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Australian Transport Safety Bureau

Data entry error and operational non-compliance involving Airbus A320, PK-AZE

Perth Airport, Western Australia, on 24 November 2017

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Addendum

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Safety summary

What happened

On 24 November 2017, an Airbus A320 aircraft, registered PK-AZE and operated by PT Indonesia AirAsia, departed Perth, Western Australia on a scheduled passenger flight to Denpasar, Indonesia. Shortly after take-off from runway 21, the aircraft turned left, contrary to the cleared standard instrument departure, and at a height of about 223 ft above ground level, which was below the minimum height for turns specified by the operator. Air traffic control (ATC) assigned a series of headings to the flight crew. The aircraft was also turned through one of the headings assigned by ATC. An additional heading was subsequently issued by ATC to return the aircraft back to its planned track. The flight continued to Denpasar without further incident.

What the ATSB found

The ATSB found that during pre-flight preparations, the first officer (FO) as the pilot flying programmed the flight management guidance system (FMGS) using runway 03 based on the assumption that their departure runway would be the same as the runway on which they had previously landed. That programming occurred prior to the FO obtaining the automatic terminal information service (ATIS) information, which stated that runway 21 was in-use. In addition, the captain did not separately listen to the ATIS as required by the operator's procedures and likely relied on the briefing conducted by the FO.

Despite the various cues available to the flight crew, including several ATC instructions for using runway 21 and airport signage, and the flight crew reporting feelings of unease about the flight preparations, the incorrect programming of the FMGS was not detected. Shortly after take-off, the aircraft's flight director indicated a left turn was required. The FO commenced a left turn and engaged the autopilot, which continued the left turn to navigate towards the first programmed waypoint (in-line with the opposite runway direction and behind the aircraft). However, ATC quickly noticed the diversion from their cleared track and corrected the crew's heading.

Once the crew had detected the error, the captain reprogrammed the correct flight plan in the FMGS, rather than selecting the heading assigned by ATC. This resulted in the aircraft turning through the assigned heading, requiring further instructions by ATC.

It was also established that ATC were unaware of the nature of the problem and were not utilised fully as an additional resource to assist the flight crew.

What's been done as a result

Following the incident, Indonesia AirAsia have included a similar 'change of departure runway' scenario in their line operations flight training. Further, they have plans to launch a cross-departmental initiative to increase the awareness and skill sets of pilots, especially in the area of threat and error management.

Safety message

This incident demonstrates that deviating from standard procedures, even slightly, can render them ineffective and result in errors. Data input errors continue to be one of ATSB's Safety Watch priorities.

It further highlights the significance of stopping and re-evaluating the situation while on the ground when there is a feeling of uncertainty about the flight, even if it results in undesirable delays. This provides an opportunity to detect errors before they affect operations. Once airborne, workload and time limitations become even more critical due to the rapidly changing situation.

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The occurrence

Pre-flight preparation

On 24 November 2017, at about 1145 Western Standard Time,[1] an Airbus A320 aircraft, registered PK-AZE and operated by PT Indonesia AirAsia, was being prepared for a flight from Perth Airport, Western Australia to Denpasar (Bali) Airport, Indonesia. The captain was the pilot monitoring (PM) and the first officer (FO) was the pilot flying (PF).[2] The captain conducted the exterior inspection of the aircraft while the FO entered the flight plan into the flight management guidance system (FMGS) as per the required cockpit preparation procedure.

The crew had operated the aircraft into Perth on the previous sector, and the aircraft had arrived 46 minutes after the scheduled arrival time. The previous flight had landed on runway 03. Believing that they would be using the same runway for take-off, as he had done on previous occasions, the FO entered runway 03 into the FMGS.

The FO then listened to the automatic terminal information service (ATIS),[3] which stated the runway-in-use for departure was runway 21, and wrote 'runway 21' on the paper flight plan. He then calculated and entered the aircraft's take-off speeds based on runway 03 into the FMGS. The FO reported he would normally listen to the ATIS first, then input data into the FMGS, but to make it easier on this occasion he programmed the FMGS first and then listened to the ATIS.

When the captain returned to the flight deck after conducting the exterior inspection, he asked the FO which runway would be used for take-off. The FO stated that it was runway 03. The captain reported that he did not listen to the ATIS. However, he cross-checked the information entered in the FMGS, which included comparing the flight plan with the anticipated standard instrument departure (SID) [4] chart.

The FO then conducted the take-off briefing. He later recalled stating that the departure would be from runway 03. The captain also recalled that the FO's take-off briefing stated that they would be departing from runway 03.

At 1201, the flight crew received their airways clearance from air traffic control (ATC) to depart for Denpasar using the AVNEX TWO SID and to climb to 5,000 ft as per the SID. The AVNEX TWO SID was available for both runway 03 and runway 21, with different initial waypoints before converging (refer to section titled *Perth departure procedures*).

The FO reported he 'felt that there might be something wrong' with the FMGS programming and advised the captain, but they both continued with the preparation.

Taxi to runway 21

At 1213, the flight crew received a taxi clearance from ATC and commenced taxiing (Figure 1). The clearance included a series of instructions to taxi to the holding point for runway 21 on taxiway 'Whiskey'. The flight crew read back this clearance correctly.

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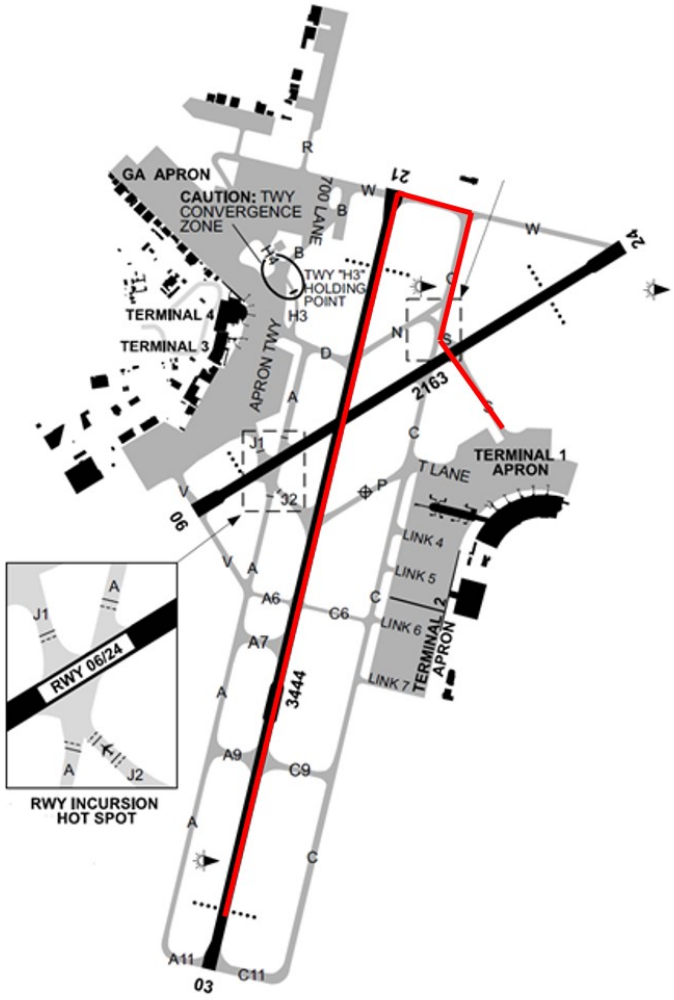
1 Western Standard Time: Coordinated Universal Time (UTC) + 8 hours.

2 Pilot flying (PF) and pilot monitoring (PM): procedurally assigned roles with specifically assigned duties at specific stages of a flight. The PF does most of the flying, except in defined circumstances; such as planning for descent, approach and landing. The PM carries out support duties and monitors the PF's actions and the aircraft's flight path.

3 Automatic terminal information service (ATIS): The provision of current, routine information to arriving and departing aircraft by means of continuous and repetitive broadcasts during the hours when the unit responsible for the service is in operation.

4 Standard instrument departure: A designated instrument flight rules departure route linking the aerodrome or a specified runway of the aerodrome with a specified point, normally on a designated air traffic services route, at which the en route phase of a flight commences.

Figure 1: Taxi and take-off path (in red) of PK-AZE



Source: Airservices Australia (modified by the ATSB)

At 1218, the Perth tower controller provided instructions to hold short of runway 21. Shortly after, he cleared the flight crew to line up on runway 21. The flight crew read back both instructions correctly. Prior to reaching the holding point for runway 21, the flight crew received an electronic centralised aircraft monitor (ECAM)[5] message BRAKE SYS 1 FAULT.[6] The captain reported that he actioned the message using the appropriate checklist. After actioning the message, the captain reported feeling there was something wrong, but was unsure of the issue.

At 1220, the controller cleared the aircraft for take-off on runway 21, which the flight crew read back correctly. At that time, the flight crew noticed the runway mode[7] had not activated on the flight mode annunciator.[8] They did not think it was unusual as sometimes the mode did not activate, particularly if the instrument landing system[9] was unavailable.

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5 The electronic centralised aircraft monitor (ECAM) monitors aircraft systems, displays aircraft system information, and specifies flight crew actions to be taken in the event of abnormal or emergency situations.

6 BRAKE SYS 1 FAULT: an alert indicating a fault detected in one channel of the brake system control unit.

7 Runway mode: provides lateral guidance orders during take-off roll and initial climb out (up to 30 ft radio altitude) if a localiser signal is available.

8 Flight management annunciator: a display located at the top of each pilot's primary flight display and informs the crew of the active and armed auto flight and auto-thrust modes.

9 Instrument landing system: standard ground aid to landing comprising two radio guidance beams and two markers for linear guidance. The system was operational on the day of the incident.

Take-off from runway 21

After becoming airborne during take-off, both pilots' navigation displays showed the next waypoint[10] was MIDLA (Figure 2). Both flight crew noticed the flight director[11] on their primary flight display was commanding a left turn. Shortly after, following the flight director, the FO turned the aircraft left and then engaged the autopilot. Recorded flight data showed the aircraft was manually turned at 223 ft above ground level (AGL) (refer to section titled *Minimum height of turns*).

Figure 2: Flight path of PK-AZE from runway 21

Source: Google Earth, modified by the ATSB

About 20 seconds later, the tower controller instructed the flight crew to turn right onto a heading of 200°. The captain read back the instruction correctly, selected the assigned heading on the flight control unit and engaged heading mode. The autopilot began to bank the aircraft to the right. As this happened, the controller asked the flight crew to confirm the instruction of heading 200°, which the flight crew read back incorrectly as 300°. The tower controller consulted another controller about the aircraft's track, the issued instruction, and whether to cancel the aircraft's assigned SID.

About this time, the captain took over PF duties from the FO. The flight crew were instructed to maintain the assigned heading of 200° and contact the departures controller. After the flight crew contacted the departures controller, they were cleared to climb to flight level (FL)[12] 180 and instructed to turn right onto a heading of 270°, which the flight crew acknowledged and selected. Shortly after, the captain gave the PF duties back to the FO and soon began reprogramming waypoints in the FMGS. The FO recalled being unaware the captain was reprograming the FMGS.

At 1225, the controller instructed the flight crew to maintain heading 290°. At this time, the captain selected waypoint SWANN in the FMGS. Flight data showed that the autopilot lateral mode changed from heading mode to navigation mode at that time, which resulted in the aircraft

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10 Waypoint: predetermined and accurately known geographical position forming start or end of a route segment.

11 Flight director: a guidance aid that is overlaid on the attitude indicator and shows the attitude required to follow a certain trajectory. It computes and displays the pitch and bank angles required in order for the aircraft to follow a selected path.

12 Flight level: at altitudes above 10,000 ft in Australia, an aircraft's height above mean sea level is referred to as a flight level (FL). FL 180 equates to 18,000 ft.

diverging from the instructed heading. The controller repeated the instruction to turn to heading 290°. The flight crew selected 290° on the flight control unit and re-selected heading mode, and the autopilot turned the aircraft to that heading (Figure 2).

The departures controller asked the flight crew whether they were issued ‘the AVNEX SID’, which the flight crew confirmed. The controller then asked whether operations were normal, which the flight crew also confirmed. The flight continued to Denpasar without further incident.

Context

Personnel information

Captain

The captain held an Air Transport Pilot (Aeroplane) Licence, multi-engine command instrument rating, and a valid Class 1 Aviation Medical Certificate. He had a total of 13,487 hours of aeronautical experience, of which 3,974 hours were on the Airbus A320. The captain had been assessed as meeting the requirement of the International Civil Aviation Organization English proficiency at a level 5 standard.[13]

The captain's last instrument rating line check was on 18 November 2017 and the last line check was completed on 29 August 2017. Although the line check was passed with an overall marginal score of two out of five, the results indicated mostly satisfactory (required standard) scores of three. Deficiencies noted in the check were in knowledge and application of standard operating procedures and operations manual, and threat and error management as both PF and PM. Previous simulator training and check sessions identified similar issues.

First officer

The first officer (FO) held a Commercial Pilot (Aeroplane) Licence, a multi-engine instrument rating, and a valid Class 1 Aviation Medical Certificate. He had a total of 955 hours of aeronautical experience, of which 766 hours were on the Airbus A320. The FO had been assessed as meeting the requirement of the International Civil Aviation Organization English proficiency at a level 4 standard.

The FO's last instrument rating line check was on 15 August 2017 and the last line check was completed on 30 June 2017. The line check was passed with all items scored as three out of five, which indicated a satisfactory result and the required standard was met. Previous simulator training and check sessions included comments about reading and understanding paper checklist procedures.

Fatigue considerations

A review of the flight crew's rosters and sleep obtained found there was a low likelihood they were experiencing a level of fatigue known to have a demonstrated effect on performance.

Meteorological information

The Perth automatic terminal information service (ATIS) details relevant at the time of the aircraft's departure indicated that the wind direction and strength was variable,[14] with a maximum tailwind of 3 kt on runway 21. The temperature was 32 °C, with CAVOK[15] conditions.

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[13] The International Civil Aviation Organization has defined six levels of language proficiency, the top three levels (4, 5 and 6) are acceptable for operational flight crew. Level 4 (operational) requires retesting every 3 years, level 5 (extended) requires retesting every 6 years and level 6 (expert) does not require further testing.

[14] The term 'variable' is used when the reporting of a mean wind direction is not possible such as, in light wind conditions (3 kt or less) or if the wind is veering or backing by 180° or more.

[15] Ceiling and visibility okay (CAVOK): visibility, cloud and present weather are better than prescribed conditions. For an aerodrome weather report, those conditions are visibility 10 km or more, no significant cloud below 5,000 ft, no cumulonimbus cloud and no other significant weather.

Perth Airport information

Perth Airport, with an elevation of 67 ft, is located about 10 km to the east of the city. A further 10 km to the east is the 'Darling Scarp' (Darling Range), an escarpment extending 345 km north-south from about Bindoon to Pemberton.

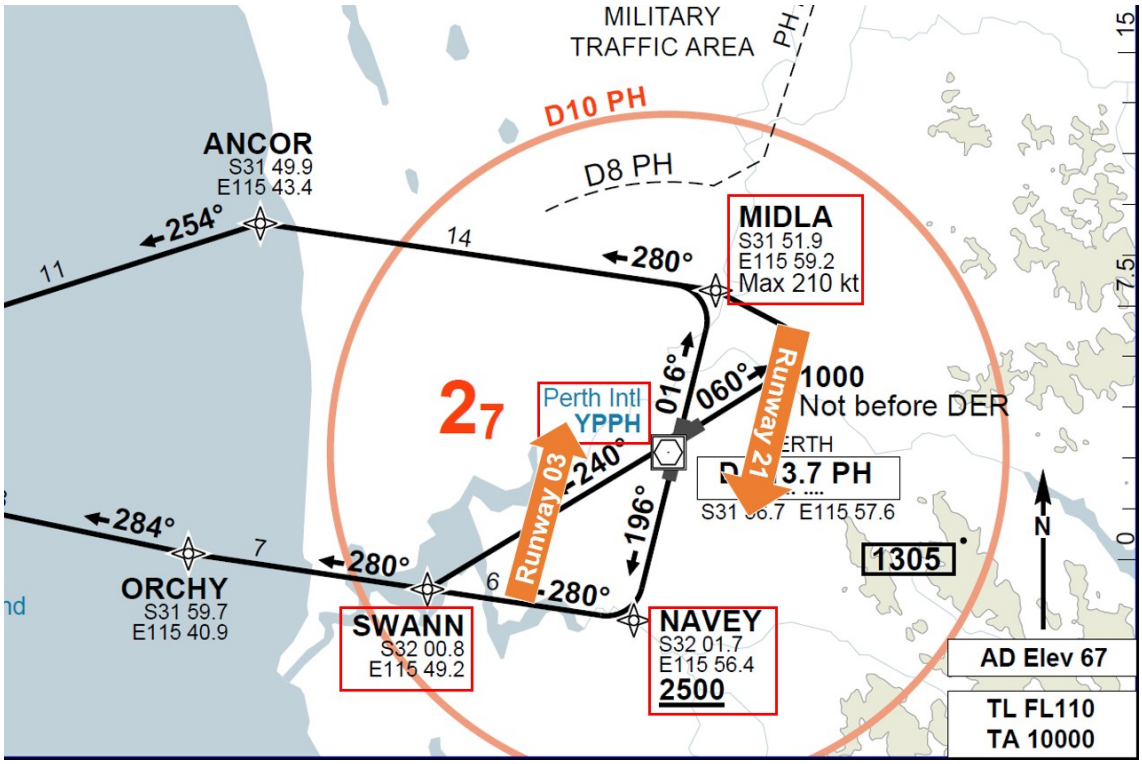
Perth Airport has two runways, 03/21 and 06/24. The movement areas, including the taxiways and runways, were marked with guidance signs, designed to assist pilots and other users with navigating the airport. These included signs that identified the holding point position with the runway designation.

Perth departure procedures

A standard instrument departure (SID) is a designated instrument flight rules departure route linking either an aerodrome or a specified runway with a specified point, normally on a designated air traffic services route, at which the en route phase of a flight commences.

At Perth, the 'AVNEX TWO' SID was used for both runways and in all directions (Figure 3). When departing from runway 03 using this departure, after take-off the crew were to maintain a heading of 016° (magnetic) for 4 NM (about 7 km) and conduct a left turn at waypoint MIDLA. For runway 21, the crew were to maintain a heading of 196° for 4 NM (about 7 km) and turn right at waypoint NAVEY at or above 2,500 ft above mean sea level.

Figure 3: AVNEX TWO AirAsia SID chart



Source: Aerostratus, modified by the ATSB

Operational information

Procedures and checklists

Cockpit checklists are an essential tool for overcoming limitations of pilot memory, and ensuring that action items are completed in sequence and without omission. According to Degani & Wiener (1993):

> The major function of the flight deck checklist is to ensure that the crew will properly configure the airplane for any given segment of flight. It forms the basis of procedural standardization in the cockpit.

From the pre-flight preparations to the take-off, the crew completed a number of procedures and checklists where there were multiple opportunities to detect a data entry error. The relevant extracts from these checklists and procedures from the Indonesia AirAsia *Flight Crew Operating Manual* are below. The captain and FO were assigned specific tasks applicable to all flights.

Preliminary cockpit preparation procedure

The *Preliminary Cockpit Preparation* procedure specified that both flight crew were to separately obtain and calculate the aircraft's take-off performance data. In this case, the pilot monitoring (PM) was required to cross-check the pilot flying's (PF's) calculations. Specifically, the procedure stated that:

> Each flight crewmember independently computes the preliminary performance data in accordance with the technical condition of the aircraft/or other criteria that may impact the aircraft performance (e.g. NOTAM [notice to airmen], runway condition, aircraft configuration).
>
> AIRFIELD DATA..... OBTAIN
>
> Obtain data needed for initializing the system, preparing the cockpit and for preliminary take-off performance computation. The airfield data should include: RUNWAY IN USE, ALTIMETER SETTING, and WEATHER DATA.
>
> PRELIMINARY TAKEOFF PERFORMANCE……COMPUTE AND CROSSCHECK

Cockpit preparation procedure

As detailed below in the *Cockpit Preparation* procedure, the PM was required to check the flight plan ('F-PLN') entered by the PF into the flight management guidance system (FMGS) with the relevant navigation chart and 'paper' flight plan. The PM was also required to check the data, including the airfield information entered into the FMGS by the PF. The take-off briefing was then conducted by the PF. During that briefing, both flight crew were required to cross-check the parameters referred to by the PF to ensure that they had been set or programmed correctly.

> F-PLN A page.....COMPLETE AND CHECK
>
> The flight crew must check, modify, or insert (as applicable) the F-PLN in the following order, according to the data given by ATIS, ATC, or MET.
>
> F-PLN.....CHECK
>
> Check the F-PLN using F-PLN page and ND PLAN mode versus the computer (paper) flight plan or navigation chart.
>
> FMS PREPARATION……CHECK
>
> After the PF prepared the FMS [FMGS], the PM checks:
>
> The airfield data
>
> All FMS entered data
>
> The takeoff performance data with the data computed on his EFB [electronic flight bag]
>
> TAKEOFF BRIEFING……PERFORM

Before pushback or start procedure

In the *Before Pushback or Start* procedure, the flight crew were required to confirm the final take-off data as follows:

> FINAL TAKEOFF DATA..... CONFIRM or RECOMPUTE
>
> If take-off conditions did not change, verify and confirm that the preliminary take-off data are still valid.
>
> FMS F-PLN page.....SELECT
>
> It is recommended to display the F-PLN page on the PM side.

Taxi procedure

For the *Taxi* procedure, the PM was to obtain the taxi clearance for the assigned runway, and both flight crew confirm any changes to the take-off briefing.

> TAXI clearance..... OBTAIN
>
> ATC clearance..... CONFIRM
>
> TAKEOFF BRIEFING.....CONFIRM

Before take-off procedure

The *Before Take-Off* procedure required the PM to obtain the take-off clearance from ATC and both flight crew confirm to the runway for departure using the available cues, such as those listed below.

> TAKEOFF OR LINE UP CLEARANCE……..OBTAIN
>
> TAKEOFF RUNWAY……CONFIRM
>
> Confirm the line up is performed on the intended runway. Useful aids are:
>
> The runway markings
>
> The runway lights

Take-off procedure

In the *Take-off* procedure below, the PM was to monitor the navigation display (ND) and confirm the aircraft was lined-up on the runway centreline.

> PFD/ND……..…….MONITOR
>
> If an ILS [instrument landing system] that corresponds to the departure runway is tuned, RWY mode appears. If not, no lateral mode appears until the aircraft lifts off.
>
> Check the FMS position on the ND (aircraft on runway centerline).

Minimum height of turns

Although flight crews were to follow the designated SID procedure after take-off, the Indonesia AirAsia *Flight Crew Operating Manual* specifically stated:

> Procedures to be followed after take-off, during the approach and go around are as per SID (including Radar departure) and STAR. **No turns shall be commenced below 400ft AGL** *[original emphasis].*

Operational philosophy

Flight crew guidance

The Indonesia AirAsia *Flight Crew Training Manual* and standard operating procedures provided guidance to flight crew for both normal and abnormal situations. There was no specific procedure listed on managing data entry errors detected in-flight, but general Airbus principles were included in the manuals.

Golden rules for pilots

The *Flight Crew Training Manual* states the pilots' responsibility is to 'fly, navigate, communicate' in that order, along with additional considerations. The flight crew must perform these three actions in sequence and must use appropriate task sharing in normal and abnormal operations, in manual flight or in flight with the autopilot engaged.

'Fly' indicates that the PF must concentrate on 'flying the aircraft' in order to achieve and maintain flight parameters such as pitch attitude, bank angle, airspeed, and heading. The PM must assist the PF and must actively monitor flight parameters, and call out any excessive deviation using standard phraseology. The PM's role of 'actively monitoring' is very important. Therefore, both flight crew must focus and concentrate on their tasks to ensure appropriate task sharing and maintain awareness of the situation and immediately resolve any uncertainty as a crew.

'Navigate' refers to and includes the following 'know where ...' statements, in order to ensure awareness of the situation, including know where you are, know where you should be, and know where you should go.

'Communicate' involves effective and appropriate crew communication between the PF and the PM, and between flight crew and ATC. In abnormal and emergency situations, the PF must recover a steady flight path, and the flight crew must identify the flight's status. The PF must then inform ATC and the cabin crew of the flight's status and the flight crew's intentions.

Communication also applies to communicating adjustments or changes to the information and/or equipment on the flight deck, such as FMGS alterations or flight path modifications. The other flight crew must be informed and an acknowledgement obtained.

The *Flight Crew Training Manual* also stated to take action if things do not go as expected. If the aircraft does not follow the desired vertical or lateral flight path, or the selected targets, and if the flight crew does not have sufficient time to analyse and solve the situation, the flight crew must immediately take appropriate or required actions, as follows:

- the PF should change the level of automation from managed guidance[16] to selected guidance,[17] or from selected guidance to manual flying.
- the PM should perform the following actions in sequence: communicate with the PF; challenge the actions of the PF, when necessary; and take over, when necessary.

Similar occurrences

A search of the ATSB's database found similar occurrences involving incorrect data entry into the aircraft's systems and navigation errors:

ATSB investigation AO-2015-029

On 10 March 2015, an Airbus A330 aircraft operated by AirAsia X was conducting a regular passenger service from Sydney, New South Wales. On departure from runway 16R (right) the aircraft was observed by ATC to enter the departure flight path of the parallel runway, 16L (left). Following advice from ATC, the flight crew identified a problem with the on-board navigation systems. Attempts to troubleshoot and rectify the problem resulted in further degradation of the navigation system, as well as to the aircraft's flight guidance and flight control systems. The crew elected to discontinue the flight but were unable to return to Sydney as the weather had deteriorated in the area and the available systems limited the flight to approaches in visual conditions. The aircraft was instead radar vectored to Melbourne, Victoria and the flight completed in visual conditions.

The ATSB found that when setting up the aircraft's FMGS, the captain inadvertently entered the wrong longitudinal position of the aircraft. This adversely affected the onboard navigation systems. However, despite a number of opportunities to identify and correct the error, it was not noticed until after the aircraft became airborne and started tracking in the wrong direction. The flight crew attempted to troubleshoot and rectify the situation while under a heavy workload. Combined with limited guidance from the available checklists, this resulted in further errors by the flight crew in the diagnosis and actioning of flight deck switches. Finally, the ATSB identified that effective monitoring and assistance by ATC reduced the risk to the occurrence aircraft and other aircraft in the area.

ATSB occurrence 201806598

On 26 September 2018, a foreign-operated Boeing 737-800 was conducting a regular passenger service from Melbourne, Victoria. During initial climb, the aircraft did not adhere to the assigned

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16 Managed mode: To fly along the pre-planned flight plan, entered in the flight management guidance system.

17 Selected mode: For specific ATC requests, or when there is not sufficient time to modify the flight plan.

runway 34 KEPPA 1 SID and conducted an early left turn. ATC queried the crew about which waypoint they were tracking to. The crew responded they were tracking to ATNOL, which was the first waypoint on the KEPPA SID 1 from runway 27. It was subsequently determined the crew had entered the incorrect departure runway of runway 27 into the flight management computer.

Safety analysis

Introduction

Very shortly after take-off from runway 21 at Perth, Western Australia, the aircraft was turned at a low height in the opposite direction to their clearance and towards an escarpment. Air traffic control (ATC) assigned a series of headings to the flight crew to correct their path. During that time, the aircraft also turned through one of the assigned headings. An additional heading was issued by ATC to return the aircraft back to its planned track. The flight continued without further incident.

Although there were time delays for the flight crew's sectors that day, there was insufficient evidence to indicate that this contributed to the development of the incident.

This analysis will examine why the incorrect runway was programmed into the flight management guidance system (FMGS) and why this error was not detected by the flight crew. It will also discuss the flight crew's pre-flight preparations with regard to obtaining the automatic terminal information service (ATIS) and explore their actions in response to the early turn.

Incorrect runway-in-use

Based on their recent landing on runway 03, the first officer (FO), who was the pilot flying had the expectation that the take-off runway would remain the same, as experienced on previous occasions. Consequently, he entered runway 03 into the FMGS in preparation for the departure. This was done prior to listening to the ATIS and obtaining the airfield data, which indicated that runway 21 was in-use. This was performed out-of-sequence, where the operator's procedure required the airfield data to be obtained before programming the FMGS. While the FO commented in his interview that he would normally follow the procedure, on this occasion, he elected to program the FMGS first to make it 'easier'.

Although the FO correctly noted the ATIS details for runway 21 on his paper flight plan, he did not detect that it was different to what he had programmed. In this case, the FO may not have detected the runway he used for programming was different due to not having an expectation it would have been incorrect. Expectations can influence perception, as people often hear what they expect to hear and see what they expect to see (Hawkins 1987). Research has also found that the pilots checking their own work are less likely to detect their own error than cross-checking by other crew members (Thomas, Petrilli, and Dawson 2004).

Independently cross-checking the runway-in-use

The captain did not separately obtain the ATIS as required by the operator's procedures and likely relied upon the FO's briefing that runway 03 was the runway-in-use. Further, he subsequently either did not check or detect that runway 21 was written on the flight planning documents nor that it was inconsistent with the information programmed into the FMGS.

Cross-checking is a fundamental element in all multi-crew operations, and is a vital mechanism for detecting errors. An exploratory study of error detection processes during normal line operations conducted by Thomas and others (2004) identified that cross-checking and monitoring of other crew actions was the most frequently observed error detection process. By not obtaining the ATIS independently and cross-checking the runway-in-use, this removed an opportunity for the captain to identify the programming error prior to take-off.

Non-detection of error

Research conducted during normal line operations has found over half of errors made by flight crew remain undetected (Thomas, Petrilli, and Dawson 2004). In this case, the error in the pre-flight programming remained undetected until after take-off. However, aside from

cross-checking procedures, there were multiple opportunities available to the flight crew that would have provided them with the opportunity to identify the incorrectly entered runway. These were:

- Prior to, and during taxiing, the flight crew received taxi instructions and several clearances from ATC referencing runway 21, which were all read back correctly.
- The flight crew reported that, during take-off, they both noticed that the runway mode had not activated. However, they explained that the mode might also not activate if the instrument landing system was not available, rather than considering this as a programming error.
- While taxiing to the runway, there were guidance signs identifying the runway designation.

Of note, the flight crew received an electronic centralised aircraft monitor (ECAM) message around the same time ATC issued a hold-short instruction for runway 21. This message directed the flight crew's attention to responding to the ECAM message at a time potential cues to the error were available, such as the instruction and airport signage. Further, although the flight crew reported at two separate times they felt there was something wrong with the preparation, they decided to continue with the flight. Even when cues to an error are provided there is a likelihood they can be dismissed or explained away if the information is not consistent with a person's expectations (Hawkins 1987).

Turn contrary to clearance and published procedure

The FMGS was programmed for the runway 03 AVNEX TWO departure, which required a left turn after take-off at waypoint MIDLA. Therefore, after take-off from runway 21, the flight director indicated a left turn was required to capture the flight path to waypoint MIDLA to the north. The recorded flight data showed that the aircraft was turned left when at 223 ft above ground level. This was contrary to the runway 21 departure, which required a right turn at waypoint NAVEY to the south not below 2,500 ft. This was also below the operator's stipulated minimum turn height of 400 ft.

The left turn continued momentarily after the autopilot was engaged, but was quickly corrected when ATC assigned a heading instruction for the flight crew to regain the cleared flight path. During the left turn, the flight crew had not realised the autopilot was flying a different path to what was actually cleared. A left turn was consistent with the crew's expectations based on their pre-flight briefing for runway 03, although the low height of the directed turn should have been unusual and not consistent with the briefing. Following the flight director at this stage suggests the crew were relying on automation at the expense of their own monitoring, possibly due to an over-reliance on automation (Parasuraman and Riley 1997).

Managing an unexpected situation after take-off

The flight crew were in an abnormal situation when they identified the programming error in the FMGS. Air traffic control provided the flight crew with a number of heading instructions to regain the cleared flight path and also asked if operations were normal, which they confirmed was the case. As highlighted by Tullo (2010), ATC can potentially assist with problem-resolution in abnormal situations. In this case, ATC were unaware of the nature of the problem and the flight crew did not utilise them fully as an additional resource. By making ATC aware of the abnormal situation, it could have potentially reduced the flight crew's workload in deciding subsequent action to evaluate and solve the problem. This may have reduced the need for the flight crew to reprogram the FMGS at a time when their workload would have already been high, as they were required to complete other checklists.

Although the flight crew correctly identified the problem, the captain's chosen solution of reprogramming the FMGS increased workload during an already high workload situation. Such circumstances reduces the ability to monitor the flight path (Dismukes and others 1998).

With reference to the operator's 'fly' then 'navigate' golden rule for pilots, the role of the captain as pilot monitoring was to focus on the flight parameters including heading, and communicate any deviations to the pilot flying. In this case, while ATC had provided the necessary navigation information (heading), the captain attempted to achieve this objective by manipulating the aircraft's FMGS rather than selecting or flying to the given heading, at the expense of monitoring the flight parameters. During that time, the aircraft also turned through one of the assigned headings and an additional heading instruction was needed to be issued by ATC to return the aircraft back to its planned track.

Findings

From the evidence available, the following findings are made with respect to the data entry error related operational non-compliance of an Airbus A320, registered PK-AZE that occurred at Perth Airport, Western Australia, on 24 November 2017. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- Based on a recent landing, the first officer assumed runway 03 would be in use and programmed this runway for take-off into the flight management guidance system (FMGS) before listening to the automatic terminal information service (ATIS). Although the first officer copied runway 21 from the data recorded onto the flight plan, he did not notice this differed from what he had programmed into the FMGS and briefed the captain for a runway 03 take-off.
- The captain did not obtain any independent information about the runway-in-use for pre-departure checks, including listening to the ATIS and reviewing data recorded on the flight plan, and likely relied on verbal information from the first officer.
- The incorrect programming of the FMGS was not detected before take-off despite numerous cues that the departure runway and flight path was different to what was briefed. Although the flight crew sensed there was something amiss with their pre-flight preparation, they continued without further checking.
- Shortly after take-off from runway 21, the aircraft was turned left at 223 ft above ground level. This was below the minimum allowable height of 400 ft stipulated by the operator, and well before and in the opposite direction to the cleared standard instrument departure.

Other factors that increased risk

- The flight crew did not communicate the nature of the problem to air traffic control and so did not effectively utilise air traffic control as an available resource. This resulted in the captain unnecessarily reprogramming the FMGS at a time when workload was already high.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action taken by Indonesia AirAsia in response to this occurrence.

Line operations flight training, and threat and error management

Following the incident, Indonesia AirAsia have included a similar change of departure runway scenario in their line operations flight training. Further, they have plans to launch a cross-departmental initiative to increase the awareness and skill sets of pilots, especially in the area of threat and error management.

General details

Occurrence details

Date and time:	21 November 2014 – 1222 WST	
Occurrence category:	Incident	
Primary occurrence type:	Aircraft preparation	
Location:	Perth Airport, Western Australia	
	Latitude: 31º 56.42'' S	Longitude: 115º 7'58.02' E

Captain

Licence details:	Air Transport Pilot's Licence (Aeroplane), issued July 2008
Endorsements:	A320 systems
Ratings:	Class ratings: single-engine land, multi-engine land Type ratings: B737-3/4/5, A320 Instrument rating: multi-engine land
Medical certificate:	Class 1, valid to March 2019
Aeronautical experience:	13,487 hours
Last flight review:	August 2017

First officer

Licence details:	Commercial Pilot's Licence (Aeroplane), issued 2014
Endorsements:	A320 systems
Ratings:	Class ratings: single-engine land, multi-engine land Type ratings: A320 Instrument rating: multi-engine land
Medical certificate:	Class 1, valid to June 2019
Aeronautical experience:	955 hours
Last flight review:	June 2017

Aircraft details

Manufacturer and model:	Airbus A320	
Registration:	PK-AZE	
Operator:	PT Indonesia AirAsia	
Serial number:	5098	
Type of operation:	Air transport high capacity - Passenger	
Departure:	Perth Airport, Western Australia	
Destination:	Denpasar Airport, Indonesia	
Persons on board:	Crew – 6	Passengers – 145
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	None	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- flight crew
- Indonesia AirAsia
- Airservices Australia.

References

Degani, A and Wiener EL 1993, Cockpit checklists: Concepts, design, and use, *Human Factors, 35*(2), 28-43.

Dismukes RK, Young GE, Sumwalt III RL, and Null CH 1998, Cockpit interruptions and distractions: Effective management requires a careful balancing act. *ASRS Directline*, issue 10, pp. 4-9.

Hawkins, FH 1987, *Human factors in flight*. Aldershot: Ashgate.

Orasanu, J 2010, Ch. 5. Flight crew decision-making. In Kani, B, Helmreich, R, Anca, J. *Crew resource management* (2nd ed). San Diego: Academic Press.

Parasuraman, R and Riley, V 1997, Humans and automation: Use, misuse, disuse, abuse. *Human factors, 39*(2), 230-253.Thomas, MJW, Petrilli, RM, and Dawson, D 2004, An exploratory study of error detection processes during normal line operations. Proceedings of the 26th Conference of the European Association for Aviation Psychology.

Thomas MJ, Petrilli RM, and Dawson D 2004, An exploratory study of error detection processes during normal line operations (Doctoral dissertation, European Association for aviation psychology).

Tullo FJ 2010, Teamwork and Organizational Factors. In Kani, B, Helmreich, R, Anca, J. *Crew resource management* (2nd ed). San Diego: Academic Press.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003 (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the flight crew, Indonesia AirAsia, Airservices Australia, and the Civil Aviation Safety Authority.

Submissions were received from Indonesia AirAsia, Airservices Australia, and the Civil Aviation Safety Authority. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The ATSB is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within atsb'S jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the Transport Safety Investigation Act 2003 and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Terminology used in this report

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing factor: a factor that, had it not occurred or existed at the time of an occurrence, then either:

(a) the occurrence would probably not have occurred; or

(b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or

(c) another contributing factor would probably not have occurred or existed.

Other factors that increased risk: a safety factor identified during an occurrence investigation, which did not meet the definition of contributing factor but was still considered to be important to communicate in an investigation report in the interest of improved transport safety.

Other findings: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which ‘saved the day’ or played an important role in reducing the risk associated with an occurrence.