

الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY



Air Accident Investigation Sector

Serious Incident

- Final Report -

AAIS Case N° AIFN/0011/2015

Takeoff from Taxiway

Operator: Shaheen Air International

Aircraft Type: Boeing 737-400

Registration: AP-BJR

State of the Operator: Pakistan

Place of Occurrence: Sharjah International Airport, the United Arab Emirates

Date of Occurrence: 24 September 2015



Occurrence Brief

Name of the Operator	:	Shaheen Air International
Aircraft manufacturer	:	The Boeing Company
Aircraft model	:	Boeing 737-400
Nationality	:	Pakistan
Registration	:	AP-BJR
Manufacturer serial number	:	25164
State of Occurrence	:	The United Arab Emirates
Date and time	:	24 September 2015, at 0239 UAE local time
Injuries	:	None

Investigation Objective

This Investigation is performed pursuant to the United Arab Emirates (UAE) Federal Act No. 20 of 1991, promulgating the *Civil Aviation Law, Chapter VII- Aircraft Accidents, Article 48*. It is in compliance with *CAR Part VI Chapter 3*, in conformity with *Annex 13* to the Convention on International Civil Aviation.

The sole objective of this Investigation is to prevent aircraft accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

Investigation Process

The Air Accident Investigation Sector (AAIS) of the UAE was notified that a Shaheen Air International Boeing 737 departed from the taxiway Bravo instead of Runway 30 at Sharjah International Airport. The AAIS Duty Investigator was informed four days after the Occurrence via the (DI) hotline, +971506414667.

The Occurrence was classified as a Serious Incident in accordance with ICAO Annex 13 and the AAIS opened an Air Accident Investigation File (AIFN/0011/2015).

An investigator-in-charge (IIC) was appointed by the AAIS. The State of the Aircraft Operator and Registration, Pakistan Safety Investigation Board (PSIB) was notified and assigned an Accredited Representative to the Investigation. Sharjah Aerodrome Operator assigned an Adviser to assist the IIC. The AAIS led the Investigation and issued the Final Report.

The digital flight data was downloaded by the Operator and data for the Incident flight was provided to the Investigation. Interviews of the flight crewmembers were performed by the PSIB on behalf the AAIS and the crew were also asked to respond to a questionnaire that was issued by the AAIS.

The information contained in this Final Report is derived from the factual information gathered during the investigation of the Incident. Before issuing the Final Report, as per *Annex*



13, a draft was circulated to the Aircraft Operator, the Pakistan Safety Investigation Board, the GCAA and the Aerodrome Operator for comments.

The AAIS Reports are publicly available at:

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

Notes:

1. Whenever the following words are mentioned in this Report with first Capital letter, they shall mean the following:
 - (Aircraft)- the aircraft involved in this serious incident;
 - (Investigation)- the investigation into the circumstances of this serious incident;
 - (Incident)- this investigated serious incident;
 - (Commander)- the commander of the incident flight;
 - (Copilot)- the copilot of the incident flight;
 - (Controller)- The air traffic control officer that was communicating with the aircraft;
 - (Report)- this serious incident Final Report.
2. Unless otherwise mentioned, all times in this Final Report are UAE local time (UTC+ 4 hours).
3. Photos and figures used in this Final Report are taken from different sources and are adjusted from the original for the sole purpose to improve 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 addition of text boxes, arrows or lines.



Abbreviations

AAIS	The Air Accident Investigation Sector, UAE GCAA
ADC	Aerodrome controller
AIP	<i>Aeronautical information publication</i>
ATC	Air traffic control
ATCO	Air traffic control officer
CAR	<i>Civil Aviation Regulation</i> of the United Arab Emirates
CAAP	<i>Civil Aviation Advisory Publication</i>
DCA	Department of Civil Aviation of Sharjah
DFDR	Digital flight data recorder
FC	Flight Cycles
FH	Flight Hours
GCAA	The General Civil Aviation Authority of the United Arab Emirates
GMC	Ground movement controller
GND	Ground – Air traffic controller
ICAO	The International Civil Aviation Organization
IIC	Investigator-in-Charge
ILS	Instrument landing system
IRVR	Instrumented runway visual range
kg	kilograms
km	kilometer
LT	Local time
m	meters
MSN	Manufacture serial number
OM-A	Operations Manual Part A
OMDB	Dubai International Airport, UAE
OMDW	Al Maktoum International Airport, UAE
OMSJ	Sharjah International Airport, UAE
PF	Pilot flying
PCAA	Pakistan Civil Aviation Authority
PM	Pilot monitoring
ROSI	Reporting of a Safety Incident (the UAE mandatory reporting program)
SMR	Surface movement radar



SOP	<i>Standard Operating Procedures</i>
UAE	The United Arab Emirates
UTC	Co-Ordinated Universal Time
V₁	Takeoff decision speed
V₂	Takeoff safety speed
VCR	Visual control room
V_R	Rotation speed



Synopsis

On 24 September 2015, Shaheen Air International scheduled passenger flight number SAI791, operated by a Boeing 737-400 Aircraft, registration AP-BJR, departed from Sharjah International Airport (OMSJ), the United Arab Emirates, at 0239 local time (LT) to Bacha Khan International Airport (OPPS), Pakistan. Instead of the assigned runway 30, the Aircraft took off from the parallel taxiway Bravo. The Investigation was informed four days after the Incident and was not able to interview the flight crewmembers.

Using the Aircraft flight data, and air traffic communications, the taxi route up to takeoff was determined. This confirmed that the Aircraft did turn onto taxiway Bravo and departed from this taxiway.

The air traffic Controller lost the visual watch on the Aircraft as it taxied from taxiway Alpha 20 towards taxiway Bravo and regained sight of the Aircraft on taxiway Bravo as it passed the taxiway Alpha 18 intersection. No attempt was made by ATC to stop the Aircraft during its take-off roll on the taxiway. The Controller decision was to allow the takeoff to continue as the Aircraft speed was unknown and taxiway Bravo was sterile at the time.

After takeoff, the flight crew were not informed about the taxiway takeoff and the flight continued for an uneventful landing at the destination airport. The crew were made aware of the Incident by the Aircraft Operator five days later.

The Investigation could not determine why the flight crew did not notice that they had lined up on a taxiway, but the flight crew stated that they had no doubt, but that they were lined up on the runway and they never had reason to question the visible cues, including the lighting. The difference between runway and taxiway lighting is significant yet this was not recognized by the flight crew.

The Air Accident Investigation Sector determines that the cause of the Incident was that, most probably, the flight crew did not devote sufficient attention to the taxi route, or taxi route lighting and signage. The flight crew misunderstood the air traffic control instructions and failed to identify that the Aircraft had been aligned on a taxiway, instead of on the runway, resulting in a takeoff from the taxiway.

Contributory factors to the Incident included:

- the Aircraft Operator standard operating procedures (SOP) did not require verification by the crew that the aircraft is lined up on the correct runway;
- the early takeoff clearance given by ATC;
- the urgency of the air traffic Controller for the Aircraft to depart;
- the red stop bar lights at the CAT II/III holding point for runway 30 was already OFF;
- the brighter green lead-on lights for taxiway Bravo;
- similar numeric descriptors for taxiway and runway designation;
- the air traffic Controller lost visual watch on the Aircraft; and
- the possibility that the flight crew assumed that taxiway Bravo was the runway due the width of the taxiway.

The Investigation has issued several safety recommendations addressed to Shaheen Air International, Sharjah Aerodrome, Sharjah Air Traffic Services, and the General Civil Aviation Authority of the United Arab Emirates.



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1. Factual Information

1.1 History of the Flight

On 24 September 2015, Shaheen Air International scheduled passenger flight number SAI791, operated by a Boeing 737-400 Aircraft, registration AP-BJR, departed from Sharjah International Airport (OMSJ), United Arab Emirates, at 0239 UAE local time for Bacha Khan International Airport (OPPS), Pakistan. The Aircraft took off from taxiway Bravo that was parallel to the assigned take-off runway 30. The air traffic Controller witnessed the takeoff from the taxiway.

There were 156 persons onboard the Aircraft consisting of two flight crewmembers, one observer pilot, five cabin crewmembers, and 148 passengers.

The flight crew consisted of the Commander, the copilot, and one observer pilot. The Commander was the pilot flying, and the Copilot was the pilot monitoring. The same crew had flown the three and a half hours inbound flight from Pakistan, and landed at OMSJ at 0130 LT, with a transit time of approximately 60 minutes before flying back to Pakistan.

For the night departure of the Incident flight, the visibility was normal, and the air traffic was light as there was one arrival and no other immediate departures. The taxiway green centerline lights, taxiway signage, and stop bar lights were functional during the Aircraft taxi.

During the departure, the air traffic Controller was performing the combined functions of ground and tower monitoring and communication. In addition, there was an ATC supervisor on duty in the control tower.

The Commander had stated that the following speeds, in knots, were calculated for the Incident flight: V_1 : 175; V_R : 180; V_2 : 183.

Clearance for taxi and full length runway after pushback and engine start was requested at 0233:26 by the Copilot. The air traffic Controller, via Ground frequency, gave clearance to taxi to Alpha, Alpha two zero, holding point Bravo two zero, runway three zero. Read back by the Copilot was "Alpha to holding point runway three zero".

The Aircraft commenced taxiing at 0234:04 and approximately 58 seconds later, the Aircraft entered taxiway Alpha on a heading of 121 degrees.

At 0237:54, with the Aircraft continuing on taxiway Alpha at an average ground speed of 10 knots, the air traffic Controller instructed the crew to change to the Tower radio frequency.

After changing to Tower radio frequency, at 0238:10 the Copilot advised the air traffic Controller that they would be holding short of runway three zero. Thirteen seconds later, the air traffic Controller instructed the crew to hold short at Bravo two zero to which the Copilot replied that they would hold short of "three zero". The Aircraft had reached the end of taxiway Alpha after traveling approximately 960 meters and was turning towards taxiway Alpha two zero at an average speed of eight knots.

With the Aircraft still in the turn and before reaching taxiway Alpha two zero, at 0238.49 the air traffic Controller gave the Copilot clearance for takeoff with the instruction "Cleared for takeoff runway three zero, Bravo two zero without delay clear takeoff, surface wind is one three zero degrees five knots. Bye bye". The read back by the Copilot confirmed runway three zero for takeoff without mention of Bravo two zero. The Aircraft was approximately 200 meters from the runway CAT I/II holding and 360 meters from entering the runway. At this stage of taxi, the Aircraft was now moving at an average speed of seven knots.

As the Aerodrome was not equipped with surface movement radar (SMR), the only means available to monitor ground maneuvering of an aircraft was visually, aided by binoculars. The air traffic Controller had noticed that the Aircraft speed had slowed as it taxied towards



Alpha two zero and communicated to the Copilot to keep the speed up until cleared onto the runway.

Shortly after the Aircraft had crossed the OFF stop bar at Alpha two zero, the air traffic Controller again repeated takeoff clearance by transmitting ‘...without delay cleared for takeoff runway three zero...’ The Copilot responded by repeating the takeoff clearance. The time was now 0239:12 and the Aircraft ground speed was seven knots. It was not confirmed by the Investigation whether the CAT I/II red stop bar for the runway 30 holding point was ON or OFF when takeoff clearance was given.

At 0239:16, the Aircraft started a left turn, following the green lead-on lights, towards the Bravo taxiway and away from taxiway Alpha two zero on a heading of 30 degrees. The Aircraft speed during the turn had decreased to an average of four knots.

The air traffic Controller was expediting the Incident Aircraft for take off as there was another aircraft, an Airbus A320, which was on a seven-mile final for runway 30.

At 0239:28 the Aircraft had entered taxiway Bravo and the air traffic Controller requested the Copilot to expedite the takeoff as there was traffic turning on final approach to land. The Copilot informed the air traffic Controller that they would expedite.

During this phase of the Aircrafts’ movement, the air traffic Controller had stated that visual watch of the Aircraft was not maintained due to the window frame design in the visual control room of the watch tower which had obscured the air traffic Controller’s view. The Aircraft was approximately 1 km away from the control tower.

Both engine thrust levers were advanced at 0239:30 and the Aircraft speed increased. At 0239:52, both thrust levers were at takeoff thrust as the Aircraft passed the intersection of taxiways Bravo with Alpha 18. The Aircraft speed had passed 69 knots and was quickly approaching 80 knots.

Initially the air traffic Controller thought that the Aircraft was on runway 30 during the takeoff roll but then realized that the lights of the Aircraft appeared to be on taxiway Bravo and that the Aircraft was passing the taxiway Alpha 18 holding point towards Bravo 14. The Aircraft speed was approximately 128 knots as it passed the taxiway Bravo 14 intersection.

The on-duty ATC supervisor also witnessed the Aircraft on Bravo taxiway. Between the air traffic Controller and the supervisor, a decision was made to allow the Aircraft to continue the takeoff, as they could not determine how fast the Aircraft was moving and there was no threat to the Aircraft from vehicles or obstructions on taxiway Bravo.

At 0240:25, the Aircraft was airborne, and at 0241:15, the Copilot informed the air traffic Controller that they were switching over to Dubai ATC. The message was acknowledged by the air traffic Controller. There was no discussion between the flight crew and the air traffic Controller about the takeoff from the taxiway.

The Aircraft continued to its destination for an uneventful landing.

Information about the Incident flight was not immediately passed to the Operator and the flight crew were made aware of the Incident five days after the flight.

The Commander stated that he was familiar with OMSJ as he had operated flights there prior to the Incident flight. His last flight into OMSJ was three months before the Incident, on 24 June 2015.

The flight crew statements indicated that the instruction from the air traffic Controller was to taxi Alpha, Alpha two zero, Holding Point three zero. They did not recollect holding point Bravo two zero being mentioned. During the taxi to Alpha two zero, the Commander mentioned that he was monitoring the approach and runway clearance. The Commander stated that there

was no pressure from the air traffic Controller to depart. The crewmembers also stated that during the rolling take off, there was no doubt but that they were on runway 30.

Figure 1. illustrates the Aircraft taxi route and eventual takeoff.

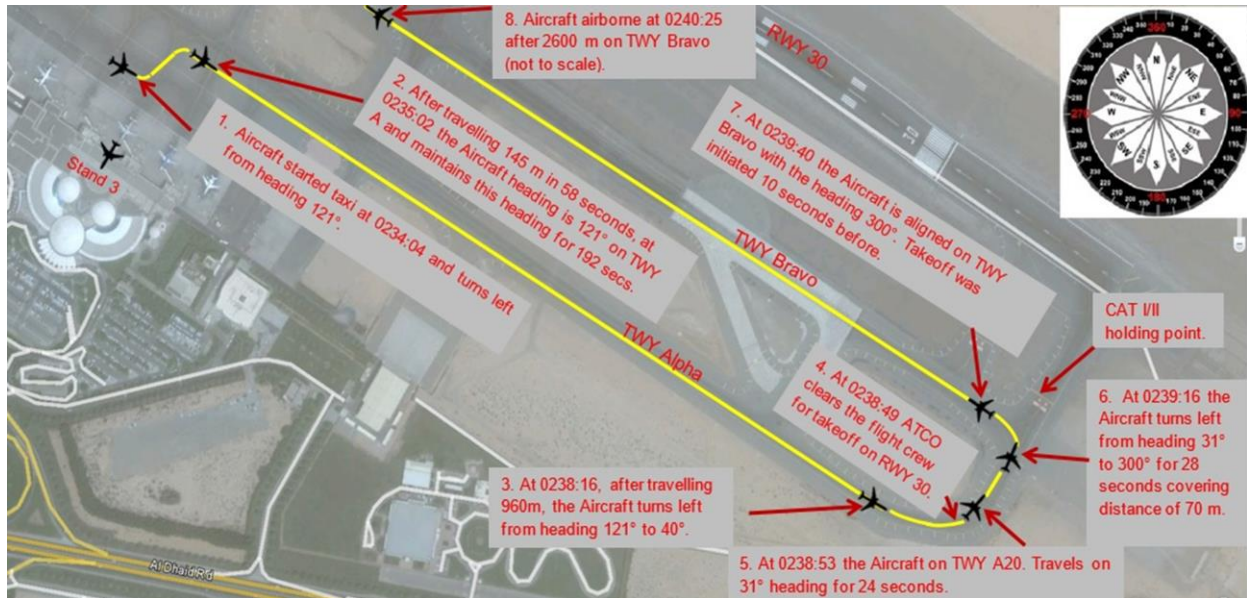


Figure 1. Aircraft taxi and take-off route

1.2 Injuries to Persons

There were no reported injuries.

Table 1. Injuries to persons

Injuries	Flight Crew	Cabin Crew	Other Crew 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	3	5	0	148	156	0
TOTAL	3	5	0	148	156	0

1.3 Damage to Aircraft

The Aircraft was undamaged.

1.4 Other Damage

There was no damage to property and/or the environment.



1.5 Personnel Information

1.5.1 Flight Crew Information

	Commander	Copilot	Observer pilot
Age	44	39	53
Type of license	ATPL	CPL	ATPL
Valid to	31 March 2016	31 March 2016	30 June 2016
Rating	B-737/300-800	B-737/300-800	B-737/300-800
Total flying time	4079:50	1049:15	3165:40
Total on this type	1235:55	182:20	388:40
Total last 30 days	75:20	64:10	57:00
Total last 72 hours	11:50	14:20	10:55
Total last 24 hours	6:20	4:30	4:25
Medical class	Valid Class 1 certificate	Valid Class 1 certificate	Valid Class 1 certificate
ELP	Level 4	Level 4	Level 4

The Commander, who had served in the military as a pilot with the rank of captain, was the pilot flying and he was seated in the left cockpit seat. The Copilot in the right hand cockpit seat was the pilot monitoring and was communicating with the air traffic Controller.

The observer pilot in the observer's seat, as per the Operator, was responsible to monitor all activities in the cockpit. This same pilot had flown with the Commander, as an observer, on two sectors the day before the Incident flight.

Even though the flight to and from Sharjah was flown at night, none of the crewmembers indicated that they were sleep deprived. The Investigation reviewed the Operator's crew roster which indicated that the crewmembers were assigned sufficient off-days prior to the Incident flight and that their previous flying schedule was considered normal.

1.5.2 The Air Traffic Controller

The air traffic Controller responsible for the Incident flight, held a valid license issued by the GCAA. In addition, the air traffic Controller had several years' experience at this control tower and had completed the required competency check and training approximately two months before the Incident.

It was the air traffic Controller's first night shift of a five-day cycle and had reported for duty at 2130 LT. Over the previous three days, the air traffic Controller had worked two morning shifts followed by an afternoon shift. The air traffic Controller was standing and wearing a headset during communications with the Incident flight crew.

After the Incident, in accordance with ATC procedures, the air traffic Controller was relieved from the controller position by the supervisor after the inbound aircraft had landed.

1.6 Aircraft Information

1.6.1 Aircraft General Data

Manufacturer:	The Boeing Company
Model:	Boeing 737-400
MSN:	25164
First Flight:	1993
Nationality and registration mark:	Pakistan, AP-BJR



Name of the owner:	KAL Aviation FZE, Sharjah, UAE
Name of the operator:	Shaheen Air International
Certificate of Registration (CoR)	
Number:	839/2
Issuing Authority:	Pakistan Civil Aviation Authority
Issuance date:	17 March 2015
Certificate of Airworthiness (CoA)	
Number:	787/1
Issuing Authority:	Pakistan Civil Aviation Authority
Issuance date:	30 May 2015
Valid to:	30 May 2016
Total hours since new:	48377 as of 23 September 2015
Total cycles since new:	32777 as of 23 September 2015
Engines:	CFMI CFM56-3C1
Maximum Takeoff Weight:	68,040 kg
Maximum Landing Weight:	56,246 kg

The Aircraft was not equipped, as it is not a mandatory requirement, with a runway awareness advisory system (RAAS) that may have aided the flight crew situation awareness during the taxi with information related to the aerodrome taxiways and runway.

1.7 Meteorological Information

The Incident Aircraft commenced taxiing at 0233 and took off at 0240 LT. During this nighttime departure, there was no moonlight as the moon had set at 0153. The weather was not significant with clear visibility and the airfield temperature was 28 degrees Celsius.

1.8 Aids to Navigation

The taxiways, holding points and runway 12/30 are clearly indicated on the Jeppesen plate. The Operator provided a copy of the Jeppesen plate, OMSJ/SHJ (10-9) dated 10 March 2015, that was used by the flight crew.

Even though the Aerodrome is approved by the GCAA for CAT I operations only, it was noted by the Investigation that Jeppesen plate (10-1P1) used by the flight crew for OMSJ/SHJ dated 20 March 2015, under section (2.) – *ARRIVAL*, states: “

“2.2 CAT II OPERATIONS:

- RWY [runway] 30 and RWY 12 approved for CAT II operations, special aircrew and ACFT certification required.”

1.9 Communications

The Investigation was provided with a copy of the air traffic radio communications between the Aircraft flight crew and Sharjah air traffic control unit.

Aircraft movements at Sharjah on 24 September 2105, from 0215 to 0245, were considered light as there were three aircraft on frequency. The air traffic Controller was communicating and monitoring both the Ground and Tower frequencies.

During the Aircraft taxi, clearance was given to the flight crew by the air traffic Controller, via ground frequency, to taxi via “...Alpha, Alpha two zero, holding point Bravo two



zero, runway three zero”. The read back from the Copilot was “Alpha to holding point runway three zero...”

Upon reaching the end of the straight section of taxiway Alpha, the air traffic Controller had switched over to Tower frequency and instructed the Copilot “...to hold Bravo two zero.” The response from the Copilot was “Hold short of three zero...”

Soon after, the air traffic Controller issued the takeoff clearance and stated “...Runway three zero Bravo two zero without delay clear takeoff surface wind is one three zero degrees five knots...” The read back from the Copilot was “Cleared for takeoff runway three zero Shaheen seven niner zero wind copied.”

As the Aircraft started to turn to a heading of 31° on taxiway Alpha 20, the air traffic Controller instructed the Copilot to “...keep your speed up until you’ve cleared the runway.” The Copilot did not hear this communication and requested that the message be repeated.

Shortly after, the air traffic Controller again communicated the take-off clearance by stating “...without delay cleared take off runway three zero...” which the Copilot read back correctly.

After the Aircraft had entered taxiway Bravo, the air traffic Controller communicated to the crew to “...expedite please I’ve got traffic turning final”. The Copilot acknowledged the message, and stated that they would be expediting.

There was no further ATC communication with the Aircraft until airborne, and ATC did not pass any information to the flight crew that they had taken off from the taxiway.

1.10 Aerodrome Information

Sharjah International Airport has one runway orientated southeast/northwest with runway designations 12/30. It is designated as a code 4F precision approach runway to CAT II standards and both runway 12 and runway 30 are provided with an instrument landing system, ILS.

The GCAA approval limitation for the aerodrome operation is CAT 1, as stated in the published UAE *Aeronautical Information Publication (AIP)* for OMSJ.

The Investigation was not aware of any significant NOTAM¹ that issued by the Aerodrome Operator the night of the Incident.

There are no hot spots² identified by the Aerodrome Operator after the inauguration of the new runway and the commissioning of the additional parallel taxiway Bravo.

The Aerodrome was not equipped with a Runway Incursion Monitoring and Conflict Alerting System (RIMCAS) or surface movement radar (SMR) monitoring equipment.

1.10.1 Taxiways

The Aerodrome had two parallel taxiways, Alpha and Bravo, which were also parallel to the single runway 12/30.

Prior to October 2014, there was one taxiway (Alpha) parallel to the runway. After the new runway became operational in October 2014, the previous runway was designated as a

¹ NOTAM: Is a notice to airmen, filed with an aviation authority to alert aircraft pilots of potential hazards along a flight route or at a location that could affect the safety of the flight.

² HOT SPOT: A location on an aerodrome movement area with a history or potential risk of collision or runway incursion and where heightened attention by pilots/drivers is necessary.

taxiway and is now known as taxiway Bravo. The distance between the centerline of taxiway Bravo and the runway is 250 meters.

The taxiways designation, prior to the new runway, were mostly identified by a single letter. From October 2014, there were several changes to the taxiway identification system with many being given an alphanumeric designation. Examples of changes included taxiway Golf to Alpha 20; taxiway Foxtrot to Alpha 18; and taxiway Charlie to Alpha 6.

The Investigation noted that the displaced threshold stripes on taxiway Bravo are still faintly visible. As per the UAE AIP, aircraft high power engine runs are carried out at this location. The AIP states that the taxiway was 25 meter wide. This measurement was between the yellow painted edge lines. The Investigation noted that the width of the taxiway Bravo intersection with taxiway Alpha 20 was 45 meters. Signs of the previous runway imprint could be seen through the painted surface, and taxiway Bravo was extending beyond taxiway Alpha 2, at the west end, and taxiway Alpha 20, at the east end, into what was probably the previous runway end safety area (RESA).



Figure 2. Runway threshold and painted taxiway Bravo threshold

All taxiway centerline lights and lead-in lights to the runway were green. However, it was noted by the Investigation that, at nighttime, there was a difference in the green shade and level of brightness used only for the centerline lead-on lights from taxiway Alpha 20 to taxiway Bravo. The same condition existed at the western end of the taxiway Alpha with taxiway Alpha 2 lead-on lights to taxiway Bravo.

Taxiway Bravo also had two intermediate holding point red stop bars, Bravo Golf (BG) at the eastern end adjacent to the taxiway Alpha 18 intersection, and Bravo Alpha (BA) at the western end. These two holding points on taxiway Bravo were not activated during the night of the Incident. Subsequently, the air traffic service provider issued procedures to the air traffic controllers requiring use of the stop bars.

As an aircraft moves away from the controllers view, they normally use a known reference point to determine the aircraft position along the taxiways and runway. At night, the runway is dark and not identifiable. During an aircraft takeoff from the displaced ends of the runway, there is no reference point to know where an aircraft is situated on the runway except for the red stop bar at taxiway Bravo 14. The extremities of taxiways Alpha and Bravo makes it difficult for the controllers to confirm the aircraft position as the stop bars are not visible and the centerline green lights fade as the distance increases away from the control tower.

With this Incident, the Aircraft was approximately one kilometer away from the control tower as it taxied passing taxiway Alpha 20 towards Bravo.

The threshold of runway 12 was at a distance of approximately three kilometers from the Tower.

1.10.2 Runway 12/30

Runway 12/30 was 4060 meters long and 60 meters wide, and had a 300 meters displaced threshold at runway 30. At the western end of the runway, taxiways Bravo 2 and Bravo 3 lead to the threshold of runway 12 by following the centerline green lights and yellow painted centerline. At the eastern end of runway, centerline green lights and a yellow painted centerline lead to the threshold of runway 30 from taxiways Bravo 19 and Bravo 20. Two additional taxiways, Bravo 6 and Bravo 14, lead to the runway and are sometimes used for an



intersection takeoff. All taxiways that lead to the runway had the required runway holding point and included signage and red stop bars. The green lead-in lights for the runway come on only when the stop bar goes off.

Except for low visibility operations, the intermediate holding point red stop bars at taxiways Alpha 20 and Alpha 2 are not always used. Beyond that stop bar, there were two sets of centerline green lights. One row of the green lights went towards the centerline of taxiway Bravo and the other row of lights lead towards the CAT I/II hold point. Provided the CAT I/II hold point red stop bar was off, the green centerline lights beyond the stop bar will come on and lead the aircraft to runway 30 via taxiway Bravo 20 at the eastern end and runway 12 via taxiway Bravo 2 at the western end.

The runway was equipped with an ICAO precision approach CAT II lighting system for approaches at runways 12 and 30. All aerodrome ground lighting (AGL) was remotely controlled and monitored in the ATC Tower.

1.10.3 Visual control room

The Tower visual control room (VCR), together with the Airport, were constructed in the 1970s at the eastern end of the passenger terminal building. It was elevated above the ground and surrounded by nine equally sized angled transparent glass panels which are held in place and joined together by segmented metal strips. As stated by the air traffic Controller, which was verified by the Investigation, when the controller is at the assigned seat for Ground or Tower positions, the metal strip obscures the view of taxiway Alpha 20 and the lead-on to taxiway Bravo. The VCR is not equipped with Aerodrome cameras and monitors.

The Investigation was informed by the Aerodrome Operator, that the VCR will be renovated and refurbished in order to better enhance the working conditions within the Tower. This plan was a result of several GCAA audit findings dating back to 2011.



Figure 3. OMSJ Tower - visual control room

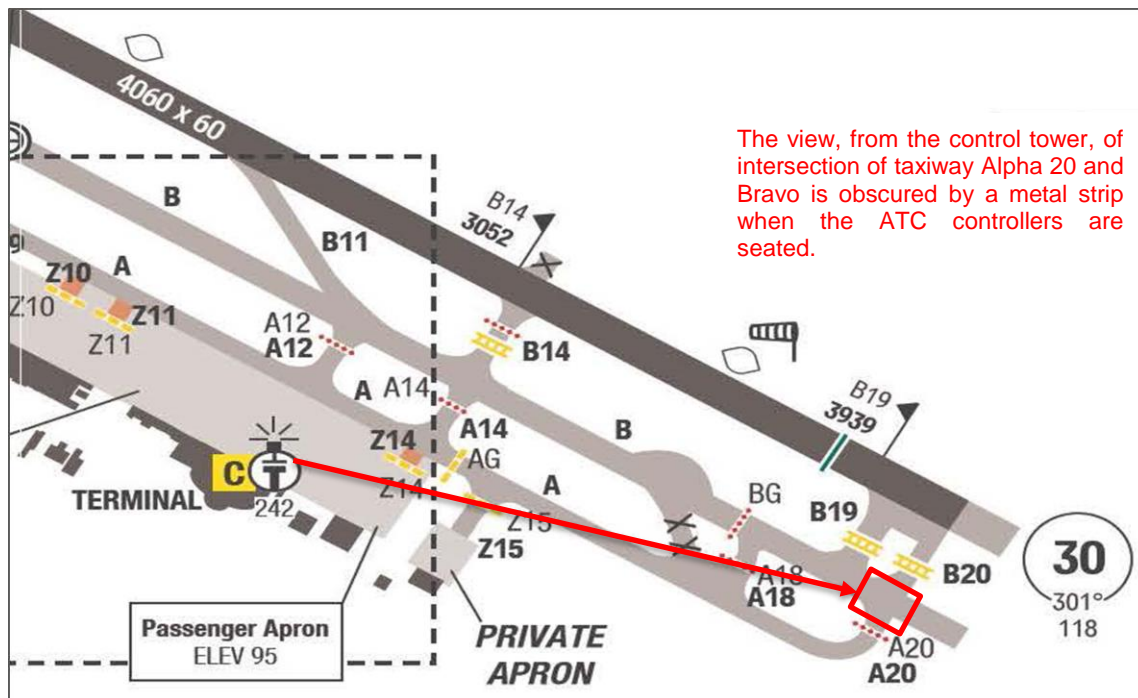


Figure 4. OMSJ Tower location in the Aerodrome

1.11 Flight Recorders

The Investigation was informed of the Incident four days after it occurred, thus access to the Aircraft cockpit voice recording was not requested as it would have been overwritten during the intervening time. The Operator did provide a download of the digital flight data recording to the Investigation.

Besides the statements of the air traffic controllers, there was no other evidence, to support what was noticed by the controllers. In addition, the flight crew statements supported their recollection of the takeoff as being from runway 30.

During review of the DFDR data, the GPS recorded in the DFDR data was derived data and could not be used to plot the path of the Aircraft during taxi and takeoff, as these plots were not accurate.

However, the Investigation was able to calculate the Aircraft routing during taxi and takeoff by synchronizing the air traffic Controller and Copilot radio transmissions together with relevant recorded flight data, which confirmed that the Aircraft took off from taxiway Bravo. (Appendix A).

1.12 Wreckage and Impact Information

The Aircraft was intact.

1.13 Medical and Pathological Information

No medical or pathological investigations were conducted as a result of this Incident.

1.14 Fire

There was no signs of fire.



1.15 Survival Aspects

Not required to be conducted for this Incident.

1.16 Tests and Researches

No tests or research were required to be conducted for this Incident.

1.17 Organizational and Management Information

1.17.1 The Aircraft Operator

The Aircraft Operator holds an air operator certificate (AOC) issued by the Pakistan Civil Aviation Authority to operate several aircraft types, including the Hawker Beechcraft 400X type. The company's operations manual together with checklists, charts and airport briefings was the responsibility of the Operations Department.

Pilots employed at the Operator included ex-military pilots who had held different military ranking.

After the new runway was inaugurated at OMSJ in 2014, the Operator did not perform a risk assessment to identify whether any threats existed that may have affected the performance of the flight crew and continued safe operation of an aircraft.

1.17.1.1 *Standard operating procedures (SOP)*

Guidance procedures for the Commander and Copilot could be found in the Operator's flight manuals including the *OM-A* and the *Boeing 737-400 SOP*. The pilot flying and the pilot monitoring are tasked to perform specific functions before and during taxi as well as before takeoff.

Neither the *OM-A* nor the *SOP* had a statement for the flight crew to ensure and verbalize a positive runway identification before the take-off roll is commenced.

The following are extracts from the Operator's *SOP*, revision 38, dated 11 November 2014:

- a. *SOP 1.2 – Crew Duties*. The responsibilities of the phase of flights are mentioned with the PF responsible for the taxiing, and the PM for checklist reading, Comms, monitoring taxiing.
- b. *SOP 2.2.2 – Departure briefing*. The PF shall carry out the departure briefing which includes the "Taxi procedure"
- c. *SOP 2.2.6 – Initiation of reject maneuver by V1*. Experience has shown that rejected takeoffs were sometimes hazardous even though the performance was calculated based on flight tests and this includes item h- Runway line up not considered. Crew are reminded that since 80 knots rejecting the takeoff becomes a serious action, and may lead to a hazardous situation, in particular as speed approaches V1, it is prudent to be "GO-MINDED".
- d. *SOP 5.1(b) – Taxi*, maximum taxi speed 25 knots on straight run – on turns maximum is 10 knots.
- e. *SOP 5.1(h) – Taxi*, prior to entering runway- both pilots shall check that approach path is safe for runway entry and clear of any conflicting traffic. Each pilot shall respectively announce "Approach / Runway Clear My Side"



- f. SOP 6.0 – *Rejected takeoff procedure*, the captain has the sole responsibility for the decision to reject the takeoff.

1.17.2 Aerodrome operator

Sharjah International Airport is owned by the Government of Sharjah. The aerodrome operator is the Sharjah Department of Civil Aviation (SHJ DCA) and maintains the aerodrome license issued by the GCAA.

The GCAA approval limitation for the aerodrome operation is ILS CAT I³.

Sharjah Airport Authority (SAA) is responsible for the day-to-day operation of the Airport services.

1.17.2.1 UAE AIP for OMSJ

In the *AIP*, dated November 2016, the following is stated in section 2.23.3 – *CAT I Operations*, concerning OMSJ:

“2.23.3.1 – For operational purposes the ILS approaches are CAT I only while awaiting CAT II approval from GCAA. Exception see 2.23.3.2 below.

2.23.3.2 – Aircraft approved by GCAA Flight Operations under CAR OPS 1.430 are permitted to carry out lower than standard CAT I ILS approaches to RWY [runway] 12/30 at OMSJ, to a RVR not less than 400 M.”

1.17.2.2 OMSJ Aerodrome Manual

The GCAA accepted *Aerodrome Manual* for OMSJ that was available to the Investigation after the Incident, was issue 10, version 1, dated 23 January 2013. As this manual had not been updated after that date, there was no mention of the new runway that was commissioned in October 2014.

1.17.2.3 OMSJ aircraft movements

The annual average of aircraft movements and passengers for the period 2014 to November 2016 was approximately 70,000 and 10 million passengers, respectively.

The Investigation was not informed by the Aerodrome Operator how many days and for what number of flights, during the three years from 2014 to 2016, that the Aerodrome had operated under low visibility minima. Paragraph 4.19.4.2 – *Recording of Information*, of the *Sharjah Operations Manual* states that: “ All aircraft movements in RVR 550m or less shall be logged, using the appropriate form in Appendix B, when Low Visibility Procedures are in force. Aircraft movement logs are to be forwarded to the GCAA weekly.”

1.17.3 Sharjah air traffic services

Air traffic control services at OMSJ was contracted out by the SHJ DCA to Serco Middle East as stated in the *Aerodrome Organizational Exposition*.

1.17.3.1 Controllers responsibilities

The responsibilities of the air traffic controllers are stated in the GCAA accepted Air Traffic Services *Sharjah Operations Manual*. This manual, version 1.1, dated 4 February 2016,

³ Precision Approach Runway, Category I. A runway served by visual aids and nonvisual aid(s) intended for landing operations following an instrument approach with a decision height (DH) not lower than 60 m (200 ft) and either a visibility not less than 800 m or a Runway Visual Range not less than 550 m.



in section 3.5 – *Control Positions*, itemizes the areas of responsibility for the Aerodrome and Ground controller. Aerodrome control (ADC) has the call sign Tower and communicates on frequency 118.6MHz, whereas the Ground control is known as ground movement control (GMC) with call sign Ground and communicates on frequency 121.875MHz. In summary, the controllers are responsible for the following:

- Aerodrome controller. – Normally responsible for operations on the runway and aircraft flying within the area of responsibility of the aerodrome control tower;
- Ground controller. Normally responsible for traffic on the maneuvering area with the exception of runways.

During the time of the Incident flight from pushback to takeoff, one controller assumed the responsibilities of both ADC and GMC positions.

1.17.3.2 Taxiway Alpha 12

Taxiway Alpha 12 is mentioned in the factual information as a safety concern and was not contributory to the Incident.

During the Investigation visit to the Aerodrome, an aircraft was noticed not following ATC instructions and taxied from taxiway Bravo 11 through taxiway Alpha 12 to Alpha. Paragraph 3.4.1.11 of the *Sharjah Operations Manual* states

“Taxiway Alpha 12 is not authorized to use from B11, day or night

- There are no taxiway centerline lights or markings joining Bravo 11 to Alpha 12
- There is no sign from Bravo 11 indicating Alpha 12.”

1.17.3.3 CAT II Operations

Sharjah taxiway 12/30 has been approved by the GCAA for CAT I operations only.

However, a review of the *Sharjah Operations Manual* in Section 4.7 – *ATC Procedures in CAT II conditions*, states that the runway has CAT II approvals and states the following:

“4.7.1 Sharjah International Airport is single runway operation (Runway 12/30) with precision ILS CAT II approaches to RWY [runway] 12/30.

- The arriving minima on Runway 12/30 are restricted to ILS CAT II operations with a minima of 350 m RVR or cloud ceiling not less than 100 feet.

4.7.2 Authorized Aerodrome Operating Minima

- 4.7.2.1 UAE GCAA authorizes Low Visibility Operations at Sharjah International Airport to the following minima:”
 - a) Arrivals IRVR 350 m or greater
 - b) Departures IRVR 350 m or greater.”

1.17.3.4 Reporting of incidents

After the Incident Aircraft had departed, there was no radio call to the flight crewmembers to alert them that the takeoff had been made from the taxiway. Paragraph 8.5.10.1 of *Sharjah Operations Manual– Incident involving airline operators*, states that:



“Following an aviation incident, air traffic Controllers shall ensure that pilots involved in the incident are aware that the incident has occurred and that reporting action is being taken.”

Timely reporting of the Incident by Sharjah air traffic unit to the AAIS Duty Investigator was not actioned as per GCAA *Civil Aviation Advisory Publication (CAAP) 22 – Safety Incident Reporting*, until four days after the Incident.

1.17.4 GCAA CAAP 69 – UAE Radiotelephony Standards

CAAP 69 contains guidelines on phraseology to be used when communicating with an aircraft.

Section 3.4 – *Taxi Instructions*, states:

“3.4.4 - Taxi instructions issued by a controller will always contain a clearance limit, which is the point at which the aircraft must stop unless further permission to proceed is given. The clearance limit may not necessarily be a position from which an aircraft can enter the runway for departure, or enter the apron, but may be some other position on the aerodrome depending on prevailing circumstances. Taxi instructions may also include a taxi route.

3.4.5 - When a taxi clearance contains a taxi limit beyond a runway, it shall contain either an explicit clearance to cross, or an instruction to hold short of that runway.”

In section 3.6 – *Takeoff Procedures*, states:

“3.6.1 - At busy aerodromes with separate ground and tower frequencies, aircraft are usually transferred to the tower at, or when approaching the runway holding point. Care should be taken to ensure that the phraseology used during the taxi manoeuvre cannot be interpreted as a clearance to enter or take off from the runway.”

1.18 Additional Information

The Investigation reviewed similar incidents at OMSJ as well as a few examples of taxiway confusion and taxiway departures to determine any similarities with the investigated Incident.

1.18.1 Taxiway confusion at Sharjah International Airport

On 19 April 2016, and during a night departure of an Airbus A320, taxi clearance was given by the air traffic controller to proceed, after pushback, via taxiways Alpha, Alpha 20, Bravo 20, runway 30. The crew read back was correct.

At 0110 UAE local time, the air traffic Controller gave clearance for takeoff from runway 30 via Bravo 20. The aircraft was on Alpha 20 when clearance for takeoff was given. A short time after, the air traffic controller questioned the crew as the controller had noticed that the aircraft had turned onto the Bravo taxiway. The controller immediately gave the instruction to stop. The flight crew stated that they missed the runway and taxied onto taxiway Bravo instead. The aircraft was allowed to taxi to runway 30 via Bravo 19 and departed from the runway without further incident.

As a result of this Incident, the Air Traffic Services issued new procedures for the controllers:

- “For aircraft departing on runway 30 and using taxiway A20
- BG stop bar on TWY Bravo shall be selected ON



- Clearance for takeoff shall not be given until the aircraft has passed Taxiway Bravo and cannot mistake it for the runway

“For aircraft departing on RWY 12 and using TWY A2

- BA stop bar on TWY Bravo shall be selected ON
- Clearance for takeoff shall not be given until the aircraft has passed Taxiway Bravo and cannot mistake it for the runway.”

1.18.2 Attempted takeoff from taxiway at Al Maktoum International Airport, the UAE

The AAIS issued the final report⁴ for a Hawker Beechcraft attempted takeoff from a taxiway incident that occurred at Al Maktoum International Airport on 23 May 2014.

On the day of that incident, and at about 1522 UAE local time, a taxi clearance was given for taxiway Whiskey for departure from runway 30. The air traffic controller issued the clearance, which was “Straight ahead right via Whiskey then Victor 21 holding point hold short of runway 30.” The crew replied with “Whiskey, Victor 21, hold short of runway 30, holding point.” When the aircraft was taxiing out on taxiway Whiskey, the ATC offered the intersection takeoff for runway 30 via taxiway Victor 16 which was accepted by the crew. The tower instructed the crew to turn left onto Victor 16 and hold short of runway 30 that was read back correctly.

As the aircraft approached the end of taxiway Whiskey, it turned left at the intersection of Whiskey 16, and then, mistakenly, made a premature left turn and lined up on taxiway Victor instead of continuing straight ahead on taxiway Whiskey 16 to runway 30.

The air traffic controller did not observe that the aircraft was lined up on the taxiway when takeoff clearance was given. The aircraft commenced the takeoff roll on taxiway Victor and continued accelerating along the taxiway without any awareness of the situation on the part of the air traffic controller.

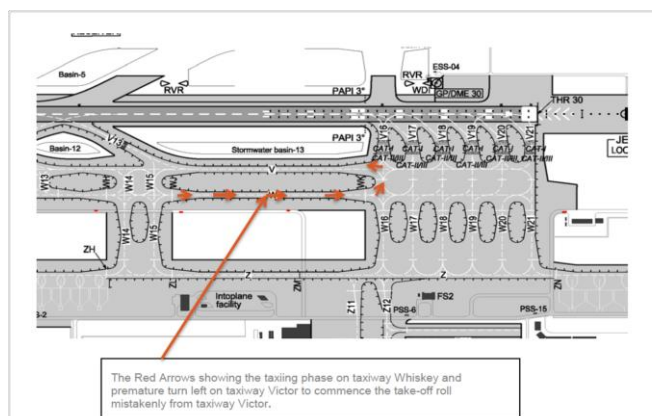


Figure 5. Taxiway attempted takeoff at OMDW

When the Aircraft reached approximately 50 knots ground speed, the air traffic controller realized that, the Aircraft was mistakenly taking off from the taxiway and immediately instructed the crew to stop. Accordingly, the commander rejected the takeoff.

The AAIS determined that a contributing factor to that incident was that the tower controller did not maintain a continuous visual watch on the aircraft ground movement.

⁴ AAIS Report No. AIFN/0010/2014



1.18.3 Attempted takeoff from taxiway at Changi⁵

On 12 July 2015, at approximately 0225 Singapore local time, a Boeing 767 was instructed by Changi International Airport control tower to taxi on the green taxiway centerline lights to runway 20C for departure. The flight crew was instructed to take off from runway 20C but instead lined up the aircraft on taxiway Echo Papa and commenced the takeoff roll. The runway controller saw the aircraft accelerating for takeoff and instructed the crew to stop. About the same time, the flight crew realized their error, retarded the thrust levers, and brought the aircraft to a smooth stop.



Figure 6. Attempted takeoff on taxiway – Singapore

During the turn onto the taxiway Echo Papa, the copilot, who was the pilot flying, did not see the lit red stop bar lights ahead of him. The stop bar lights was only noticed as the aircraft ground speed started to increase during the attempted takeoff on the taxiway.

While the aircraft was taxiing on taxiway November Charlie 2, the flight crew contacted the runway controller and reported that they were ready for departure. The controller asked the flight crew to expedite taxiing and gave the clearance for to line up on runway 20C and take off as the controller had expected the flight crew to follow the green lights leading to the runway.

The Air Accident Investigation Bureau (AAIB) of Singapore Bureau stated in the final report that it would be advisable for the ATC controllers not to issue line up and takeoff clearances in one transmission. Issuing a line up clearance first and then a takeoff clearance later will give ATC a chance to monitor the aircraft's movement to ensure that it is on the right route to the departure runway. In this occurrence, there were red stop bar lights on the taxiway used for the attempted takeoff. However, this line of defence was breached by the flight crew. Withholding takeoff clearance until the last moment constitutes another line of defence.

1.18.4 Attempted takeoff from a taxiway at Hong Kong⁶

In the night of 27 November 2010, at approximately 0124, Hong Kong local time, the flight crew of an Airbus A340 were instructed by the tower of Hong Kong International Airport to expedite the departure while the crew were busy in doing some cockpit tasks. The crew inadvertently turned onto a parallel taxiway and commenced a rolling takeoff. The aircraft accelerated until reaching to 75 knots when the tower movements controller told the crew to stop. Accordingly, the crew rejected the takeoff.

The aircraft was about 1,400 meters from the end of the outer parallel taxiway (Bravo) when the tower movements controller confirmed that the crew were ready for departure and asked them to expedite the taxi and to line up on runway 07 as another aircraft was on an 18 nautical miles final approach to runway 07L. The A340 was nearing the end of taxiway Bravo when the controller cleared the crew for takeoff.

When the aircraft reached the end of taxiway Bravo, the commander made a right turn onto taxiway Alpha 1, which crosses the inner taxiway (Alpha) and leads to runway 07L. Instead

⁵ Reference: AAIB Final Report No. AIB/AAI/CAS.114

⁶ Reference: Final Report issued by the Accident Investigation Division of the Hong Kong Civil Aviation



of taxiing the aircraft onto runway 07L, the commander turned onto taxiway Alpha and transferred control to the copilot, who commenced a rolling takeoff.

As the aircraft speed increased, the position of the aircraft on the taxiway was detected by the ground movements controller on the advanced surface movement guidance and control system. The ground controller alerted the tower movements controller who instructed the crew to “Stop rolling.”

The crew brought the aircraft to a stop at approximately 1,400 meters from the west end of the taxiway, after approximately 14 seconds from commencing the takeoff.

The final report states that a causal factor was a combination of an increase in cockpit workload and the difficulties experienced by both the captain and the copilot in stowing the electronic flight bag (EFB) at a critical point of taxiing, shortly before takeoff which distracted their peripheral external attention and resulted in a temporary degradation of their situation awareness.

The final report also concluded that the operator’s *SOP* was insufficient in solely delegating responsibility for taxiing to the commander, and in not requiring the verification of the departure runway before commencement of the take-off roll. The investigation also found that the commander, the copilot, or the relief pilot, who was occupying the observer seat, had realized, until the controller’s call that the takeoff had commenced on the taxiway. The crew stated that they saw the red stop bar lights perpendicular to the centerline but dismissed them as part of the lighting system leading to the displaced runway threshold. No queries were ever raised among the three pilots concerning the correct positioning of the aircraft.

Taxiway Alpha 1 was known as a hot spot in Hong Kong International Airport. Prior to the incident, three other flight crews were confused between runway 07L and taxiway Alpha where they commenced takeoff. These incidents also had occurred after midnight, with good visibility and light traffic, and after the crews were cleared for takeoff before reaching taxiway Alpha 1.

The final report noted that the information in the Hong Kong *AIP* about the hot spot was not incorporated in the A340 operator’s airport briefing. Among the recommendations generated by the investigation were that the operator ensure that safety-significant information is incorporated in airport briefings in a timely manner and that Hong Kong ATC managers ensure that clearance for takeoff on runway 07L is not issued until ensuring that the aircraft has passed taxiway Alpha or has entered the runway.

1.18.5 Takeoff from taxiway at Oslo Airport, Norway

On 25 February 2010, at approximately 1519 Norway local time, an Airbus A320 took off from the taxiway Mike of Oslo Airport Gardermoen instead of runway 01L. The crew were unaware of that confusion until they were informed of this by the air traffic controller after takeoff.

The investigation, that was carried out by the Accident Investigation Board of Norway, concluded operator-, control tower-, and the airport-related causes and contributing factors to the serious incident. The final report stated that there were deficient procedures and insufficient alertness in the cockpit, in combination with insufficient monitoring by the control tower, and insufficient signposting in the maneuvering area, resulted in the flight crew making a taxiing mistake and taking off from taxiway Mike.

1.19 Useful or Effective Investigation Techniques

This Investigation was conducted in accordance with the *Civil Aviation Law and Regulations* of the United Arab Emirates, the AAIS-approved policies and procedures, and in accordance with the Standards and Recommended Practices of *Annex 13* to the Chicago Convention.



2. Analysis

2.1 General

Taxiway takeoffs and taxiway confusion continue occurring despite the number of safety initiatives that have been put in place. Similar to other incidents, human-to-machine interface will always have potential threat of errors as a consequence of operational and/or environmental factors. How this is managed and mitigated so that errors are captured and minimized depends on many factors.

Flight crewmembers must ensure pre-taxi and pre-departure briefings are completed thoroughly and in at the appropriate time. These briefings should include the intended taxi route and any areas or items of concern that may be encountered during the taxi, as well as policies for changes to a briefed plan. During the taxi, flight crews should plan to minimize heads-down time and verbally confirm when a flight crewmember is heads-down.

This Report discusses factors that possibly influenced the flight crewmembers situation awareness to be compromised during the line-up and eventual takeoff from taxiway Bravo.

2.2 The Aircraft taxi and takeoff

Based on the visual evidence of the air traffic controllers that the Aircraft took off from taxiway Bravo, the Investigation calculated the time taken and distance travelled during the taxi and takeoff by using the Aircraft flight data and the air traffic control audio recordings to confirm what the controllers had reported.

The Commander, as per the Operator's procedure, was responsible for safely taxiing the Aircraft. He was an experienced pilot, familiar with Sharjah aerodrome, and had served in the military as a pilot before joining the Operator. The Copilot in the right seat was the pilot monitoring and was performing the communications with air traffic control. The Investigation could not determine what was the function of the third pilot in the cockpit and whether he had any responsibilities during the taxi.

At the start of taxi, the air traffic Controller clearance to the Copilot was for the Aircraft to taxi along "Alpha to Alpha two zero, holding point Bravo two zero, runway three zero." The read back by the Copilot was "Alpha to holding point runway three zero." without mentioning the holding point Bravo two zero. The air traffic Controller did not notice the error in the read back. The crew stated that they had referred to the Jeppesen plates to confirm the taxiways and runway.

Before the Aircraft reached the end of taxiway Alpha, the Copilot was instructed to change from Ground frequency to Tower frequency, which was complied with. The air traffic Controller for Ground and Tower was the same person. The average of the Aircraft taxi speed during this phase was approximately 10 knots.

ATC clearance for takeoff was given as the Aircraft approached taxiway Alpha 20, with the additional request "Without delay." The air traffic Controller had an aircraft on a seven nautical miles final approach for runway 30. At this stage of the taxi, the Aircraft had not crossed the Alpha 20 taxiway intermediate holding point OFF red stop bar.

Fifteen seconds later, the air traffic Controller requested the Copilot to keep the speed up until clear of the runway.

Again, after another eight seconds, the air traffic Controller repeated the clearance for takeoff with the additional words of "...without delay cleared for takeoff runway three zero..." The Aircraft had just passed the OFF intermediate stop bar on taxiway Alpha 20. As the Commander was already following the taxiway green centerline lights, he would have seen the



green lead-on centerline lights to taxiway Bravo on his left side. The CAT I/II holding point red stop bar (at a distance of 110 meters from the Aircraft) had they been ON, would have also been visible to the flight crew.

However, as the Investigation did not have verification of the switch position of the CAT I/II holding point red stop bar for runway 30, the most likely position for the stop bar lights was OFF as the air traffic Controller had issued an expedited take-off clearance to the Copilot.

Four seconds later, the air traffic Controller requested the Copilot to take off “without delay”. The DFDR data indicated that the Aircraft turned away from taxiway Alpha 20, heading on approximately 30 degrees towards taxiway Bravo. The Aircraft speed during the turn had slowed from seven to three knots that indicates a flight crew cautious command inputs along the taxi route.

After another 12 seconds, the air traffic Controller repeated his instructions for the crew to expedite the takeoff. Shortly after, the Commander advanced the thrust levers to part power and as the Aircraft crossed the intersection of taxiway Bravo and taxiway Alpha 18, the thrust levers were at take-off power.

As the Aircraft was not fitted with a runway awareness advisory system (RAAS), the only means available for the crew to determine the Aircraft position on the aerodrome during the taxi and takeoff, was by visual reference to the signage and lighting.

The flight crew, as they stated, had no doubt that the Aircraft took off from runway 30.

With clear visibility during the nighttime departure, the Investigation could not determine why the lack of situation awareness was not regained by the crewmembers after they had lined up on taxiway Bravo. With the Aircraft take-off lights turned on, their cognitive ability failed to recognize that the only visible lights were one row of green centerline lights along the taxiway yellow painted centerline. In addition, even though runway 30 has a displaced threshold, after an aircraft turns towards the runway, the runway white edge lights and white centerline lights would become visible.

The Investigation could not confirm whether there was any communication amongst the flight crewmembers to verify the Aircraft position prior to takeoff, or whether there was distraction that may have diverted their attention away from the serviceable visual external cues on the taxiway.

A rolling takeoff reduces the crew’s time to conduct a thorough outside visual check and to verify runway alignment before initiating the take-off roll. It is possible that the Commander was fixated on the taxi and takeoff of the Aircraft along the centerline lights and together with a confirmation bias mindset that the Aircraft was on the runway, the lack of edge lights on taxiway Bravo and that the centerline green lights did not trigger an alert as he processed the available information. The Aircraft take-off lights could have added to his confirmation bias as these lights are brighter than the taxiway lights and may have had the effect of reducing the visibility of the green centerline lights.

From the Commander’s position in the left seat, he would not have noticed the signage and the red RWY AHEAD painting for the runway holding point at taxiway Bravo 20. During this phase of the taxi as well as during the takeoff, the Copilot was probably concentrating their watch inside the cockpit especially as they were performing a rolling takeoff, thus he would have missed the opportunity to notice the line up on the taxiway together with the lack of edge lighting and the green centerline lights.

There was no evidence to indicate that the flight crewmember’s performance was influenced by fatigue, but at the time of the Incident, the flight crew were on duty for approximately six hours and had been awake for at least eight hours. Their body clock at 0239 (0339 Pakistan time) coincided with the phase of deepest sleep together with lowest body



temperature. This could have resulted in a reduction in mental ability and memory lapses. Pilots are constantly flying during this time and the crewmembers of the Incident flight would have had similar duty schedules.

The Investigation recommends that the Operator should examine its procedures and training to ensure that the following items are addressed: use of the current airport diagram not only during the planning phases, but also while taxiing; minimizing cockpit tasks during taxi; observe “sterile cockpit” procedures; always practice a “heads-up, eyes out” mode while taxiing; read back accuracy; and always to verify the aircraft position before the takeoff is commenced.

The Investigation recommends that the Operator should define the cockpit duties of the third pilot, when assigned to a flight. This should also be included in crew resource management (CRM) training.

2.3 The Operator

Information relevant to this Investigation regarding the Operator was limited to safety management, crew resource management, and *flight crew operating manuals*.

As part of safety management, the Operator is required to perform a risk assessment in order to identify any potential hazard associated with the operation of an aircraft, including at an aerodrome. After the new runway at OMSJ was commissioned, the Operator did not carry out a risk assessment to determine what threats the new runway may pose for flight crew, especially during nighttime operation when people are more prone to be affected by the body’s circadian rhythm.

The Aircraft involved in this Incident was not equipped with any additional aids, for example runway awareness and advisory system (RAAS), that may have warned the flight crew that they were aligned on the taxiway during the takeoff. The Operators’ procedures, including training, should specifically address crew continued assessment of the prevailing visual cues that may influence their decision-making process during taxi and takeoff.

Positive runway identification by the crewmembers before the thrust levers are advanced for takeoff is not mentioned in the Operator’s *standard operating procedures (SOP)*. This phase of the flight becomes even more critical during a rolling takeoff. For the Incident flight, this was compounded by the request from air traffic control to expedite the departure. The Operator should enhance the procedures to ensure that crewmembers verbally confirm that the aircraft is aligned on the assigned runway before takeoff is commenced.

All three flight crewmembers stated that they never doubted that they were on the runway. However, although the difference between runway and taxiway lighting is significant, the flight crew attention was not triggered, and even during the takeoff, the crew had a confirmation bias that they were on the runway and continued with the takeoff. Assuming they did have a difference of opinion with the location of the Aircraft, it may be possible that it was not verbalized, especially as the Operator gives the sole responsibility for taxiing the Aircraft to the Commander.

The CRM is the effective use of all available resources amongst the flight crewmembers to assure a safe and efficient operation, reducing error, avoiding stress and increasing efficiency. The inability of the three flight crewmembers to identify that the Aircraft was on the taxiway, may indicate shortfalls in applying the CRM appropriately.

The Investigation recommends that the Operator reemphasize the principles of CRM and enhance effective communication amongst flight crewmembers.

The Investigation recommends that the Operator evaluate the potential benefits of the runway awareness advisory system (RAAS) for fitment on an aircraft.



2.4 Air Traffic Control Services

2.4.1 Air Traffic Controller Communication

Air traffic movement was light at the time of the departure of the Aircraft, and during this period, the Controller was responsible for both Ground and Tower frequencies in addition to visually watching the departing Aircraft.

During the communications between the flight crew and the air traffic Controller, the Controller did not request the Copilot to correct the read back omissions. Initial clearance for taxi by the air traffic Controller on the Ground frequency included “Alpha, Alpha two zero, holding point Bravo two zero, runway three zero.” The Copilot read back the message, but omitted the reference to Bravo two zero. This occurred again, when on the Tower frequency, as the Aircraft had started to turn towards taxiway Alpha 20, the Copilot was instructed by the air traffic Controller to “Hold Bravo two zero.” The Copilot responded by saying “Hold short of three zero”.

The same read back error happened for the third time at a critical phase of the taxi. As the Aircraft was approaching taxiway Alpha 20 holding point, takeoff clearance was given and the air traffic Controller stated “Shaheen seven niner one, runway three zero, bravo two zero, without delay clear takeoff, surface wind is one three zero degrees, five knots, bye bye.” The Copilot read back the clearance, but again left out Bravo two zero. Soon after, the Commander started to turn the Aircraft towards taxiway Bravo.

A pilot read back presents the first and most efficient opportunity to catch miscommunications. It provides a verification to the controller that the pilot heard and understood the instruction, and it gives an opportunity to the controller to reaffirm the instructions given. An effective read back can mitigate the effects of expectation because it gives the controller an opportunity to correct any error.

It is possible, that the crew mistakenly understood that the holding point at Alpha 20 was the actual runway holding point, as Bravo two zero was never repeated by the Copilot. As the air traffic Controller never informed the crew that the read back was incorrect, this may have confirmed the mistaken perception the crew had. The crew may have developed an erroneous mental model that taxiway Alpha two zero holding point led to the runway. Contributory to this would have been that the red stop bar lights at taxiway Bravo 20 CAT I/II holding point to runway 30 were probably OFF.

As with previous accident investigations, ATC can negatively affect the decision making process of flight crewmembers leading to errors. An increase in cockpit workload can occur when instructions to expedite the takeoff are given, especially when the aircraft is still taxiing and has not reached the runway holding point. For this Incident, the mental readiness of the flight crew should not have been a factor for the takeoff even if they had issues within the cockpit. However, the Investigation believes that the nature of the clearance given over a 43 seconds period that included the words to “Depart without delay.”, “Keep the speed up.”, and “Expedite.”, could have influenced the flight crew in making the incorrect decision to turn and eventually take off from the taxiway.

The Investigation recommends that Sharjah Air Traffic Services:

- Reemphasize to the controllers the use of standard phraseology as mentioned in GCAA CAAP 69.
- Reemphasize read back accuracy and the negative effect this can have on the pilots’ mental model.
- Ensure that there is effective use of the runway holding points and intermediate holding point stop bars.



- Reemphasize to controllers their responsibility to maintain a visual watch on the aircraft, and before issuing a clearance for takeoff, to verify that the aircraft is at the runway holding point.

2.4.2 Conflict with aircraft on approach for runway 30

When the clearance was given for the Aircraft to take off, the aircraft on approach was on a seven nautical miles final. At an approximate approach average speed of 145 knots, this aircraft would have taken approximately 174 seconds to touchdown. At the initial ATC request for takeoff of the Incident Aircraft at 0238:49, until the Aircraft aligned on taxiway Bravo and started the take-off roll at 0239:40, the aircraft on the approach would have had just over a 2-minute separation.

Assuming that the Aircraft had continued along the correct taxi route at an average speed of seven knots, and that it did continue along taxiway Alpha 20, taxiway Bravo 20 to runway 30, it would have taken 104 seconds to travel the approximate 375 meters to align on the runway 30 heading of 300 degrees. At this stage, the approaching aircraft would have been three nautical miles or 70 seconds from the runway. To reach the threshold, the Aircraft would have had to travel an additional approximate distance of 275 meters. Thereafter, if the Aircraft had travelled at 25 knots, it would have taken another 21 seconds to reach the threshold. The air traffic Controller would have had to reassess the situation and decide whether the approaching aircraft had to perform a go-around in order to avoid an unsafe condition.

This was the air traffic Controller's first night duty, thus, had to work against the natural body clock to modify his sleeping habits in order to sleep during the day. At the time of the departure for the Incident flight, the air traffic Controller had been awake for approximately seven to eight hours and would have been experiencing circadian cycle effects. Similar to the flight crewmembers, the air traffic Controller body would normally experience deep sleep as well as a decrease in natural body temperature at the time of the Incident. As a result, this may have influenced the performance and alertness of the air traffic Controller.

The Investigation recommends that Sharjah Air Traffic Services reemphasize to controller's how to identify and manage the risk associated with working at night when the body will be affected by the circadian cycle.

2.4.3 Combination of Ground and Tower controller responsibilities

The air traffic Controller in communication with the Aircraft had assumed the combined responsibilities of the Ground and Tower positions.

Prior to taking over this combined position, depending on the air traffic Controller's last plugged in frequency; the Aerodrome (Tower) controller (ADC), would have normally been responsible for operations on the runway and for airborne aircraft; and the Ground movement controller (GMC), would normally have been responsible for traffic on the maneuvering area with the exception of the runways. The Ground controller would normally give taxi clearance and then hand over the departure to the Tower controller.

The Investigation believes that this combined position could have influenced the air traffic Controller's decision-making process especially as there was an aircraft on approach. The air traffic Controller transferred the Ground responsibility with a frequency change from Ground to Tower whilst the Aircraft was still on taxiway Alpha. Thus, the air traffic Controller was now communicating with both aircraft on the Tower frequency.

Soon after, and while the Aircraft was still on taxiway Alpha, take-off clearance was issued as the air traffic Controller had already switched over, and was communicating with the Copilot, on the Tower frequency. It is an acceptable practice that ATC clearances are issued



prior to the holding point, if possible, to prevent the aircraft stopping. This is in-line with the basic ATC principles of safe, orderly, and expeditious movement of air traffic.

It is possible that if the air traffic Controller had kept the Aircraft on the Ground frequency, the Aircraft would have probably continued to taxi along the assigned taxi route until reaching the ON stop bar lights at the taxiway Bravo 20 runway holding point. This would have enabled the Copilot to confirm the Aircraft position to the air traffic Controller. Thus, there would have been no need to issue expedited take-off instructions to the Copilot and the air traffic Controller would have, most likely, allowed the aircraft on approach to land.

In addition, as the air traffic Controller was responsible for all aircraft movements, Ground and Tower, there was no other air traffic control officer to assist in watching the moving Aircraft and communicating with the flight crews. Combining the responsibilities, required the air traffic Controller to be the eyes and ears of two people, as well as requiring him to make decisions to ensure that safety was not compromised.

Controllers are trained to take the responsibilities of both Ground as well as Tower positions. At Sharjah, it is not uncommon for one controller to assume the roles of Ground and Tower controllers on the same time. However, this combined responsibility is not mentioned in the *Sharjah Operations Manual*, except for the seating plan as mentioned in paragraph 7.4.3 of the *Manual*.

The Investigation recommends that Sharjah Air Traffic Services re-address the risk of assigning one air traffic controller to assume the combined responsibilities of Ground and Tower.

2.4.4 Reporting of the Incident

The air traffic Controller and the supervisor collectively decided to allow the Aircraft to continue the takeoff, as they were not sure of the Aircraft speed and there was no impending danger along taxiway Bravo. However, after the Aircraft was airborne, there was no communication about the Incident to the flight crew.

It was approximately four days after the Incident that notification was issued by Sharjah ATC and Sharjah DCA to the Investigation and to the Operator. In addition to reporting a safety incident to the GCAA, the *Sharjah Operations Manual* requires that ATC controllers shall ensure that pilots involved in an incident are made aware that the incident has occurred.

The Investigation recommends that Sharjah Air Traffic Services review and implement procedures for the immediate notification of serious incidents and accidents to the Air Accident Investigation Sector (AAIS), the flight crew, and the concerned aircraft operator.

The Investigation recommends that Sharjah Aerodrome Operator review and implement procedures for the immediate notification of serious incidents and accidents to the Air Accident Investigation Sector (AAIS).

2.5 Sharjah International Airport

2.5.1 Runway confusion

Runway confusion is a subset of runway incursions and can result in an unintentional takeoff or landing on a taxiway or wrong runway. Statistics show that pilots are generally not aware of the error until after it has occurred. Factors that the Investigation reviewed in order to understand why the Incident occurred included the visual effects of the signage, lighting, taxiway designation, and the taxiway Bravo intersection with taxiway Alpha 20.

As the Aircraft turned towards taxiway Alpha 20, the flight crew failed to recognize that taxiway Bravo 20 was straight ahead. The flight crew probably missed the lit taxiway signboard indicating taxiway Bravo was to the left of taxiway Alpha 20. This may have been because of the read back errors and the possibility that the wording "Alpha two zero." as it was mentioned



first during the ATC communications, were the only words that were accepted by the mental capacity of the flight crew.

The words “Bravo two zero”, even though different, could have sounded similar to the flight crew, especially as “two zero” was repeated. In the same transmission to the Pilots, the words runway “three zero” were also mentioned. Thus, similar words starting with “two zero” twice, and the word “zero” three times were repeated. The flight crew also stated that the instructions they remembered being given by the air traffic Controller were to taxi “Alpha, Alpha two zero, holding point three zero.” They did not recollect holding point “Bravo two zero” being mentioned.

The Pilots circadian rhythm was at a time when their alert level could have been compromised and it is possible that the repetition of words including the words “bravo two zero” was less important and probably allowed their mental cognitive capacity to reject these words.

After this Incident, another taxiway confusion incident occurred (paragraph 1.18.1 of this Report), but the cause of this occurrence was not determined. The Investigation could not determine whether or not the taxiway designation and the repetition of similar words had contributed to this error.

When the Aircraft had passed the OFF intermediate holding point stop bar at taxiway Alpha 20, it continued to follow the green curved lead-on lights towards taxiway Bravo. The color of these lights, at nighttime, is of a different shade of green to the green lights along the taxiway centerline which may have led the Commander to add to the perceived confirmation bias that the Aircraft was now entering the runway. The Commander stated that at this phase of the taxi, he was monitoring the approach and runway clearance. Thus, the Commander had a confirmation that the Aircraft was correctly positioned and was about to enter the runway. The crew did not recognize that the straight taxiway centerline lights directly ahead of the Aircraft led towards the runway holding point. The processing of information during this phase of the taxi allowed the situation awareness of the flight crew to be significantly affected. The taxi speed of the Aircraft was always well below the allowable speed, yet the lighting and signage did not register in the flight crew cognitive reasoning. The flight crew understanding of the information that they were gathering never raised any doubt that it was incorrect.

The Investigation believes that the flight crew could have been influenced by the width of taxiway Bravo, especially as their last flight was from Sialkot International Airport, Pakistan, which has no parallel taxiway and a single runway with a width of 45 meters (the same as taxiway Bravo). Taxiway Bravo is mentioned in the UAE AIP as having a width of 25 meters because the taxiway width beyond the intersection with taxiway Alpha 20 has yellow painted edge lines denoting the 25 meters width.

As a safety concern, for takeoff and landing aircraft, the Investigation believes that there is a risk involved with taxiway Bravo as a flight crew can mistake taxiway Bravo for a runway. This is due to the brighter green lead-on centerline lights, the physical size, imprint of the previous runway edge paint, aircraft tire imprints left on the taxiway surface, and that the threshold was still visible with the entire area having a whitish appearance. It is most likely that if this is not addressed, the taxiway confusion and potential taxiway takeoff will reoccur together with the risk of an aircraft landing on taxiway Bravo.

Annex 14 – Aerodromes, paragraph 5.2.1.4, with reference to color and conspicuity states that runway markings shall be white; and section 5.2.1.5 states that taxiway markings, runway turn pad markings and aircraft stand markings shall be yellow.

In Attachment A22 of *Annex 14*, and under the heading of *Taxiway design guidance for minimizing the potential for runway incursions*, it is stated:

“22.4 –Existing taxiways wider than recommended in this Annex, can be rectified by painting taxi side stripe markings to the



recommended width. As far practicable, it is preferable to redesign such locations properly rather than to repaint such locations.

22.9 –Avoid the placement of different pavement materials (asphalt and cement concrete) at or near the vicinity of the runway holding position, as far as practicable. This design principle avoids creating visual confusion as to the actual location of the runway holding position.”

The Investigation recommends that the Sharjah Aerodrome Operator should:

- Review and mitigate any risk associated with the use of similar designations for taxiways that lead to runway 12/30 that may cause taxiway confusion.
- Review and mitigate any risk associated with the green lead-on lights towards taxiway Bravo beyond taxiway Alpha 20 and taxiway Alpha 2.
- Determine whether the intersection of taxiway Alpha 20 with taxiway Bravo and taxiway Alpha 2 with taxiway Bravo should be designated as a hot spot, especially as there have been two incidents of taxiway confusion.
- As part of the Aerodrome Runway Safety program, review and mitigate any risk associated with the previous runway markings, color and width of taxiway Bravo.

2.5.2 Aerodrome Visual Control Room and SMR

As the Investigation confirmed, especially during nighttime, the metallic structure within the visual control room hinders the controller’s view of a departing aircraft. The GCAA had raised several audit findings related to the condition of the visual control room prior to the Incident flight.

The air traffic Controller was standing in order to have a better view of the departing Aircraft. However, the Controller had lost visual watch of the departing aircraft at a critical stage of the taxi, jeopardizing the safety of the departing and arriving aircraft, and potential risk of a go-around situation for the arriving aircraft.

The Investigation calculated that for a period of approximately 36 to 39 seconds, the Controller did not have a view of the Aircraft’s position. This was calculated from the time the Controller had lost visual watch on the Aircraft from the intersection of taxiway Alpha 20 with taxiway Bravo, until just past the intersection of taxiway Bravo with taxiway Alpha 18. The speed of the Aircraft at that stage was approaching 80 knots. Had there been any equipment on the taxiway, the Incident had the potential of being catastrophic.

It is possible that this situation could have been avoided had the Aerodrome been equipped with surface movement radar (SMR) to assist the controller’s continuous watch of the Aircraft position and awareness of the Aircraft speed.

In addition, as there were no reference points along the extremities of the taxiways leading to runway 12/30, controllers have to depend on feedback from the flight crew to know the exact aircraft position along the taxiways. This was not requested for the Incident flight, as during the communications there was no mention of the Aircraft position.

With reference to having an unobstructed view of the taxiways, *ICAO Aerodrome Design Manual (Document 9157, part 2)*, under section 1.1 for the design of taxiways, requires that all sections of the taxiway system should be visible from the aerodrome control tower. The *Document* also recommends having remote cameras to monitor sections of taxiways shadowed by terminal buildings or other aerodrome structures if such obstructions cannot be practically avoided.



After the two taxiway Incidents at OMSJ, controllers were instructed to use the two stop bars along taxiway Bravo. Where these stop bars are located, and with the displaced threshold, an aircraft can still attain a speed between 60 to 80 knots before any action is taken, either by the flight crew, or by the air traffic controllers. At this speed, there is potential for damage to aircraft as well as injuries to occupants of the aircraft.

From the *Annex 13* Investigation that occurred in Hong Kong (refer to section 1.18.4 in this Report), during the taxiway take-off roll, the crew did not observe the taxiway red stop bar lights perpendicular to the centerline as they had dismissed them as part of the lighting system leading to the displaced runway threshold. The aircraft speed was 75 knots when the position of the aircraft on the taxiway was detected by the advanced surface movement guidance and control system which allowed the controller to stop the crew from taking off.

The recommendation for having an SMR was made by the GCAA in 2011. Since this time, the number of yearly aircraft movements has increased to an average of 70,000 and there has been a significant increase in passenger numbers to 10 million passengers. The Investigation was unable to determine how many days and aircraft movements were affected as a result of low visibility operations.

The Investigation recommends that the Sharjah Aerodrome Operator together with Sharjah Air Traffic Services:

- Address the limitations and associated risk affecting the controllers' performance within the visual control room.
- Re-assess and mitigate any risk involved due to the lack of a surface movement radar to assist controllers in improving the monitoring of aerodrome movements.

2.5.3 Aerodrome and *Sharjah Operations Manuals*

The following information was not contributory to the Incident but could impact on safe operations at Sharjah Airport.

Sharjah aerodrome is certified by the GCAA for Category I (CAT I) operations which is also reflected in the UAE *AIP*. However, the reference manual used by the air traffic controllers (*Sharjah Operations Manual*), mentions procedures in CAT II conditions and states that the UAE GCAA authorizes low visibility operations at Sharjah International Airport for arrivals and departures with an IRVR⁷ of 350 meters, or more.

There are other sections within the *Sharjah Operations Manual* that allude to the Aerodrome operating under ILS CAT II, indicating that the Aerodrome has GCAA approval for CAT II operations.

With reference to paragraph 3.4.1.11 of the *Sharjah Operations Manual*, taxiway Alpha 12 is not allowed to be used from taxiway Bravo 11. During a night visit to the Aerodrome, the Investigation observed that an aircraft, after landing on runway 12, was cleared to taxi Bravo 11, Bravo, Alpha 14, to Alpha, but instead taxied from taxiway Bravo 11, Alpha 12, to Alpha. This area is a potential hot spot.

The intersection of taxiway Bravo 11 and taxiway Alpha 12 restriction is not reflected in the published UAE *AIP*. The available *Aerodrome Manual* for OMSJ was not referred to, as it had not been updated since 2013.

The Investigation recommends that the Sharjah Aerodrome readdress:

⁷ IRVR: Instrumented runway visual range



- The current manuals issued by Sharjah air navigation service provider and ensure that the information in the manuals is updated to reflect the correct current GCAA approval for runway 12/30.
- The process of updating the *Aerodrome Manual* to ensure that it reflects the current status of the aerodrome.
- The limitations on taxiway Bravo 11 to Alpha 12 and determine whether this should be inserted in the *Aerodrome Manual* and the UAE *AIP*.
- The intersection of taxiway Bravo 11 and Alpha 12 and determine whether this area should be designated as a hot spot, or not.



3. Conclusions

3.1 General

From the evidence available, the following findings, causes and contributing factors were made 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-** are statements of all significant conditions, events or circumstances in this Incident. The findings are significant steps in this Incident sequence but they are not always causal or indicate deficiencies.
- **Causes-** are actions, omissions, events, conditions, or a combination thereof, which led to this Incident.
- **Contributing factors-** are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident. 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 Pakistan.
- (b) The Aircraft was not equipped with a runway awareness advisory system (RAAS).

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 *Civil Aviation Regulations* of Pakistan.
- (b) The flight crewmembers possessed valid class 1 medical certificates and were adequately rested to operate the flight.

3.2.3 Findings relevant to the Aircraft flight operations

- (a) The flight was conducted in accordance with the procedures in the *Company Operations Manual*.
- (b) The Commander was the pilot flying.
- (c) The flight crew had referred to the OMSJ Jeppesen plates for the taxi route.
- (d) The Commander was responsible, as per the *SOP*, for the safe conduct of aircraft taxiing.
- (e) All radio communications were performed by the Copilot, who was the pilot monitoring.
- (f) There was a third pilot who occupied the observer's seat in the cockpit.



- (g) The Copilot did not correctly read back the air traffic Controller instructions, and in three communications left out the words “Bravo two zero”.
- (h) The flight crew were not aware that the Aircraft took off from the taxiway and were advised of the Incident five days after its occurrence.

3.2.4 Findings relevant to the Aircraft Operator

- (a) The Operator’s *SOP* did not state how the crew shall positively identify a runway.
- (b) The Operator did not perform any risk assessment of the runway at OMSJ after it was commissioned in October 2014.
- (c) The Operator did not define the responsibilities of the third pilot in the cockpit.

3.2.5 Findings relevant to the Aerodrome Operator

- (a) The GCAA approval limitation for the Aerodrome operation was CAT 1 as stated in the published UAE *AIP* for OMSJ.
- (b) The Aerodrome was equipped with a precision approach CAT II lighting system for approaches at runway 12 and runway 30.
- (c) Jeppesen plate (10-1P1) states that OMSJ both runways 12 and 30 are approved for CAT II operations.
- (d) The available *Aerodrome Manual* was last updated in January 2013.
- (e) The Aerodrome was not equipped with Runway Incursion Monitoring and Conflict Alerting System (RIMCAS) or Surface Movement Radar (SMR) monitoring equipment.
- (f) Runway 12/30 was approved by the GCAA in October 2014.
- (g) Taxiway Bravo was decommissioned as a runway in October 2014.
- (h) There were two parallel taxiways, Alpha and Bravo, parallel to the runway.
- (i) The previous threshold ground marks of taxiway Bravo, when it was a runway, were not totally void and its remain was still visible with faint whitish appearance.
- (j) The Controller’s view of the Aircraft movement was degraded by the ergonomic design of the visual control room tower.
- (k) There were no hot spots identified on any of the Airport charts or current manuals.
- (l) There was a different shade of green for the centerline lead-on lights from taxiway Alpha 20 to taxiway Bravo. Similar condition also existed in the intersection of taxiway Alpha 2 to taxiway Bravo.

3.2.6 Findings relevant to air navigation services

- (a) *Sharjah Operations Manual* stated that the UAE GCAA authorizes low visibility operations for CAT II operations.
- (b) The air traffic Controller did not correct the read back errors made by the Copilot.
- (c) The air traffic Controller lost visual watch on the Aircraft during the taxi phase.
- (d) The stop bars along taxiway Bravo were not activated for the Incident flight.
- (e) ATC did not advise the Aircraft flight crew that they had taken off from the taxiway.



- (f) During the time of the Incident flight from pushback to takeoff, one controller assumed the responsibilities of both the ADC and GMC positions.
- (g) The phraseology used by the air traffic Controller was not standard as mentioned in CAAP 69.
- (h) The UAE AAIS was informed about the Incident after four days of its occurrence.

3.3 Causes

The Air Accident Investigation Sector determines that the cause of the Incident was that, most probably, the flight crew did not devote sufficient attention to the taxi route, or taxi route lighting and signage. The flight crew misunderstood the air traffic control instructions and failed to identify that the Aircraft had been aligned on a taxiway, instead of on the runway, resulting in a takeoff from the taxiway.

3.4 Contributing Factors

Contributory factors to the Incident were:

- (a) the Aircraft Operator *standard operating procedures (SOP)* did not require verification by the crew that the aircraft is lined up on the correct runway before commencement of takeoff;
- (b) the early takeoff clearance given by ATC when the Aircraft was approximately 200 meters away from runway 30 holding point;
- (c) the urgency of the air traffic Controller for the Aircraft to depart;
- (d) the red stop bar lights at the CAT II/III holding point for runway 30 was already OFF;
- (e) the brighter green lead-on lights for taxiway Bravo were probably mistakenly interpreted as the lead-in lights for the runway
- (f) similar numeric descriptors for taxiway and runway designation;
- (g) the air traffic Controller lost visual watch on the Aircraft for some time and
- (h) the possibility that the flight crew assumed that taxiway Bravo was the runway due the width of the taxiway.



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*⁸, and are based on the conclusions listed in Section 3 of this Report. The AAIS expects that all safety issues identified by the Investigation are addressed by the receiving States and organizations.

4.2 Final Report Safety Recommendations

4.2.1 Shaheen Air International

It is recommended that Shaheen Air International:

SR11/2017

Review training and procedures for flight crewmembers to ensure that the following are addressed: use of the current airport diagram not only during the planning phases, but also while taxiing; minimizing cockpit tasks during taxi; observe “sterile cockpit” procedures; always practice a “heads-up, eyes out” mode while taxiing; read back accuracy; and always to verify the aircraft position before the takeoff is commenced.

SR12/2017

Review and address flight crew performance regarding read back of air traffic control instructions.

SR13/2017

Issue checklist procedures to ensure that there is positive runway verification by all crewmembers before takeoff is commenced.

SR14/2017

Reemphasize the principles of CRM and enhance effective communication amongst flight crewmembers.

SR15/2017

Evaluate the potential benefits of the runway awareness advisory system (RAAS) for fitment on applicable aircraft.

SR16/2017

Define the cockpit duties of the third pilot, when assigned to a flight. This should also be included in crew resource management (CRM) training.

4.2.2 Sharjah Air Traffic Services – Serco Middle East

It is recommended that Sharjah Air Traffic Services:

⁸ Paragraph 6.8 of *Annex 13 to the Convention on International Civil Aviation* states: 'At any stage of the investigation of an accident or incident, the accident or incident investigation authority of the State conducting the investigation shall recommend in a dated transmittal correspondence to the appropriate authorities, including those in other States, any preventive action that it considers necessary to be taken promptly to enhance aviation safety'.



SR17/2017

Re-emphasize to the controllers: the use of standard phraseology as mentioned in GCAA CAAP 69; read back accuracy; and the effective use of the runway holding points and intermediate holding point stop bars.

SR18/2017

Re-emphasize to the controllers the responsibility of keeping a visual watch on the aircraft, and before issuing clearance for takeoff, to verify that the aircraft is at the runway holding point.

SR19/2017

Evaluate and mitigate the risk, and establish procedures, of allowing a single air traffic controller to assume the combined responsibilities of the Ground and Tower positions.

SR20/2017

Review and implement procedures for the immediate notification of serious incidents and accidents to the Air Accident Investigation Sector (AAIS), the flight crew, and the concerned aircraft operator.

4.2.3 Sharjah Department of Civil Aviation

It is recommended that Sharjah Department of Civil Aviation:

SR21/2017

Review and implement procedures for the immediate notification of serious incidents and accidents to the Air Accident Investigation Sector (AAIS).

SR22/2017

Re-assess and mitigate the risk associated with the use of similar designations for taxiways that lead to runway 12/30 that may cause taxiway confusion.

SR23/2017

Re-assess the risk associated with the green lead-on lights towards taxiway Bravo beyond taxiway Alpha 20 and taxiway Alpha 2.

SR24/2017

Review and determine whether the intersection of taxiway Alpha 20 with taxiway Bravo, and taxiway Alpha 2 with taxiway Bravo, to be designated as a hot spot.

SR25/2017

Re-assess the risk associated with the visibility of previous runway markings, and the width of taxiway Bravo as part of the Aerodrome Runway Safety program.

SR26/2017

Together with Sharjah Air traffic services, address the limitations and associated risk affecting the controller's performance within the Tower visual control room.

SR27/2017

Re-assess the need of surface movement radar to assist controllers in improving the monitoring of aerodrome movements.



SR28/2017

Ensure that the manuals issued by Sharjah Air Traffic Services contain the correct information to reflect the current GCAA approval for runway 12/30.

SR29/2017

Re-address the process of updating the *Aerodrome Manual* and ensure that it is revised to reflect the current status of the aerodrome.

SR30/2017

Review the limitations on taxiway Bravo 11 to Alpha 12 and determine whether or not to be inserted in the *Aerodrome Manual* and the *UAE AIP*, and whether this intersection should be declared a hot spot.

SR31/2017

Review and ensure that the information on the Jeppesen plates and *UAE AIP* for OMSJ aerodrome reflects the Aerodrome status.

SR32/2017

Review and implement procedures for the immediate notification of serious incidents and accidents to the AAIS.

4.3 The General Civil Aviation Authority (GCAA) of the United Arab Emirates

It is recommended that the GCAA:

SR33/2017

Share this Report (AIFN/0011/2015) with the UAE National Runway Safety Team (NRST) and all Local Runway Safety Teams, emphasizing on the safety recommendations contained herein.

SR34/2017

Monitor both Sharjah Air Traffic Services and Sharjah Department of Civil Aviation for the implementation of the safety recommendations within this Report, AIFN/0011/2015.

This Final Report is issued by:

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General Civil Aviation Authority
The United Arab Emirates.**

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Appendix A. Aircraft DFDR data with ATC Communication

Table 4 summarizes the flight data and ATC communications that was used to determine the Aircraft position as it taxied along the taxiways and to confirm the air traffic Controller statement that the Aircraft did take off from taxiway Bravo.

Table 4. Aircraft flight data with ATC communications					
FDR Time (Local time)	Aircraft AIR / GROUND Mode	Aircraft Ground Speed (knots)	Heading (Degrees)	Communication between ATC (GND/TWR) and Shaheen	Remarks- ATC (GND/TWR) / Shaheen and FDR Data
0233:26	GROUND	0	121.6	Sharjah ground Shaheen seven niner one is fully ready for taxi require full length, November.	Shaheen
0233:31	GROUND	0	121.6	Shaheen seven niner one taxi alpha, alpha two zero, holding point bravo two zero runway three zero.	GND
0233:37	GROUND	0	121.6	ALPHA to holding point runway three zero Shaheen seven niner one	Shaheen
0234:04	GROUND	1	121.3	Aircraft started moving	DFDR Data
0235:02	GROUND	6	120.9	Aircraft completed right turn and started taxi on taxiway Alpha and travelled 148 meters.	DFDR Data
0237:54	GROUND	12	122.3	Shaheen seven niner one change frequency one one eight decimal six advise ready for departure	GND (the Aircraft had travelled 882m and was still on taxiway A)
0237:55	GROUND	12	122.3	One one eight six goodbye	Shaheen
0238:10	GROUND	11	122	Sharjah tower Shaheen seven niner one a'salaam alaykum we'll be holding short runway three zero.	Shaheen
0238:15	GROUND	10	122	Shaheen seven niner one Sharjah tower	TWR
0238:16	GROUND	10	121.3	Aircraft reached the end of taxiway Alpha at a distance of approximately 960 meters and started left turn onto taxiway Alpha 20	DFDR Data
0238:21	GROUND	10	112.5	Please come again Shaheen seven niner one	Shaheen
0238:23	GROUND	10	108.3	Shaheen seven niner one Tower good morning hold bravo two zero	TWR
0238:27	GROUND	10	99.5	Hold short of three zero Shaheen seven niner one	Shaheen
0238:49	GROUND	8	52	Shaheen seven niner one Runway three zero bravo two zero without delay clear take off surface wind is one three zero degrees five knots bye bye	TWR
0238:50	GROUND	8	48.2	Cleared for takeoff runway three zero Shaheen seven niner zero wind copied	Shaheen
0238:53	GROUND	8	38	Aircraft started a heading towards 31° on taxiway Alpha 20	DFDR Data
0239:04	GROUND	7	30.9	Thank you keep your speed up until you've cleared the runway	TWR
0239:05	GROUND	7	30.9	Please come again ma'am	Shaheen
0239:12	GROUND	7	30.9	Shaheen seven niner one without delay cleared takeoff runway three zero surface wind one three zero degrees five knots bye bye	TWR



0239:13	GROUND	7	30.9	Cleared for takeoff runway three zero copied surface wind one three zero five Shaheen seven niner one bye	Shaheen
0239:16	GROUND	6	30.6	Aircraft started left turn from taxiway Alpha 20 to taxiway Bravo	DFDR Data
0239:28	GROUND	3	355.1	Shaheen seven niner one expedite please I've got traffic turning final	TWR
0239:29	GROUND	4	352.6	Roger ma'am copied expediting Shaheen seven niner one	Shaheen
0239:30	GROUND	4	349.5	Engine and aircraft speed started increasing	DFDR Data
0239:40	GROUND	16	300.6	Aircraft aligned on taxiway Bravo	DFDR Data
0239:52	GROUND	69	299.9	Both engines at takeoff thrust	DFDR Data
0240:25	AIR	197	301.6	Aircraft AIR mode	DFDR Data
0241:15	AIR	230	303.4	Sharjah tower Shaheen seven niner one over to Dubai	Shaheen
0241:18	AIR	231	303	Roger good flight	TWR