= Malaysia Airlines Flight 370 =

Malaysia Airlines Flight 370 ( MH370 / MAS370 ) was a scheduled international passenger flight operated by Malaysia Airlines that disappeared on 8 March 2014 while flying from Kuala Lumpur International Airport , Malaysia , to Beijing Capital International Airport in China . The aircraft last made voice contact with air traffic control at 01 : 19 MYT , 8 March ( 17 : 19 UTC , 7 March ) when it was over the South China Sea , less than an hour after takeoff . It disappeared from air traffic controllers ' radar screens at 01 : 22 MYT . Malaysian military radar continued to track the aircraft as it deviated westwards from its planned flight path and crossed the Malay Peninsula . It left the range of Malaysian military radar at 02 : 22 while over the Andaman Sea , 200 nautical miles ( 370 km ) north @-@ west of Penang in north @-@ western Malaysia . The aircraft , a Boeing 777 @-@ 200ER , was carrying 12 Malaysian crew members and 227 passengers from 15 nations .

A multinational search effort began in the Gulf of Thailand and the South China Sea , from whence the aircraft 's signal was last seen on secondary surveillance radar , and was soon extended to the Strait of Malacca and Andaman Sea . Analysis of satellite communications between the aircraft and Inmarsat 's satellite communications network concluded that the flight continued until at least 08 : 19 and flew south into the southern Indian Ocean , although the precise location cannot be determined . Australia took charge of the search on 17 March , when the search moved to the southern Indian Ocean . On 24 March , the Malaysian government noted that the final location determined by the satellite communication is far from any possible landing sites , and concluded that " Flight MH370 ended in the southern Indian Ocean . " The current phase of the search , the largest and most expensive in aviation history , is a comprehensive survey of the sea floor about 1 @,@ 800 kilometres ( 970 nmi ) south @-@ west of Perth , Western Australia , which began in October 2014 . Nothing was found of the aircraft until 29 July 2015 , when a piece of marine debris , later confirmed to be a flaperon from Flight 370 , washed ashore on Réunion Island . Although multiple additional small pieces of debris have been found , the bulk of the aircraft has still not been located , prompting many theories about its disappearance .

Malaysia established the Joint Investigation Team ( JIT ) to investigate the incident , working with foreign aviation authorities and experts . Neither the crew nor the aircraft 's communication systems relayed a distress signal , indications of bad weather , or technical problems before the aircraft vanished . Two passengers travelling on stolen passports were investigated , but eliminated as suspects . Malaysian police have identified the captain as the prime suspect if human intervention was the cause of the disappearance , after clearing all others on the flight of suspicious motives . Power was lost to the aircraft 's satellite data unit ( SDU ) at some point between 01 : 07 and 02 : 03 ; the SDU logged onto Inmarsat 's satellite communication network at 02 : 25 ? three minutes after the aircraft left the range of radar . Based on analysis of the satellite communications , the aircraft turned south after passing north of Sumatra and the flight continued for five hours with little deviation in its track , ending when its fuel was exhausted .

With the presumed loss of all on board , Flight 370 is the second deadliest incident involving a Boeing 777 and the second deadliest incident in Malaysia Airlines ' history , behind Flight 17 in both categories . Malaysia Airlines was struggling financially , a problem that was exacerbated by a decline in ticket sales after Flight 370 and the crash of Flight 17 ; the airline was renationalised by the end of 2014 . The Malaysian government received significant criticism , especially from China , for failing to disclose information promptly during the early weeks of the search . Flight 370 's disappearance brought to public attention the limits of aircraft tracking and flight recorders , including several issues raised four years earlier ? but never mandated ? following the loss of Air France Flight 447 . In response to Flight 370 's disappearance , the International Civil Aviation Organization ( ICAO ) adopted new standards for aircraft position reporting over open ocean , extended recording time for cockpit voice recorders , and , from 2020 , will require new aircraft designs to have a means to recover the flight recorders , or the information they contain , before the recorders sink below water .

= = Aircraft = =

Flight 370 was operated with a Boeing 777 @-@ 2H6ER , serial number 28420 , registration 9M @-@ MRO . It was the 404th Boeing 777 produced , first flown on 14 May 2002 , and was delivered new to Malaysia Airlines on 31 May 2002 . The aircraft was powered by two Rolls @-@ Royce Trent 892 engines and configured to carry 282 passengers . It had accumulated 53 @,@ 471 @.@ 6 hours and 7 @,@ 526 cycles in service and had not previously been involved in any major incidents , though a minor incident while taxiing at Shanghai Pudong International Airport in August 2012 resulted in a broken wing tip . Its last maintenance " A check " was carried out on 23 February 2014 . The aircraft was in compliance with all applicable Airworthiness Directives for the airframe and engines . A replenishment of the crew oxygen system was performed on 7 March 2014 , a routine maintenance task ; an examination of this procedure found nothing unusual .

The Boeing 777 was introduced in 1994 and is generally regarded as having an excellent safety record . Since its first commercial flight in June 1995 , there have been only four other serious incidents involving hull @-@ loss : British Airways Flight 38 in 2008 ; a cockpit fire in a parked EgyptAir Flight 667 at Cairo International Airport in 2011 ; the crash of Asiana Airlines Flight 214 in 2013 , in which three people died ; and Malaysia Airlines Flight 17 , which was shot down over Ukraine with 298 people aboard in July 2014 .

= = Passengers and crew = =

Malaysia Airlines released the names and nationalities of the 227 passengers and 12 crew members , based on the flight manifest , later modified to include two Iranian passengers travelling on stolen passports .

= = = Crew = = =

All 12 crew members were Malaysian citizens . Two pilots were among the crew :

The pilot in command was 53 @-@ year @-@ old Captain Zaharie Ahmad Shah from Penang . He joined Malaysia Airlines as a cadet pilot in 1981 and , after training and receiving his commercial pilot 's licence , became a Second Officer with the airline in 1983 . Zaharie was promoted to Captain of the Boeing 737 @-@ 400 in 1991 , Captain of Airbus A330 @-@ 300 in 1996 , and to Captain of Boeing 777 @-@ 200 in 1998 . He had been a Type Rating Instructor and Type Rating Examiner since 2007 and had 18 @,@ 365 hours of flying experience .

The co @-@ pilot was 27 @-@ year @-@ old First Officer Fariq Abdul Hamid . He joined Malaysia Airlines as a cadet pilot in 2007 and became a Second Officer on Boeing 737 @-@ 400 aircraft . He was promoted to First Officer of Boeing 737 @-@ 400 aircraft in 2010 and later transitioned to Airbus A330 @-@ 300 aircraft in 2012 . In November 2013 , he began training as First Officer on Boeing 777 @-@ 200 aircraft . Flight 370 was his final training flight and he was scheduled to be examined on his next flight . Fariq had 2 @,@ 763 hours of flying experience .

= = = Passengers = = =

Of the 227 passengers , 152 were Chinese citizens , including a group of 19 artists with six family members and four staff returning from a calligraphy exhibition of their work in Kuala Lumpur ; 38 passengers were Malaysian . The remaining passengers were from 13 different countries . Twenty passengers ? 12 of whom were from Malaysia and eight from China ? were employees of Freescale Semiconductor .

Under a 2007 agreement with Malaysia Airlines , Tzu Chi ? an international Buddhist organisation ? immediately sent specially trained teams to Beijing and Malaysia to give emotional support to passengers ' families . The airline also sent its own team of caregivers and volunteers and agreed to bear the expenses of bringing family members of the passengers to Kuala Lumpur and providing them with accommodation , medical care , and counselling . Altogether , 115 family members of the Chinese passengers flew to Kuala Lumpur . Some other family members chose to remain in China ,

fearing they would feel too isolated in Malaysia .

= = Disappearance = =

Flight 370 was a scheduled flight in the early morning hours of 8 March 2014 from Kuala Lumpur , Malaysia to Beijing , China . It was one of two daily flights operated by Malaysia Airlines from its hub at Kuala Lumpur International Airport ( KLIA ) to Beijing Capital International Airport ? scheduled to depart at 00 : 35 local time ( MYT ; UTC + 08 : 00 ) and arrive at 06 : 30 local time ( CST ; UTC + 08 : 00 ) . On board were 227 passengers , 10 cabin crew , two pilots , and 14 @,@ 296 kg ( 31 @,@ 517 lb ) of cargo .

The planned flight duration was 5 hours , 34 minutes , which would consume an estimated 37 @,@ 200 kg ( 82 @,@ 000 lb ) of jet fuel . The aircraft carried 49 @,@ 100 kilograms ( 108 @,@ 200 lb ) of fuel , including reserves , allowing an endurance of 7 hours , 31 minutes . The extra fuel was enough to divert to alternate airports ? Jinan Yaoqiang International Airport and Hangzhou Xiaoshan International Airport ? which would require 4 @,@ 800 kg ( 10 @,@ 600 lb ) or 10 @,@ 700 kg ( 23 @,@ 600 lb ) , respectively , to reach from Beijing .

= = = Departure = = =

At 00 : 42 MYT , Flight 370 took off from runway 32R , and was cleared by air traffic control ( ATC ) to climb to flight level 180 ? approximately 18 @,@ 000 feet ( 5 @,@ 500 m ) ? on a direct path to navigational waypoint IGARI ( located at 6 ° 56 ' 12 ? N 103 ° 35 ' 6 ? E ) . Voice analysis has determined that the First Officer communicated with ATC while the flight was on the ground and that the Captain communicated with ATC after departure . Shortly after departure , the flight was transferred from the airport 's ATC to " Lumpur Radar " air traffic control on frequency 132 @.@ 6 MHz . ATC over peninsular Malaysia and adjacent waters is provided by the Kuala Lumpur Area Control Centre ( ACC ) ; Lumpur Radar is the name of the frequency used for en route air traffic . At 00 : 46 , Lumpur Radar cleared Flight 370 to flight level 350 ? approximately 35 @,@ 000 ft ( 10 @,@ 700 m ) . At 01 : 01 , Flight 370 's crew reported to Lumpur Radar that they had reached flight level 350 , which they confirmed again at 01 : 08 .

= = = Communication lost = = =

The aircraft 's final automated position report and last transmission , using the Aircraft Communications Addressing and Reporting System ( ACARS ) protocol , was sent at 01 : 07 MYT ; among the data provided in the message was total fuel remaining ? 43 @,@ 800 kg ( 96 @,@ 600 lb ) . The final verbal contact with air traffic control occurred at 01 : 19 : 30 , when Captain Shah acknowledged a send @-@ off by Lumpur Radar to Ho Chi Minh ACC :

Lumpur Radar : " Malaysian three seven zero , contact Ho Chi Minh one two zero decimal nine . Good night . "

Flight 370 : " Good night . Malaysian three seven zero . "

The crew was expected to contact air traffic control in Ho Chi Minh City as the aircraft passed into Vietnamese airspace , just north of the point where contact was lost . The captain of another aircraft attempted to reach the crew of Flight 370 " just after [ 01 : 30 ] " using the international distress frequency to relay Vietnamese air traffic control 's request for the crew to contact them ; the captain said he was able to establish contact , but only heard " mumbling " and static . Calls made to Flight 370 's cockpit at 02 : 39 and 07 : 13 were unanswered but acknowledged by the aircraft 's satellite data unit .

= = = Radar = = =

At 01 : 20 : 31 MYT , Flight 370 was observed on radar at the Kuala Lumpur ACC as it passed the navigational waypoint IGARI ( 6 ° 56 ? 12 ? N 103 ° 35 ? 6 ? E ) in the Gulf of Thailand ; five

seconds later , the Mode @-@ S symbol disappeared from radar screens . At 01 : 21 : 13 , Flight 370 disappeared from the radar screen at Kuala Lumpur ACC and was lost about the same time on radar at Ho Chi Minh ACC , which reported that the aircraft was at the nearby waypoint BITOD . Air traffic control uses secondary radar , which relies on a signal emitted by a transponder on aircraft ; therefore , the transponder was no longer functioning on Flight 370 after 01 : 21 . The final transponder data indicated that the aircraft was flying at its assigned cruise altitude of flight level 350 and was travelling at 471 knots ( 872 km / h ; 542 mph ) true airspeed . There were few clouds around this point and no rain or lightning nearby . Later analysis estimated that Flight 370 had 41 @,@ 500 kg ( 91 @,@ 500 lb ) of fuel when it disappeared from secondary radar .

At the time that the transponder stopped functioning , military radar showed Flight 370 turning right , but then beginning a left turn to a south @-@ westerly direction . From 01 : 30 : 35 ? 01 : 35 , military radar showed Flight 370 at 35 @,@ 700 ft ( 10 @,@ 900 m ) on a 231 ° magnetic heading , with a ground speed of 496 knots ( 919 km / h ; 571 mph ) . Flight 370 continued across the Malay Peninsula , fluctuating between 31 @,@ 000 ? 33 @,@ 000 ft ( 9 @,@ 400 ? 10 @,@ 100 m ) in altitude . A civilian primary radar at Sultan Ismail Petra Airport with a 60 nmi ( 110 km ; 69 mi ) range made four detections of an unidentified aircraft between 01 : 30 : 37 and 01 : 52 : 35 ; the tracks of the unidentified aircraft are " consistent with those of the military data . " At 01 : 52 , Flight 370 was detected passing just south of Penang Island . From there , the aircraft flew across the Strait of Malacca passing close to the waypoint VAMPI , and Pulau Perak at 02 : 03 , after which it flew along air route N571 to waypoints MEKAR , NILAM , and possibly IGOGU . The last known location , from and near the limits of Malaysian military radar , was at 02 : 22 , 10 nmi ( 19 km ; 12 mi ) after passing waypoint MEKAR and 200 nmi ( 370 km ; 230 mi ) northwest of Penang at an altitude of 29 @,@ 500 ft ( 9 @,@ 000 m ) .

Countries were reluctant to release information collected from military radar because of sensitivity about revealing their capabilities . Indonesia has an early warning radar system but its air traffic control radar did not register any aircraft with the transponder code used by Flight 370 , despite the aircraft possibly having flown near , or over , the northern tip of Sumatra . Indonesian military radar tracked Flight 370 earlier when en route to waypoint IGARI before the transponder is thought to have been turned off , but did not provide information on whether it was detected afterwards . Thailand and Vietnam also detected Flight 370 on radar before the transponder stopped working . The radar position symbols for the transponder code used by Flight 370 vanished after the transponder is thought to have been turned off . Thai military radar detected an aircraft that might have been Flight 370 , but it is not known what time the last radar contact was made . The signal did not include identifying data . No radar contact was detected by Australia , including the JORN over @-@ the @-@ horizon radar system , which was believed to be looking north to detect illegal migrants and not west over the Indian Ocean where Flight 370 is thought to have flown .

= = = Satellite communication resumes = = =

At 02 : 25 MYT , the aircraft 's satellite communication system sent a " log @-@ on request " message ? the first message on the system since the ACARS transmission at 01 : 07 ? which was relayed by satellite to a ground station , both operated by satellite telecommunications company Inmarsat . After logging on to the network , the satellite data unit aboard the aircraft responded to hourly status requests from Inmarsat and two ground @-@ to @-@ aircraft phone calls , at 02 : 39 and 07 : 13 , which went unanswered by the cockpit . The final status request and aircraft acknowledgement occurred at 08 : 10 . The aircraft sent a log @-@ on request at 08 : 19 : 29 , which was followed , after a response from the ground station , by a " log @-@ on acknowledgement " message at 08 : 19 : 37 . The log @-@ on acknowledgement is the last piece of data available from Flight 370 . The aircraft did not respond to a status request from Inmarsat at 09 : 15 .

= = = Response by air traffic control = = =

At 01 : 38 MYT , Ho Chi Minh Area Control Centre ( ACC ) contacted Kuala Lumpur Area Control Centre to query the whereabouts of Flight 370 and informed them that they had not established verbal contact with Flight 370 , which was last detected by radar at waypoint BITOD . The two centres exchanged four more calls over the next 20 minutes with no new information .

At 02 : 03 , Kuala Lumpur ACC relayed to Ho Chi Minh ACC information received from Malaysia Airlines ' operations centre that Flight 370 was in Cambodian airspace . Ho Chi Minh ACC contacted Kuala Lumpur ACC twice in the following eight minutes asking for confirmation that Flight 370 was in Cambodian airspace . At 02 : 15 , the watch supervisor at Kuala Lumpur ACC queried Malaysia Airlines ' operations centre , which said that it could exchange signals with Flight 370 and that Flight 370 was in Cambodian airspace . Kuala Lumpur ACC contacted Ho Chi Minh ACC to ask whether the planned flight path for Flight 370 passed through Cambodian airspace . Ho Chi Minh ACC responded that Flight 370 was not supposed to enter Cambodian airspace and that they had already contacted Phnom Penh ACC ( which controls Cambodian airspace ) , which had no contact with Flight 370 . Kuala Lumpur ACC contacted Malaysia Airlines ' operations centre at 02 : 34 , inquiring about the communication status with Flight 370 , and were informed that Flight 370 was in a normal condition based on a signal download and that it was located at 14 ° 54 ? 00 ? N 109 ° 15 ? 00 ? E. Later , another Malaysia Airlines aircraft ( Flight 386 bound for Shanghai ) attempted , at the request of Ho Chi Minh ACC , to contact Flight 370 on the Lumpur Radar frequency ? the frequency on which Flight 370 last made contact with Malaysian air traffic control ? and on emergency frequencies . The attempt was unsuccessful .

At 03 : 30 , Malaysia Airlines ' operations centre informed Kuala Lumpur ACC that the locations it had provided earlier were " based on flight projection and not reliable for aircraft positioning . " Over the next hour , Kuala Lumpur ACC contacted Ho Chi Minh ACC asking whether they had contacted Chinese air traffic control . At 05 : 09 , Singapore ACC was queried for information about Flight 370 . At 05 : 20 , an undisclosed official ? identified in the preliminary report released by Malaysia as " Capt [ name redacted ] " ? contacted Kuala Lumpur ACC requesting information about Flight 370 ; he opined that , based on known information , " MH370 never left Malaysian airspace . "

The watch supervisor at Kuala Lumpur ACC activated the Kuala Lumpur Aeronautical Rescue Coordination Centre ( ARCC ) at 05 : 30 , over four hours after communication was lost with Flight 370 . The ARCC is a command post at an Area Control Centre that coordinates search @-@ and @-@ rescue activities when an aircraft is lost .

= = = Announcement of disappearance = = =

Malaysia Airlines issued a media statement at 07 : 24 MYT , one hour after the scheduled arrival time of the flight at Beijing , stating that contact with the flight had been lost by Malaysian ATC at 02 : 40 and that the government had initiated search @-@ and @-@ rescue operations ; the time when contact was lost was later corrected to 01 : 21 . Neither the crew nor the aircraft 's communication systems relayed a distress signal , indications of bad weather , or technical problems before the aircraft vanished from radar screens .

= = = Reported sightings = = =

The news media reported several sightings of an aircraft that fit the description of the missing Boeing 777 . For example , on 19 March 2014 , CNN reported that witnesses , including fishermen , an oil rig worker and people on the Kuda Huvadhoo atoll in the Maldives saw the missing airliner . Some claimed to have seen it crash . Three months later , the Daily Telegraph reported that a British woman claimed she may have seen the aircraft on fire .

= = = Presumed loss = = =

On 24 March , Malaysian Prime Minister Najib Razak appeared before media at 22 : 00 local time to give a statement regarding Flight 370 , during which he announced that he had been briefed by the

Air Accidents Investigation Branch that it and Inmarsat ( the satellite data provider ) had concluded that the airliner 's last position before it disappeared was in the southern Indian Ocean . As there were no places there where it could have landed , the aircraft must therefore have crashed into the sea .

Just before Najib spoke at 22 : 00 MYT , an emergency meeting was called in Beijing for relatives of Flight 370 passengers . Malaysia Airlines announced that Flight 370 was assumed lost with no survivors . It notified most of the families in person or via telephone , and some received a SMS ( in English and Chinese ) informing them that it was highly likely that the aircraft had crashed with no survivors .

On 29 January 2015 the Director General of the Department of Civil Aviation Malaysia , Azharuddin Abdul Rahman , announced that the status of Flight 370 would be changed to an " accident " , in accordance with the Chicago Convention on International Civil Aviation .

If the official assumption is confirmed , Flight 370 was the deadliest aviation incident in the history of Malaysia Airlines at the time of its disappearance , surpassing the 1977 hijacking and crash of Malaysian Airline System Flight 653 that killed all 100 passengers and crew on board , and the deadliest involving a Boeing 777 , surpassing Asiana Airlines Flight 214 ( 3 fatalities ) . In both of those categories , Flight 370 was surpassed 131 days later by Malaysia Airlines Flight 17 , another Boeing 777 @-@ 200ER , which was shot down on 17 July 2014 , killing all 298 people aboard .

= = Search = =

A search and rescue effort was launched in Southeast Asia soon after the aircraft 's disappearance . After initial analysis of communications between the aircraft and a satellite , the surface search was moved the following week to the southern Indian Ocean . Between 18 March and 28 April 19 vessels and 345 sorties by military aircraft searched over 4 @,@ 600 @,@ 000 square kilometres ( 1 @,@ 800 @,@ 000 sq mi ) . The current phase of the search is a bathymetric survey and sonar search of the sea floor , about 1 @,@ 800 kilometres ( 970 nmi ; 1 @,@ 100 mi ) south @-@ west of Perth , Western Australia . Since 30 March 2014 the search has been coordinated by the Joint Agency Coordination Centre ( JACC ) , an Australian government agency established specifically to co @-@ ordinate the search effort to locate and recover Flight 370 , which primarily involves the Malaysian , Chinese , and Australian governments .

The search for Flight 370 is the most expensive search operation in aviation history . In June 2014 , Time estimated that the total search effort to that point had cost approximately US $ 70 million . The tender for the underwater search is AU $ 52 million ( US $ 43 million or ? 35 million ) ? shared by Australia and Malaysia ? for 12 months .

= = = Southeast Asia = = =

The Kuala Lumpur Aeronautical Rescue Coordination Centre ( ARCC ) was activated at 05 : 30 MYT ? four hours after communication was lost with the aircraft ? to co @-@ ordinate search and rescue efforts . Search efforts began in the Gulf of Thailand and South China Sea . On the second day of the search , Malaysian officials said that radar recordings indicated Flight 370 may have turned around ; the search zone was expanded to include part of the Strait of Malacca . On 12 March , the chief of the Royal Malaysian Air Force announced that an unidentified aircraft ? believed to be Flight 370 ? had travelled across the Malay peninsula and was last sighted on military radar 370 km ( 200 nmi ; 230 mi ) northwest of Penang Island ; search efforts were subsequently increased in the Andaman Sea and Bay of Bengal .

Records of signals sent between the aircraft and a communications satellite over the Indian Ocean revealed that the aircraft had continued flying for almost six hours after its final sighting on Malaysian military radar . Initial analysis of these communications determined that Flight 370 was along one of two arcs ? equidistant from the satellite ? when its last signal was sent ; the same day this analysis was publicly disclosed , 15 March , authorities announced they would abandon search efforts in the South China Sea , Gulf of Thailand , and Strait of Malacca to focus their efforts on the

two corridors . The northern arc ? from northern Thailand to Kazakhstan ? was soon discounted as the aircraft would have had to pass through heavily militarised airspace and those countries claimed their military radar would have detected an unidentified aircraft entering their airspace .

= = = Southern Indian Ocean = = =

The focus of the search shifted to the Southern Indian Ocean west of Australia and within Australia 's aeronautical and maritime Search and Rescue regions that extend to 75 ° E longitude . Accordingly , on 17 March , Australia agreed to lead the search in the southern locus from Sumatra to the southern Indian Ocean .

= = = = Initial search = = = =

From 18 ? 27 March 2014 the search effort focused on a 305 @,@ 000 km2 ( 118 @,@ 000 sq mi ) area about 2 @,@ 600 km ( 1 @,@ 400 nmi ; 1 @,@ 600 mi ) south @-@ west of Perth that Australian Prime Minister Tony Abbott said is " as close to nowhere as it 's possible to be " and which is renowned for its strong winds , inhospitable climate , hostile seas , and deep ocean floors . Satellite imagery of the region was analysed ; several objects of interest and two possible debris fields were identified on images captured between 16 ? 26 March . None of these possible objects were found by aircraft or ships .

Revised estimates of the radar track and the aircraft 's remaining fuel led to a move of the search 1 @,@ 100 km ( 590 nmi ; 680 mi ) north @-@ east of the previous area on 28 March , which was followed by another shift on 4 April . An intense effort began to locate the underwater locator beacons ( ULBs ; informally known as " pingers " ) attached to the aircraft 's flight recorders , whose batteries were expected to expire around 7 April . Two ships equipped with towed pinger locators ( TPLs ) and a submarine equipped with a hull @-@ mounted acoustic system began searching for pings along a 240 @-@ kilometre ( 150 mi ) seabed line believed to be the Flight 370 impact area . Operators considered it a shot in the dark , when comparing the vast search area with the fact that a TPL could only search up to 130 km2 ( 50 sq mi ) per day . Between 4 ? 8 April several acoustic detections were made that were close to the frequency and rhythm of the sound emitted by the flight recorders ' ULBs ; analysis of the acoustic detections determined that , although unlikely , the detections could have come from a damaged ULB . A sonar search of the sea @-@ floor near the detections was carried out between 14 April and 28 May without any sign of Flight 370 . In a March 2015 report , it was revealed that the battery for the ULB attached to Flight 370 's flight data recorder had expired in December 2012 and may not have been as capable .

= = = = Underwater search = = = =

In late June 2014 details of the next phase of the search were announced ; officials have called this phase the " underwater search " , despite the previous seafloor sonar survey . Continued refinement of analysis of Flight 370 's satellite communications identified a " wide area search " along the arc where Flight 370 was located when it last communicated with the satellite . The priority search area within the wide area search is in its southern extent . Some of the equipment to be used for the underwater search operates best when towed 200 m ( 650 ft ) above the seafloor at the end of a 10 km ( 6 mi ) cable . Available bathymetric data for this region was of poor resolution , thus necessitating a bathymetric survey of the search area before the underwater phase began . Commencing in May , the bathymetric survey charted around 208 @,@ 000 km2 ( 80 @,@ 000 sq mi ) of seafloor through 17 December 2014 , when it was suspended for the ship conducting the survey to be mobilised in the underwater search .

The underwater phase of the search , which began on 6 October 2014 , uses three vessels equipped with towed deep water vehicles , which use side @-@ scan sonar , multi @-@ beam echo sounders , and video cameras to locate and identify aircraft debris . A fourth vessel participated in the search between January ? May 2015 ; it had an autonomous underwater vehicle ( AUV ) to

search areas which cannot be effectively searched by equipment on the other vessels . The governments of Malaysia , China , and Australia have agreed to thoroughly search 120 @,@ 000 km2 ( 46 @,@ 000 sq mi ) of seafloor . As of 29 June 2016 , over 110 @,@ 000 km2 ( 42 @,@ 000 sq mi ) of seafloor have been searched during the underwater phase of the search and the current phase is expected to be completed around August 2016 , weather permitting . In case the search does not recover the aircraft , the governments of Malaysia , China , and Australia have agreed not to extend the search area any further .

Following the discovery of the flaperon on Réunion , the ATSB reviewed their drift calculations for debris from the aircraft and , according to the JACC , they are satisfied that the search area is still the most likely crash site . Reverse drift modelling of the debris , to determine its origin after 16 months , also supports the current underwater search area , although reverse drift modelling is very imprecise over long periods .

= = Marine debris = =

On 29 July 2015 , aircraft debris was found on a beach in Saint @-@ André , on Réunion , an island in the western Indian Ocean , about 4 @,@ 000 km ( 2 @,@ 200 nmi ; 2 @,@ 500 mi ) west of the underwater search area . The object had a stenciled internal marking " 657 BB , " consistent with the code for a portion of a right wing flaperon ( a trailing edge control surface ) from a Boeing 777 . The following day , a damaged suitcase was found which may be associated with Flight 370 . The location is consistent with models of debris dispersal 16 months after an origin in the current search area , off the west coast of Australia . On 31 July , a Chinese water bottle and an Indonesian cleaning product were found in the same area .

The first object to be found was transported from Réunion ? an overseas department of France ? to Toulouse , for examination by France 's civil aviation accident investigation agency , the Bureau d 'Enquêtes et d 'Analyses pour la Sécurité de l 'Aviation Civile ( BEA ) , and a French defence ministry laboratory . Malaysia sent investigators to both Réunion and Toulouse . French police conducted a search of the waters around Réunion for additional debris .

On 2 August , Malaysian officials confirmed that the object was a flaperon from a Boeing 777 aircraft and that the verification was made with investigators from France , Malaysia , Boeing , and the US National Transportation Safety Board ( NTSB ) . Three days later , the Prime Minister of Malaysia announced that the discovered flaperon was confirmed to be from Flight 370 ; French officials only stated that a " very high probability " existed that the object was from Flight 370 . On 3 September , French officials announced that serial numbers found on the flaperon link it " with certainty " to Flight 370 . This serial number was retrieved via borescope .

A week after the discovery of a flaperon from Flight 370 on a beach on Réunion , France announced plans for an aerial search for possible marine debris around the island . On 7 August 2015 , France began searching an area 120 km ( 75 mi ) by 40 km ( 25 mi ) along the east coast of Réunion . Foot patrols for debris along beaches were also planned . Malaysia asked authorities in neighbouring states to be on alert for marine debris which could be from an aircraft . On 14 August it was announced that no debris that could be related to Flight 370 had been found at sea off Réunion , but that some had been found on land . Air and sea searches for debris ended on 17 August .

On 2 March 2016 , it was reported that an object ( with the text " no step " on it ) had been found off the coast of Mozambique and early photographic analysis suggested it could have come from the aircraft 's horizontal stabilizer . It was found in late February by Blaine Gibson on a sandbank in the Mozambique Channel , between Mozambique in eastern Africa and Madagascar ; and in the same part of the southern Indian Ocean where the only confirmed piece of debris , a flaperon , had been found the previous July . The fragment was sent to Australia where experts examined whether it originated from Flight 370 .

In December 2015 , Liam Lotter found a grey piece of debris on a beach in southern Mozambique , but only after he read in March 2016 about Gibson 's find ( some 300 kilometers from his find ) did his family alert authorities . It was flown to Australia for analysis . Later in March , Australian officials said that it was highly likely that both pieces of debris were from Flight 370 , and Malaysian

authorities confirmed that with almost certainty it had originated from the flight ; transport Minister Darren Chester said that investigators had found the pieces were consistent with panels from a Malaysia Airlines Boeing 777 aircraft . On 24 March 2016 , the Geoscience Australia and ATSB confirmed that two panels recovered from Mozambique match that of a Malaysia Airlines Boeing 777 . The location where both pieces were retrieved was found to be consistent with the drift model performed by CSIRO , further corroborating it could have come from Flight 370 . In April 2016 , the Australian analysis concluded that the Mozambique debris had " almost certainly " originated from the airplane . The items have been identified as coming from the right stabiliser and right wing respectively .

On 7 March 2016 more debris , possibly from the aircraft , was found on the island of Réunion . Ab Aziz Kaprawi , Malaysia 's Deputy Transport Minister , said that " an unidentified grey item with a blue border " , might be linked to Flight 370 . Both Malaysian and Australian authorities , coordinating the search in the South Indian Ocean , sent teams to verify whether the debris was from the missing aircraft .

On 21 March 2016 , South African based archaeologist Neels Kruger found a fragment with a partial Rolls Royce engine manufacturers logo on a beach near Mossel Bay , South Africa . An acknowledgement of a possible part of an engine cowling was made by the Malaysian Ministry of Transport . An additional piece of possible debris , suggested to have come from the interior of the aircraft , was found on the island of Rodrigues , Mauritius , in late March and was to be examined by Australian authorities . On 11 May 2016 , the authority determined that these two pieces of debris are " almost certainly " from Flight 370 .

On 9 June 2016 , The Sydney Morning Herald reported that a man named Samuel Armstrong had found what could possibly be debris from the aircraft , a piece with similar coloring to Malaysia Airlines ' clear @-@ gray livery on the bottom of their aircraft 's fuselage and a pyramid or seven @-@ shaped figure on it , at a location on Kangaroo Island , southern Australia . South Australian police collected the piece and it was to be delivered to the ATSB for further investigation . The examination found out it was not from the flight .

On 24 June 2016 , the Australian Transport Minister , Darren Chester , said that a piece of aircraft debris was found on Pemba Island , off of the coast of Tanzania . It was handed over to the authorities so that experts from Malaysia can determinate whether it is part of the aircraft . The Australian government released photos of the piece , believed to be an outboard wing flap , on 20 July .

= = Investigation = =

= = = International participation = = =

Malaysia set up a Joint Investigation Team ( JIT ) , composed of specialists from Malaysia , Australia , China , the UK , the US , and France , led according to ICAO standards by " an independent investigator in charge " . The team consists of an airworthiness group , an operations group , and a medical and human factors group . The airworthiness group will examine issues related to maintenance records , structures , and systems of the aircraft . The operations group will review flight recorders , operations , and meteorology . The medical and human factors group will investigate psychological , pathological , and survival factors . Malaysia also announced , on 6 April , that it had set up three ministerial committees ? a Next of Kin Committee , a committee to organise the formation of the Joint Investigation Team , and a committee responsible for Malaysian assets deployed in the search effort . The criminal investigation is being led by the Royal Malaysia Police , assisted by Interpol and other relevant international law enforcement authorities .

On 17 March , Australia took control for co @-@ ordinating search , rescue , and recovery operations . For the following six weeks , the Australian Maritime Safety Authority ( AMSA ) and Australian Transport Safety Board ( ATSB ) worked to determine the search area , correlating information with the JIT and other government and academic sources , while the Joint Agency

Coordination Centre ( JACC ) coordinated the search efforts . Following the fourth phase of the search , the ATSB took responsibility for defining the search area . In May , the search strategy working group was established by the ATSB to determine the most likely position on the aircraft at the 00 : 19 UTC ( 08 : 19 MYT ) satellite transmission . The group included aircraft and satellite experts from : Air Accidents Investigation Branch ( UK ) , Boeing ( US ) , Defence Science and Technology Group ( Australia ) , Department of Civil Aviation ( Malaysia ) , Inmarsat ( UK ) , National Transportation Safety Board ( US ) , and Thales ( UK ) .
The Malaysian Ministry of Transport issued an interim report entitled " Factual Information : Safety Information for MH370 " on 8 March 2015 . As suggested by the report 's title , it focused on providing factual information and not analysis of possible causes of the disappearance .

= = = Analysis of satellite communication = = =

The communications between Flight 370 and the satellite communication network operated by Inmarsat , which were relayed by the Inmarsat @-@ 3 F1 satellite , provide the only significant clues to the location of Flight 370 after disappearing from Malaysian military radar at 02 : 22 MYT . These communications have also been used to deduce possible in @-@ flight events ( see next section ) . The investigative team was challenged with reconstructing the flight path of Flight 370 from a limited set of transmissions with no explicit information about the aircraft 's location , heading , or speed .

= = = = Background = = = =

Aeronautical satellite communication ( SATCOM ) systems are used to transmit messages from the aircraft cockpit as well as automated messages from on @-@ board systems using the ACARS communications protocol , but may also be used to transmit FANS and ATN messages and provide voice , fax and data links using other protocols . The aircraft 's satellite data unit ( SDU ) is used to send and receive signals with the satellite communications network ; it operates independently of other aircraft equipment that communicate through the SATCOM system , many using the ACARS protocol . Signals from the SDU are relayed by a satellite , which simply changes the signal 's frequency , and then received by a ground station , which processes the signal and , if applicable , routes it to its destination ( e.g. , Malaysia Airlines ' operations centre ) ; signals to the aircraft are sent in reverse order . When the SDU is powered on and attempts to connect with the Inmarsat network , it transmits a log @-@ on request , which the ground station acknowledges . This is , in part , to determine that the SDU belongs to an active service subscriber and also used to determine which satellite should be used to transmit messages to the SDU . After connecting , if a ground station has not received any contact from a terminal for one hour , the ground station will transmit a " log @-@ on interrogation " message ? informally referred to as a " ping " ; an active terminal responds automatically . The entire process of interrogating the terminal is referred to as a ' handshake ' .

= = = = Communications from 02 : 25 to 08 : 19 MYT = = = =

Although the ACARS data link on Flight 370 stopped functioning between 01 : 07 and 02 : 03 MYT , the SDU remained operative . After last contact by primary radar west of Malaysia , the following events were recorded in the log of Inmarsat 's ground station at Perth , Western Australia ( all times are MYT / UTC + 8 ) :
02 : 25 : 27 ? First handshake ? a log @-@ on request initiated by aircraft
02 : 39 : 52 ? Ground to aircraft telephone call , acknowledged by SDU , unanswered
03 : 41 : 00 ? Second handshake ( initiated by ground station )
04 : 41 : 02 ? Third handshake ( initiated by ground station )
05 : 41 : 24 ? Fourth handshake ( initiated by ground station )
06 : 41 : 19 ? Fifth handshake ( initiated by ground station )
07 : 13 : 58 ? Ground to aircraft telephone call , acknowledged by SDU , unanswered

08 : 10 : 58 ? Sixth handshake ( initiated by ground station )
08 : 19 : 29 ? Seventh handshake ( initiated by aircraft ) ; widely reported as a " partial handshake ' " , consisting of two transmissions :
08 : 19 : 29 @.@ 416 ? " log @-@ on request " message transmitted by aircraft ( seventh " partial " handshake )
08 : 19 : 37 @.@ 443 ? " log @-@ on acknowledge " message transmitted by aircraft , last transmission received from Flight 370
The aircraft did not respond to a ping at 09 : 15 .

= = = = Deductions = = = =

A few deductions can be made from the satellite communications . The first is that the aircraft remained operational until at least 08 : 19 MYT ? seven hours after final contact was made with air traffic control over the South China Sea . The varying burst frequency offset ( BFO ) values indicate the aircraft was moving at speed . The aircraft 's SDU needs location and track information to keep its antenna pointed towards the satellite , so it can also be deduced that the aircraft 's navigation system was operational .

Since the aircraft did not respond to a ping at 09 : 15 , it can be concluded that at some point between 08 : 19 and 09 : 15 , the aircraft lost the ability to communicate with the ground station . The log @-@ on message sent from the aircraft at 08 : 19 : 29 was " log @-@ on request " . There are only a few reasons the SDU would transmit a log @-@ on request , such as a power interruption , software failure , loss of critical systems providing input to the SDU , or a loss of the link due to the aircraft 's attitude . Investigators consider the most likely reason to be that it was sent during power @-@ up after an electrical outage . At 08 : 19 , the aircraft had been airborne for 7 h 38 min ; the typical Kuala Lumpur @-@ Beijing flight is 51 ? 2 hours and fuel exhaustion was likely . In the event of fuel exhaustion and engine flame @-@ out ? which would eliminate power to the SDU ? the aircraft 's ram air turbine ( RAT ) would deploy , providing power to some instruments and flight controls , including the SDU . Approximately 90 seconds after the 02 : 25 handshake ? also a log @-@ on request ? communications from the aircraft 's inflight entertainment system were recorded in the ground station log . Similar messages would be expected following the 08 : 19 handshake but none were received , supporting the fuel exhaustion scenario .

= = = = Analysis = = = =

Two parameters associated with these transmissions that were recorded in a log at the ground station were key to the investigation :

Burst time offset ( BTO ) ? the time difference between when a signal is sent from the ground station and when the response is received . This measure is proportional to twice the distance from the ground station via the satellite to the aircraft and includes the time that the SDU takes between receiving and responding to the message and time between reception and processing at the ground station . This measure can be analysed to determine the distance between the satellite and the aircraft and results in a ring on the Earth 's surface that is equidistant from the satellite at the calculated distance , which can be reduced to arcs by eliminating parts of the rings outside the aircraft 's range .

Burst frequency offset ( BFO ) ? the difference between the expected and received frequency of transmissions . The difference is caused by Doppler shifts as the signals travelled from the aircraft to the satellite to the ground station ; the frequency translations made in the satellite and at the ground station ; a small , constant error ( bias ) in the SDU that results from drift and aging ; and compensation applied by the SDU to counter the Doppler shift on the uplink . This measure can be analysed to determine the aircraft 's speed and heading , but multiple combinations of speed and heading can be valid solutions .

By combining the distance between the aircraft and satellite , speed , and heading with aircraft performance constraints ( e.g. fuel consumption , possible speeds and altitudes ) , investigators

generated candidate paths that were analysed separately by two methods . The first assumed the aircraft was flying on one of the three autopilot modes ( two are further affected by whether the navigation system used magnetic north or true north as a reference ) , calculated the BTO and BFO values along these routes , and compared them with the values recorded from Flight 370 . The second method generated paths which had the aircraft 's speed and heading adjusted at the time of each handshake to minimise the difference between the calculated BFO of the path and the values recorded from Flight 370 . A probability distribution for each method at the BTO arc of the sixth handshake of the two methods was created and then compared ; 80 percent of the highest probability paths for both analyses combined intersect the BTO arc of the sixth handshake between 32 @.@ 5 ° S and 38 @.@ 1 ° S , which can be extrapolated to 33 @.@ 5 ° S and 38 @.@ 3 ° S along the BTO arc of the seventh handshake .

= = = Possible in @-@ flight events = = =

= = = = Power interruption = = = =

The SATCOM link functioned normally from pre @-@ flight ( beginning at 00 : 00 MYT ) until it responded to a ground @-@ to @-@ air ACARS message with an acknowledge message at 01 : 07 . Ground @-@ to @-@ air ACARS messages continued to be transmitted to Flight 370 until Inmarsat 's network sent multiple " Request for Acknowledge " messages at 02 : 03 , without a response from the aircraft . At some time between 01 : 07 and 02 : 03 , power was lost to the SDU . At 02 : 25 , the aircraft 's SDU sent a " log @-@ on request " . It is not common for a log @-@ on request to be made in @-@ flight , but it could occur for multiple reasons . An analysis of the characteristics and timing of these requests suggest a power interruption in @-@ flight is the most likely culprit . As the power interruption was not due to engine flame @-@ out , per ATSB , it may have been the result of manually switching off the aircraft 's electrical system .

= = = = Unresponsive crew or hypoxia = = = =

An analysis by the ATSB comparing the evidence available for Flight 370 with three categories of accidents ? an in @-@ flight upset ( e.g. , stall ) , a glide event ( e.g. , engine failure , fuel exhaustion ) , and an unresponsive crew or hypoxia event ? concluded that an unresponsive crew or hypoxia event " best fit the available evidence " for the five @-@ hour period of the flight as it travelled south over the Indian Ocean without communication or significant deviations in its track , likely on autopilot . No consensus exists among investigators on the unresponsive crew or hypoxia theory . If no control inputs were made following flameout and the disengagement of autopilot , the aircraft would likely have entered a spiral dive and entered the ocean within 20 nmi ( 37 km ; 23 mi ) of the flameout and disengagement of autopilot .

= = = Possible causes of disappearance = = =

= = = = Passenger involvement = = = =

Two men boarded Flight 370 with stolen passports , which raised suspicion in the immediate aftermath of its disappearance . The passports , one Austrian and one Italian , were reported stolen in Thailand within the preceding two years . Interpol stated that both passports were listed on its database of lost and stolen passports , and that no check had been made against its database . Malaysia 's Home Minister , Ahmad Zahid Hamidi , criticised his country 's immigration officials for failing to stop the passengers travelling on the stolen European passports . The two one @-@ way tickets purchased for the holders of the stolen passports were booked through China Southern Airlines . It was reported that an Iranian had ordered the cheapest tickets to Europe via telephone in

Bangkok , Thailand , and paid in cash . The two passengers were later identified as Iranian men , one aged 19 and the other 29 , who had entered Malaysia on 28 February using valid Iranian passports . The head of Interpol said the organization was " inclined to conclude that it was not a terrorist incident " . The two men were believed to be asylum seekers .

United States and Malaysian officials were reviewing the backgrounds of every passenger named on the manifest . On 18 March , the Chinese government announced that it had checked all of the Chinese citizens on the aircraft and ruled out the possibility that any were involved in " destruction or terror attacks " . One passenger who worked as a flight engineer for a Swiss jet charter company was briefly suspected as a potential hijacker because he was thought to have the relevant skill set .

= = = = Crew involvement = = = =

Investigators believe someone in the cockpit of Flight 370 re @-@ programmed the aircraft 's autopilot before it travelled south across the Indian Ocean . Police searched the homes of the pilots and seized financial records for all 12 crew members , including bank statements , credit card bills and mortgage documents . On 2 April 2014 , Malaysia 's Police Inspector @-@ General said that more than 170 interviews had been conducted as part of Malaysia 's criminal investigation , including interviews with family members of the pilots and crew .

Media reports have claimed that Malaysian police have identified Captain Shah as the prime suspect if human intervention is proven to be the cause of Flight 370 's disappearance . The United States ' Federal Bureau of Investigation ( FBI ) reconstructed the deleted data from Captain Shah 's home flight simulator ; a Malaysian government spokesman indicated that " nothing sinister " had been found on it but a leaked American document stated that a route on the pilot 's home flight simulator , closely matching the projected flight over the Indian Ocean , was found during the FBI analysis of the hard drive of the computer used for the flight simulator .

The preliminary report issued by Malaysia in March 2015 stated that there was " no evidence of recent or imminent significant financial transactions carried out " by any of the pilots or crew and that analysis of the behaviour of the pilots on CCTV showed " no significant behavioural changes " .

= = = = Cargo = = = =

Flight 370 was carrying 10 @,@ 806 kg ( 23 @,@ 823 lb ) of cargo , of which four ULDs of mangosteens and 221 kg ( 487 lb ) of lithium @-@ ion batteries are of interest , according to Malaysian investigators . The four ULDs of mangosteens were loaded into the aft cargo bay of the aircraft . The lithium @-@ ion batteries were divided among two pallets in the forward cargo bay and one pallet placed in the rear of the aft cargo bay .

The lithium @-@ ion batteries were contained in a 2 @,@ 453 kg ( 5 @,@ 408 lb ) consignment being transported between Motorola Solutions facilities in Bayan Lepas , Malaysia and Tianjin , China ; the rest of the consignment consisted of walkie @-@ talkie chargers and accessories . The batteries were assembled on 7 March and transported to the Penang Cargo Complex to be transported by MASkargo ? Malaysia Airlines ' cargo subsidiary ? to be loaded onto a lorry to transport it to Kuala Lumpur International Airport and onwards by air to Beijing . At the Penang Cargo Complex , the consignment was inspected by MASkargo employees and Malaysian customs officials , but did not go through a security screening , before the truck was sealed for transfer to the airport . The consignment did not go through any additional inspections at Kuala Lumpur International Airport before it was loaded onto Flight 370 . Because the batteries were packaged in accordance with IATA guidelines , they were not regulated as dangerous goods . Lithium @-@ ion batteries can cause intense fires if they overheat and ignite , which has led to strict regulations on their transport aboard aircraft . A fire fuelled by lithium @-@ ion batteries caused the crash of UPS Airlines Flight 6 and lithium @-@ ion batteries are suspected to have caused a fire which resulted in the crash of Asiana Airlines Flight 991 ; both were cargo aircraft . Some airlines have stopped carrying bulk shipments of lithium @-@ ion batteries on passenger aircraft , citing safety concerns .

A 4 @,@ 566 kg ( 10 @,@ 066 lb ) consignment of mangosteens was aboard Flight 370 , over half

of which was harvested in Muar , Malaysia and the remainder from Sumatra , Indonesia . The mangosteens were packaged in plastic baskets containing 8 ? 9 kg ( 18 ? 20 lb ) of mangosteens and covered with a water @-@ soaked sponge to preserve their freshness . The mangosteens were loaded into four ULDs at Kuala Lumpur International Airport and inspected by officials from Malaysia 's Federal Agriculture Marketing Authority before being loaded onto Flight 370 . According to the head of Malaysian police , Inspector @-@ General Tan Sir Khalid Abu Bakar , the people who handled the mangosteens and the Chinese importers were questioned to rule out sabotage .

= = Aftermath = =

= = = Information sharing = = =

Public communication from Malaysian officials regarding the loss of the flight was initially beset with confusion . The Malaysian government and the airline released imprecise , incomplete , and sometimes inaccurate information , with civilian officials sometimes contradicting military leaders . Malaysian officials were criticised for such persistent release of contradictory information , most notably regarding the last location and time of contact with the aircraft .

Although Malaysia 's acting Transport Minister Hishammuddin Hussein , who is also the country 's Defence Minister , denied the existence of problems between the participating countries , academics said that because of regional conflicts , there were genuine trust issues involved in co @-@ operation and sharing intelligence , and that these were hampering the search . International relations experts said entrenched rivalries over sovereignty , security , intelligence , and national interests made meaningful multilateral co @-@ operation very difficult . A Chinese academic made the observation that the parties were searching independently ; thus it was not a multilateral search effort . The Guardian noted the Vietnamese permission given for Chinese aircraft to overfly its airspace as a positive sign of co @-@ operation . Vietnam temporarily scaled back its search operations after the country 's Deputy Transport Minister cited a lack of communication from Malaysian officials despite requests for more information . China , through the official Xinhua News Agency , said that the Malaysian government ought to take charge and conduct the operation with greater transparency , a point echoed by the Chinese Foreign Ministry days later .

Malaysia had initially declined to release raw data from its military radar , deeming the information " too sensitive , " but later acceded . Defence experts suggested that giving others access to radar information could be sensitive on a military level , for example : " The rate at which they can take the picture can also reveal how good the radar system is . " One suggested that some countries could already have had radar data on the aircraft but were reluctant to share any information that could potentially reveal their defence capabilities and compromise their own security . Similarly , submarines patrolling the South China Sea might have information in the event of a water impact , and sharing such information could reveal their locations and listening capabilities .

Criticism was also levelled at the delay of the search efforts . On 11 March , three days after the aircraft disappeared , British satellite company Inmarsat had provided officials ( or its partner , SITA ) with data suggesting the aircraft was nowhere near the areas in the Gulf of Thailand and the South China Sea being searched at that time ; and may have diverted its course through a southern or northern corridor . This information was only publicly acknowledged and released by Najib on 15 March in a press conference . Explaining why information about satellite signals had not been made available earlier , Malaysia Airlines said that the raw satellite signals needed to be verified and analysed " so that their significance could be properly understood " before it could publicly confirm their existence . Hishammuddin said Malaysian and US investigators had immediately discussed the Inmarsat data upon receiving them on 12 March , and on two occasions , both groups agreed that it needed further processing and sent the data to the US twice for this purpose . Data analysis was completed on 14 March : by then , the AAIB had independently arrived at the same conclusion .

In June 2014 , relatives of passengers on Flight 370 began a crowdfunding campaign on Indiegogo to raise US $ 100 @,@ 000 ? with an ultimate goal of raising US $ 5 million ? as a reward to

encourage anyone who knows the location of Flight 370 or the cause of its disappearance to reveal what they know . The campaign , which ended 8 August 2014 , raised US $ 100 @,@ 516 from 1007 contributors .

= = = Malaysia Airlines = = =

A month after the disappearance , Malaysia Airlines ' chief executive Ahmad Jauhari Yahya acknowledged that ticket sales had declined but failed to provide specific details . This may partially result from the suspension of the airline 's advertising campaigns following the disappearance . Ahmad stated in an interview with the Wall Street Journal that the airline 's " primary focus ... is that we do take care of the families in terms of their emotional needs and also their financial needs . It is important that we provide answers for them . It is important that the world has answers , as well . " In further remarks , Ahmad said he was not sure when the airline could start repairing its image , but that the airline was adequately insured to cover the financial loss stemming from Flight 370 's disappearance . In China , where the majority of passengers were from , bookings on Malaysia Airlines were down 60 percent in March .

Malaysia Airlines retired the Flight 370 ( MH370 ) flight number and replaced it with Flight 318 ( MH318 ) beginning 14 March . This follows a common practice among airlines to rename flights following notorious accidents . The flight ? Malaysia Airline 's second daily flight to Beijing ? was later suspended beginning 2 May ; according to insiders , this was due to lack of demand .

Malaysia Airlines was given US $ 110 million from insurers in March 2014 to cover initial payments to passengers ' families and the search effort . In May , remarks from lead reinsurer of the flight , Allianz , indicated the insured market loss on Flight 370 , including the search , was about US $ 350 million .

= = = = Financial troubles = = = =

At the time of Flight 370 's disappearance , Malaysia Airlines was struggling to cut costs to compete with a wave of new , low @-@ cost carriers in the region . In the previous three years , Malaysia Airlines had booked losses of : RM1.17 billion ( US $ 356 million ) in 2013 , RM433 million in 2012 , and RM2.5 billion in 2011 . Malaysia Airlines lost RM443.4 million ( US $ 137 @.@ 4 million ) in the first quarter of 2014 ( January ? March ) . The second quarter ? the first full quarter in the aftermath of Flight 370 's disappearance ? saw a loss of RM307.04 million ( US $ 97 @.@ 6 million ) , which represented a 75 percent increase over losses from the second quarter of 2013 . Industry analysts expect Malaysia Airlines to lose further market share and face a challenging environment to stand out from competitors while addressing their financial plight . The company 's stock , down as much as 20 percent following the disappearance of Flight 370 , had fallen 80 percent over the previous five years , which contrasts with a rise in the Malaysian stock market of about 80 percent over the same period .

Many analysts and the media suggested that Malaysia Airlines would need to rebrand and repair its image and / or require government assistance to return to profitability . The loss of Flight 17 in July greatly exacerbated Malaysia Airline 's financial problems . The combined effect on consumer confidence of the loss of Flights 370 and 17 and the airline 's poor financial performance led Khazanah Nasional ? the majority shareholder ( 69 @.@ 37 percent ) and a Malaysian state @-@ run investment arm ? to announce on 8 August its plan to purchase the remainder of the airline , thereby renationalising it .

= = = = Compensation for passengers ' next @-@ of @-@ kin = = = =

Lack of evidence in determining the cause of Flight 370 's disappearance , even physical evidence that the aircraft crashed , raises many issues regarding responsibility for the accident and payments made by insurance agencies . Under the Montreal Convention , it is the carrier 's responsibility to prove lack of fault in an accident and each passenger 's next @-@ of @-@ kin are automatically

entitled , regardless of fault , to a payment of approximately US $ 175 @,@ 000 from the airline 's insurance company ? a total of nearly US $ 40 million for the 227 passengers on board .

Malaysia Airlines would still be vulnerable to civil lawsuits from passengers ' families . Compensation awarded during or settled out @-@ of @-@ court during civil trials will likely vary widely among passengers based on country of the court . An American court could likely award upwards of US $ 8 ? 10 million , while Chinese courts would likely award a small fraction of that . Despite the announcement that Flight 370 ended in the southern Indian Ocean , it was not until 29 January 2015 that the Malaysian government officially declared Flight 370 an accident with no survivors , a move that would allow compensation claims to be made . The first lawsuit related to the disappearance was filed in October 2014 ? before Flight 370 was declared an accident ? on behalf of two Malaysian boys whose father was a passenger , for negligence in failing to contact the aircraft soon after it was lost and for breach of contract for failing to bring the passenger to his destination .

Malaysia Airlines offered ex gratia condolence payments soon after the disappearance . In China , families of passengers were offered ¥ 31 @,@ 000 ( about US $ 5 @,@ 000 ) " comfort money " ; but some families rejected the offer . It was also reported that Malaysian relatives received only $ 2 @,@ 000 . In June , Malaysia 's deputy Foreign Minister Hamzah Zainuddin said that families of seven passengers received $ 50 @,@ 000 advance compensation from Malaysia Airlines , but that full payout would come after the aircraft is found or officially declared lost ( which later occurred in January 2015 ) .

= = = Malaysia = = =

Questions and criticisms were raised by air force experts and the Malaysian opposition about the state of Malaysia 's air force and radar capabilities . The failure of the Royal Malaysian Air Force to identify and respond to an unidentified aircraft ( later determined to be Flight 370 ) flying through Malaysian airspace was criticised by many . The Malaysian military became aware of the unidentified aircraft only after reviewing radar recordings several hours after the flight 's disappearance . The failure to recognise and react to the unidentified aircraft was a security breach , and was also a missed opportunity to intercept Flight 370 and prevent the time @-@ consuming and expensive search operation .

The Malaysian Prime Minister , Najib Razak , responded to criticism of his government in an opinion piece published in the The Wall Street Journal in which he acknowledged mistakes had been made , and said time would show that Malaysia had done its best , had helped co @-@ ordinate the search , and would continue to support . Najib went on to emphasise the need for the aviation industry to " not only learn the lessons of MH370 but implement them , " saying in closing that " the world learned from [ Air France Flight 447 ] but didn 't act . The same mistake must not be made again . "

Opposition leader Anwar Ibrahim criticised the Malaysian government regarding its response to Flight 370 's disappearance and the military 's response when Flight 370 turned back over the Malay Peninsula ; he called for an international committee to take charge of the investigation " to save the image of the country and to save the country . " Malaysian authorities have accused Anwar ? who was jailed on contentious charges the day before Flight 370 disappeared ? of politicising the crisis . Flight 370 's captain was a supporter of Anwar and the two knew each other .

Questioned about why Malaysia did not scramble fighter jets to intercept the aircraft as it tracked back across the Malay Peninsula , he noted that it was deemed a commercial aircraft and was not hostile , remarking : " If you 're not going to shoot it down , what 's the point of sending [ a fighter jet ] up ? "

The response to the crisis and lack of transparency in the response brought attention to the state of media in Malaysia . After decades of having tight control of media , during which government officials were accustomed to passing over issues without scrutiny or accountability , Malaysia was suddenly thrust to the forefront of global media and unable to adjust to demands for transparency .

On the second anniversary of the disappearance , 8 March 2016 , Razak said that he was hopeful that the missing Flight 370 would be found . The Malaysian Parliament observed a moment of silence to mark the anniversary . Razak said in a statement that the search had been " the most

challenging in aviation history " , but that he remained committed to completing it .

= = = China = = =

Chinese Deputy Foreign Minister Xie Hangsheng reacted sceptically to the conclusion by the Malaysian government that the aircraft had gone down with no survivors , demanding " all the relevant information and evidence about the satellite data analysis " , and said that the Malaysian government must " finish all the work including search and rescue . " The following day , 25 March , Chinese president Xi Jinping sent a special envoy to Kuala Lumpur to consult with the Malaysian government over the missing aircraft .

= = = = Relatives of passengers = = = =

On 25 March , around two hundred family members of the Chinese passengers protested outside the Malaysian embassy in Beijing . Relatives who had arrived in Kuala Lumpur after the announcement continued with their protest , accusing Malaysia of hiding the truth and harbouring the murderer . They also wanted an apology for the Malaysian government 's poor initial handling of the disaster and its " premature " conclusion of loss , drawn without physical evidence . An op @-@ ed for China Daily said that Malaysia was not wholly to be blamed for its poor handling of such a " bizarre " and " unprecedented crisis , " and appealed to Chinese people not to allow emotions to prevail over evidence and rationality . The Chinese ambassador to Malaysia defended the Malaysian government 's response , stating that the relatives ' " radical and irresponsible opinions do not represent the views of Chinese people and the Chinese government " . The ambassador also strongly criticised Western media for having " published false news , stoked conflict and even spread rumours " to the detriment of relatives and of Sino ? Malaysian relations . On the other hand , a US Department of Defense official criticised China for what he perceived as providing apparently false leads that detracted from the search effort and wasted time and resources .

The day before the second anniversary of the disappearance , 7 March 2016 , twelve Chinese families with relatives aboard the missing flight , filed a lawsuit in a Beijing , one day before the deadline for pursuing litigation against the carrier . In Kuala Lumpur , lawyer Ganesan Nethi reported that he had filed a joint lawsuit on behalf of the families of 32 passengers on 3 March 2016 , explaining that most were Chinese , along with an American and a few Indians .

= = = = Boycotts = = = =

Some Chinese have boycotted all things Malaysian , including holidays and singers , in protest of Malaysia 's handling of the Flight 370 investigation . Bookings on Malaysia Airlines from China , where the majority of passengers were from , were down 60 percent in March . In late March , several major Chinese ticketing agencies ? ELong , LY.com , Qunar and Mango ? discontinued the sale of airline tickets to Malaysia and several large Chinese travel agencies reported a 50 percent drop in tourists compared to the same period the year before . China is the third largest source of visitors for Malaysia , accounting for 1 @.@ 79 million tourists . One market analyst predicted a 20 ? 40 percent drop in Chinese tourists to Malaysia , resulting in a loss of 4 ? 8 billion yuan ( RM2.1 ? 4 @.@ 2 billion ; US $ 650 million @-@ 1 @.@ 3 billion ) .

The boycotts have largely been led or supported by celebrities . Film star Chen Kun posted a message to Weibo ? where he has 70 million followers ? stating that he would be boycotting Malaysia until their government told the truth . The post was shared over 70 @,@ 000 times and drew over 30 @,@ 000 comments . Over 337 @,@ 000 people retweeted a tweet from TV host Meng Fei , which said he would join the boycott .

China and Malaysia had dubbed 2014 to be the " Malaysia ? China Friendship Year " to celebrate 40 years of diplomatic relations between the two countries .

= = = Air transport industry = = =

The fact that , in a digitally @-@ connected world , a modern aircraft could disappear has been met with surprise and disbelief by the public ; and while changes in the aviation industry often take years to be implemented , airlines and air transport authorities have responded swiftly to take action on several measures to prevent a similar incident from occurring .

= = = = Aircraft tracking = = = =

The International Air Transport Association ? an industry trade organisation representing over 240 airlines ( representing 84 percent of global air traffic ) ? and the International Civil Aviation Organization ( ICAO ) ? the United Nations ' civil aviation body ? are working on implementing new measures to track aircraft in flight in real time . The IATA created a task force ( which includes several outside stakeholders ) to define a minimum set of requirements that any tracking system must meet , allowing airlines to decide the best solution to track their aircraft . The IATA 's task force plans to come up with several short- , medium- , and long @-@ term solutions to ensure that information is provided in a timely manner to support search , rescue , and recovery activities in the wake of an aircraft accident . The task force was expected to provide a report to the ICAO on 30 September 2014 , but on that day said that the report would be delayed , citing the need for further clarification on some issues . In December 2014 , the IATA task force recommended that , within 12 months , airlines track commercial aircraft in no longer than 15 @-@ minute intervals , although it still has not released its report and full details of proposed changes . The IATA itself did not support the deadline , which it believes cannot be met by all airlines , but the proposed standard has the support of the ICAO . Although the ICAO can set standards , it has no legal authority and such standards must be adopted by member states .

The ICAO has adopted a standard that , by November 2018 , all aircraft over open ocean report their position every 15 minutes . In March 2016 , the ICAO approved an amendment to the Chicago Convention requiring new aircraft manufactured after 1 January 2021 to have autonomous tracking devices which can send location information at least once per minute in distress circumstances .

In May 2014 , Inmarsat said it would offer its tracking service for free to all aircraft equipped with an Inmarsat satellite connection ( which amounts to nearly all commercial airliners ) . Inmarsat has also changed the time period for handshakes with their terminals from one hour to 15 minutes .

= = = = Transponders = = = =

There was a call for automated transponders after the 11 September 2001 terrorist attacks ; no changes were made as aviation experts preferred flexible control , in case of malfunctions or electrical emergencies . In the wake of Flight 370 , the air transport industry is still resistant to the installation of automated transponders , which would likely entail significant costs . Pilots have also criticised changes of this kind , insisting on the need to cut power to equipment in the event of a fire . Nonetheless , new types of tamper @-@ proof circuit breakers are being considered .

= = = = Flight recorders = = = =

The frenzied search for the flight recorders in early April , due to the 30 @-@ day battery life of the underwater locator beacons ( ULBs ) attached to them , brought attention to the limitations of the ULBs . The battery life of the ULBs is limited , and the distance the signal from the ULBs can be detected from is 2 @,@ 000 ? 3 @,@ 000 m ( 6 @,@ 600 ? 9 @,@ 800 ft ) , or 4 @,@ 500 m ( 14 @,@ 800 ft ) under favourable conditions . Even if the flight recorders are located , the cockpit voice recorder memory has capacity to store only two hours of data , continuously recording over the oldest data . This length complies with regulations and it is usually only data from the last section of a flight that is needed to determine the cause of an accident . The events which caused Flight 370 to divert from its course and disappear happened more than two hours before the flight ended . Given these limitations and the importance of the data stored on flight recorders , Flight 370 has brought

attention to new technologies that enable data streaming to the ground .

A call to increase the battery life of ULBs was made after the unsuccessful initial search in 2009 for the flight recorders on Air France Flight 447 , which were not located until 2011 . The ICAO did not make such a recommendation until 2014 , with implementation by 2018 . The European Aviation Safety Agency has stated its new regulations require that the transmitting time of ULBs fitted to aircraft flight recorders must range from 30 to 90 days . The agency proposed a new underwater locator beacon with a larger transmitting range to be fitted to aircraft flying over oceans .

In March 2016 , the ICAO adopted several amendments to the Chicago Convention to address issues raised by Flight 370 's disappearance . For aircraft manufactured after 2020 , cockpit voice recorders will be required to record at least 25 hours of data , so that they record all phases of a flight . Aircraft designs approved after 2020 will need to have a means to recover the flight recorders , or the information they contain , before the recorders sink below water . This provision is performance @-@ based so that it can be accomplished by different techniques , such as streaming flight recorder data from aircraft in distress or using flight recorders which eject from aircraft and float on the water 's surface . The new regulations will not require modifications to existing aircraft .

= = = = Safety recommendations = = = =

In January 2015 , the US NTSB cited Flight 370 and Air France Flight 447 when it issued eight safety recommendations related to locating aircraft wreckage in remote or underwater locations and repeated recommendations for a crash @-@ protected cockpit image recorder and tamper @-@ resistant flight recorders and transponders .

= = In popular culture = =

The disappearance of Malaysia Airlines Flight 370 has been dubbed one of the greatest aviation mysteries of all time .

Several documentaries have been produced about the flight . The Smithsonian Channel aired a one @-@ hour documentary about the flight on 6 April 2014 , titled Malaysia 370 : The Plane That Vanished . The Discovery Channel broadcast a one @-@ hour documentary about Flight 370 on 16 April 2014 titled Flight 370 : The Missing Links .

An episode of the television documentary series Horizon titled " Where is Flight MH370 ? " was broadcast on 17 June 2014 on BBC Two . The programme , narrated by Amanda Drew , documents how the aircraft disappeared , what experts believe happened to it , and how the search has unfolded . The programme also examines new technologies such as flight recorder streaming and automatic dependent surveillance @-@ broadcast ( ADS @-@ B ) , which may help prevent similar disappearances in the future . It concludes by noting that Ocean Shield had spent two months searching 850 square kilometres ( 330 sq mi ) of ocean , but that it had searched far to the north of the Inmarsat " hotspot " on the final arc , at approximately 28 degrees south , where the aircraft was most likely to have crashed . On 8 October 2014 , a modified version of the Horizon programme was broadcast in the US by PBS as an episode of Nova , titled " Why Planes Vanish " , with a different narrator .

The first fictional account of the mystery was Scott Maka 's MH370 : A Novella , published three months after the aircraft 's disappearance .

The aviation disaster documentary television series Mayday ( also known as Air Crash Investigation or Air Emergency ) produced an episode on the disaster , titled " Malaysia 370 : What Happened ? " In the UK , it aired on the first anniversary of Flight 370 's disappearance , 8 March 2015 .

= = = Reports = = =

MH 370 Preliminary Report ? Preliminary report issued by the Malaysia Ministry of Transport . Dated 9 April 2014 and released publicly on 1 May 2014 .

Factual Information : Safety Investigation for MH370 ? Interim report released 8 March 2015 ( 584

pages ) .
MH370 ? Definition of Underwater Search Areas ( 2014 ) ? Report by the Australian Transport Safety Bureau , released 26 June 2014 , and the most comprehensive report on Flight 370 publicly released at that time . The report focuses on defining the search area for the fifth phase , but in doing so provides a comprehensive overview / examination of satellite data , the failed searches , and possible " end @-@ of @-@ flight scenarios " .
MH370 ? Definition of Underwater Search Areas ( 2015 ) ? Report by the Australian Transport Safety Bureau , released 3 December 2015 , covering the Bayesian method analysis made by Australia 's Defence Science and Technology Group and other developments since mid @-@ 2014 in defining the search area .

= = = Press releases / Media = = =

Australian Maritime Safety Authority
Australian Transport Safety Bureau
Malaysia Airlines
Malaysian Ministry of Transport
US Department of Defense