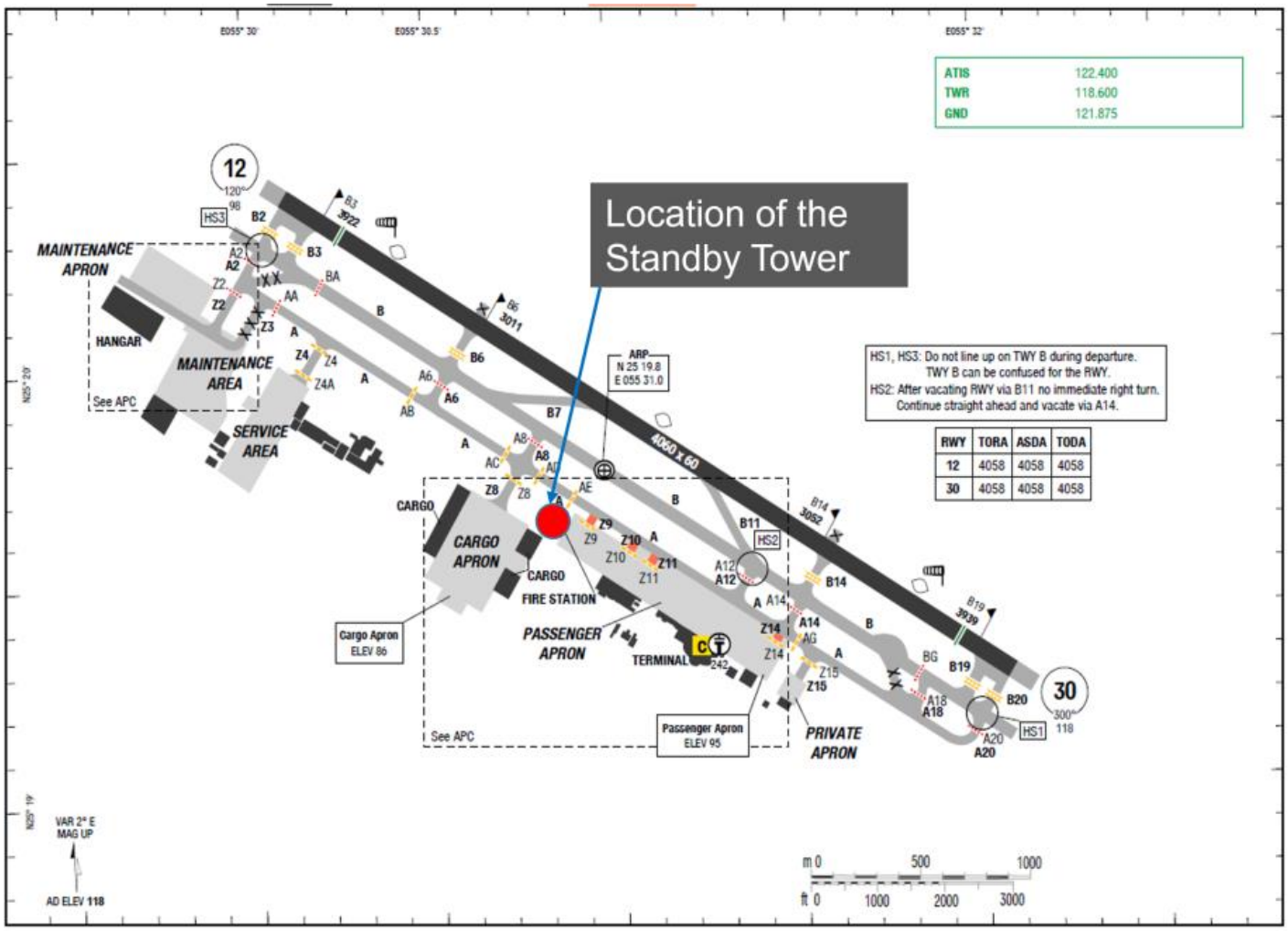
SANS is recommended to explore the possibility of re-evaluating the risks surrounding intersection takeoffs post this Incident, and prepare a safety case study, if needed, to prevent similar incidents from occurring.

This Final Report is issued by:
The Air Accident Investigation Sector
General Civil Aviation Authority
The United Arab Emirates
e-mail: aai@gcaa.gov.ae

Appendix A. ABY111 Takeoff Along Runway 12



Appendix B. Sharjah Airport Chart



Appendix C. Airbus Normal Checklist

العربية للطيران airarabia.com
A320
QUICK REFERENCE HANDBOOK

NORMAL CHECKLIST

BC.C3A
20-Apr-17

BEFORE START

COCKPIT PREP ..... COMPLETED (BOTH)
GEAR PINS and COVERS ..... REMOVED
SIGNS ..... ON/AUTO
ADIRS ..... NAV
FUEL QUANTITY ..... ____ KG.LB
TO DATA ..... SET
BARO REF ..... ____ SET (BOTH)

WINDOWS/DOORS ..... CLOSED (BOTH)
BEACON ..... ON
THR LEVERS ..... IDLE
PARKING BRAKE ..... AS RQRD

AFTER START

ANTI ICE ..... AS RQRD
ECAM STATUS ..... CHECKED
PITCH TRIM ..... ____ % SET
RUDDER TRIM ..... ZERO

BEFORE TAKEOFF

FLIGHT CONTROLS ..... CHECKED (BOTH)
FLT INST ..... CHECKED (BOTH)
BRIEFING ..... CONFIRMED
FLAP SETTING ..... CONF ____ (BOTH)
V1, VR, V2/FLX TEMP ..... ____ (BOTH)
ATC ..... SET
ECAM MEMO ..... TO NO BLUE
- *AUTO BRK MAX*
- *SIGNS ON*
- *CABIN READY ( )*
- *SPLRS ARM*
- *FLAPS TO*
- *TO CONFIG NORM*

TAKEOFF RWY ..... ____ CONFIRMED (BOTH)
CABIN CREW ..... ADVISED
TCAS ..... TA OR TA/RA
ENG MODE SEL ..... AS RQRD
PACKS ..... AS RQRD

AFTER TAKEOFF / CLIMB

LDG GEAR ..... UP
FLAPS ..... RETRACTED
PACKS ..... ON

BARO REF ..... ____ SET (BOTH)

APPROACH

BRIEFING ..... CONFIRMED
ECAM STATUS ..... CHECKED
SEAT BELTS ..... ON
BARO REF ..... ____ SET (BOTH)
MINIMUM ..... ____ SET (BOTH)
ENG MODE SEL ..... AS RQRD

LANDING

CABIN CREW ..... ADVISED
A/THR ..... SPEED/OFF
AUTOBRAKE ..... AS RQRD
ECAM MEMO ..... LDG NO BLUE
- *LDG GEAR DN*
- *SIGNS ON*
- *CABIN READY ( )*
- *SPLRS ARM*
- *FLAPS SET*

AFTER LANDING

FLAPS ..... RETRACTED
SPOILERS ..... DISARMED
APU ..... START
RADAR ..... OFF
PREDICTIVE WINDSHEAR SYSTEM ..... OFF

PARKING

APU BLEED ..... ON
ENGINES ..... OFF
SEAT BELTS ..... OFF
EXT LT ..... AS RQRD
FUEL PUMPS ..... OFF
PARK BRK and CHOCKS ..... AS RQRD
Consider HEAVY RAIN

SECURING THE AIRCRAFT

ADIRS ..... OFF
OXYGEN ..... OFF
APU BLEED ..... OFF
EMER EXIT LT ..... OFF
SIGNS ..... OFF
APU AND BAT ..... OFF
Consider COLD WEATHER