

## Biometric Technologies and Airline Security: A Case Study of Flight MH370

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**Abstract:** The airline industry is susceptible to emergencies and disasters that must be managed in order to mitigate any potential impact. This paper analyses Malaysia Airlines' response to the missing MH370 flight. This disaster marks the first plane to disappear from their fleet since the company's inception. In this study, the event is explained and the government and company's responses are reviewed, with emphasis on the biometric technologies recommended by scholars and experts. The role of the government, airports and the aviation industry will also be discussed. It is recommended that technology be employed immediately to reduce potential errors and eliminate possible terrorist activities.

**Key words:** Biometric Technologies • Airline Security • Malaysia Airlines • Aviation Industry

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### INTRODUCTION

Airline emergencies and safety procedures have become a highly topical issue, especially in the aftermath of the 9/11 attack where two Boeing 767 aircrafts were hijacked. This event shook the airline industry and highlighted the vulnerability of civil aviation to the potential of terrorism [1]. The need for emergency management planning urgently required new procedures for all carriers to be prepared for such events.

Biometric technologies initially gained high acceptance and recognition through Hollywood blockbuster films. Later, the increase in the number of security threats gave this technology greater potential acceptance amongst scientists and other research scholars.

[2] asserted that the airline industry could be enhanced by using biometric technologies to improve safety. Installing biometrics in the airline industry would reduce the cost, likelihood of guest theft, terrorist activities and improve operational efficiency and security. Biometric technologies may utilize the safety measurements to identify and verify the passengers' identities [3]. The rapidly expanding industry of biometrics changes security from physical access, such as door locks, to security formats such as computer

passwords and manual screenings to prevent terrorists' and criminals' access. Several types of biometrics are now available and many could be used in the airline industry: [4] mentioned seven biometric technologies in the market that could be used. Reports also mention that there has been exponential growth in biometrics since 11 September 2001.

This study focuses on Malaysian Airlines (MAS) flight MH370, which suddenly vanished from radar screens and 239 passengers and crew-members disappeared. This research seeks to understand the dynamics of such emergency situations and resolve how to manage similar events. Currently, the cause of the plane's disappearance is still uncertain; doubts remain because the plane was operated by a reputable pilot and was in good condition. Attention also focused on how the national carrier MAS could recover from this event, while restoring the reputation of this organization.

Unfortunately, official documents pertaining to MAS are confidential. The request to interview the airlines representatives regarding this sensitive situation was denied. Thus, study is based on the governmental reports, expert analysis and press releases issued in the days immediately following the vanishing of the aircraft [5]. There is a lack of insiders' perspective and other limitations. Such an approach yields some useful insights.

**Emergencies in the Airline Industry:** In the last few decades, the global airline industry has been subjected to several disasters and emergencies that have caused problems with arrivals and revenue, loss of lives and multiple challenges to governments, public and private sectors [6]. A wave of disaster events have affected the aviation industry, such as the 11 September 2001 attack on the World Trade Centre involving two hijacked Boeing 767 planes [7], Singapore Airlines (SIA) flight SQ006 crash due to human error in 2000 [8] and the crash of ValuJet flight 592. Because of an electric fault and loss of air pressure, this resulted in a high-impact crash into a swamp just six minutes after take-off [9].

Since the 1970s, scholars from a variety of areas adopted different approaches, analyzed statistical data and carried out case studies to determine the best practices and management styles for dealing with emergencies [10]. The Asian financial crisis [11] and the events of 11 September 2001 generated an abundance of additional studies [12]. Furthermore, specific research has been conducted in the aviation industry [13]. Aviation is constantly threatened by travel accidents involving aircraft, in regard to the nature of operating systems. Airline crashes or accidents are mainly due to technical or human failure, or a combination of the two. Whatever the cause, the victims' families certainly need to know the truth.

There is media interest in evaluating the airlines and their management. There is greater emphasis on the importance of emergency management and preparedness and an analysis of the devices used to mitigate the effect of any catastrophic event [8]. Researchers questioned why airlines have not been using biometric technology when dealing with scheduled flights after 11 September 2001. Experts argue that it is impossible to use when booking the flight and buying the tickets online. However, it should be used in the airports, especially at the departure gates.

**Malaysian Airlines Flight MH370:** MAS is the country's flagship carrier and 90% is owned by the Malaysian government. The airline carries over 16 million passengers annually and has extensive code sharing agreements with international airlines [14]. Moreover, after joining the OneWorld group, MAS planned to become "an airline of excellence" offering a high measure of safety, service, comfort and punctuality [15]. The airline has more than one hundred aircrafts and approximately half of them are used in the domestic and intra-Asian markets. They have extensive overhaul and maintenance facilities that

specialize in engine and avionics repair. The financial crisis of 1997, followed by three hard years of poor revenue and a debt of \$2.6 billion forced the Malaysian Government to intervene and rescue the airline. In 2002, MAS achieved a net group profit of \$89 million, with an average operating margin of 0.3% in recent years [14].

The Boeing 777 flight MH370 took-off from Kuala Lumpur airport KLIA on Friday 7 March 2014 at 16:41 GMT, having a codeshare with China Southern Airlines Flight 748 (CZ748). It was heading to Beijing Capital International Airport in China. With 227 passengers from 15 nations, the majority of passengers were Chinese citizens, while 12 were crew members. It went missing within the first hour of the flight [16]. The air traffic controllers lost contact with the plane and it vanished from the computer screens within 50 minutes. The last report documented that the plane was 200 km north of Kuala Lumpur [17]. On the day that contact with the aircraft was lost, there was a joint search and rescue effort initiated in the Gulf of Thailand and the South China Sea. It was later reported that this was the largest search and rescue effort in history [18]. The search area was later extended to include the Strait of Malacca, the Andaman Sea and the Indian Ocean [19]. Based on military radar data and signals sent between the plane and a satellite, investigators believed that the aircraft had first headed west back across the Malay Peninsula and then continued on a Northern or Southern track for approximately seven hours. Subsequently, the search was expanded to include an area north of China, south of Indonesia and west of Australia. By 18 March 2014, 26 countries were participating in the search [20].

The aircraft of flight MH370 was the 404<sup>th</sup> Boeing 777 produced and was delivered to MAS on 13 May 2002 and flown for the first time the next day. The plane was powered by two Rolls-Royce Trent 892 engines and configured to carry 282 passengers, 35 in business class and 247 in economy [21]. The aircraft was never involved in any major incidents, although a minor incident took place while taxiing at Shanghai Pudong International Airport in August 2012, resulting in a broken wing tip [22]. Its latest maintenance 'A' check was carried out on 23 February 2014 [23].

The flight captain was Zaharie Ahmad Shah, a 53-year-old originally from Penang. He joined MAS in 1981, had 18,365 hours of flying hours and was an expert examiner qualified to conduct simulator tests for pilots [24]. The first officer was Fariq Abdul Hamid, an employee of MAS since 2007, with 2,763 flying hours. He was assigned to the Boeing 777 after having completed his simulator training [25].

The police started to search the homes of the pilot and the co-pilot trying to find signs of any possible involvement. However, no evidence had been found according to a statement made by Capt. Isaac Yeffet. Yeffet was the former security chief for El Al, the head of global security for Israel's national carrier in the 1980s and an aviation security consultant in New Jersey. He stated that investigators should focus on the two fake-passport carrying passengers on the doomed flight and not waste time talking about a the 53-year-old captain who had been working with Malaysian Airlines for more than 30 years. Yeffet further commented that becoming a terrorist or committing suicide is a matter of unbelievable madness [26].

A scientist reported that, prior to the aircraft's disappearance, the engine manufacturing company, Rolls-Royce's, asserted that they had received an aircraft health report every thirty minutes for five hours. This implied that the aircraft had remained aloft for four hours before its transponder went offline [27]. Using a type of analysis never used before in an investigation of this sort, Inmarsat and the AAIB stated that the MH370 flew along the southern corridor and its last position was in the middle of the Indian Ocean, west of Perth. This is a remote location, far from any possible landing sites. It was, therefore, concluded with deep sadness and regret that flight MH370 ended in the Southern Indian Ocean [28]. During the investigation, the Chinese government demanded all relevant information and evidence about satellite data analysis and blamed the Malaysian government for not finishing all the work, including the search and rescue [16]. Meanwhile, the Malaysian government shifted the blame to Inmarsat and the Air Accidents Investigation Branch (AAIB), declaring that these were the sole sources of information that led to the conclusion [29].

If the official assumption of no survivors holds, flight MH370 would be the deadliest aviation incident in the Indian Ocean. It is the deadliest in the history of Malaysian Airlines, surpassing the 1977 hijacking and Malaysian Airlines System Flight 653 crash that killed all 100 passengers and crew. It would also be the deadliest involving a Boeing 777 [30].

The investigations included experts from Boeing, in accordance with the International Civil Aviation Organization (ICAO) protocols. In addition, the United States National Transportation Safety Board (NTSB) [31] and the Federal Aviation Administration (FAA) started to cooperate and coordinated with each other to avoid any risk which could hamper the work [32]. The United States Federal Bureau of Investigation (FBI) deployed technical

experts and agents to investigate the disappearance. They were supported by investigators from Interpol and other related international law enforcement authorities [33]. A joint committee reviewed every passenger named in the manifest, in addition to the two passengers who were confirmed as possessing stolen passports.

China, on the other hand, activated the International Charter on Space and Major Disasters to provide a unified system of space data acquisition and delivery to those affected by natural and man-made disasters [34]. The Chinese Government announced that after reviewing all of the Chinese citizens on the aircraft, no one was suspected of being a potential hijacker [35].

On the manifest, two men identified as an Australian and an Italian had reported that their passports were stolen in 2012 and 2013, respectively. It was confirmed by Interpol that the passports were indeed classified as lost and stolen [36] and that no check had been made against its database [37]. Malaysian immigration officials were blamed for failing to stop the passengers travelling with the stolen European passports. Two men purchased two one way tickets using the stolen passports through China Southern Airlines after ordering the cheapest tickets to Europe using a telephone in Bangkok, Thailand [38]. The tickets were paid for in cash by the two passengers. The men were later identified, one aged 19 and the other 29. They had entered Malaysia on 28 February 2014 using their valid passports.

This matter raises the importance of biometric technologies, which could have been used at the airport to correctly identify passengers [39].

Figure 1 shows the photos of the two passengers that boarded flight MH370 with stolen passports.

**Biometric Technologies:** Four different biometric technologies are described in this section. A summary of the pros and cons of these techniques is presented in Table 1.



Fig. 1: Passengers with stolen passports.

Table 1: Pros and Cons of different biometric technologies

Biometric	Pros	Cons
Face Recognition	<ul style="list-style-type: none"> <li>● Can be used covertly</li> <li>● Easy to use</li> <li>● Dual purpose: can be used as a security camera</li> </ul>	<ul style="list-style-type: none"> <li>● Environmental conditions can greatly affect matching</li> <li>● Personal features can result in high failure rates</li> </ul>
Finger Print	<ul style="list-style-type: none"> <li>● Easy, fast, reliable and well known</li> <li>● One-to-many matching</li> <li>● Long life span</li> <li>● Suitable for many environments</li> </ul>	<ul style="list-style-type: none"> <li>● Degradation of fingerprint: elderly, manual labor, drying of hand, cut</li> <li>● Requires physical interaction</li> <li>● Not suitable for all environments</li> </ul>
Hand Geometry	<ul style="list-style-type: none"> <li>● Minimal privacy concerns</li> <li>● Fast and reliable</li> <li>● Hard to produce</li> </ul>	<ul style="list-style-type: none"> <li>● Not static</li> <li>● Awkward and obtrusive</li> <li>● One-to-one matching</li> </ul>
Iris	<ul style="list-style-type: none"> <li>● Easy, fast and reliable</li> <li>● One-to-many matching</li> <li>● Multi-purpose</li> <li>● Longest life span</li> </ul>	<ul style="list-style-type: none"> <li>● Environment attributes may cause the camera to not acquire the image</li> </ul>

**Facial Recognition:** Facial Recognition is accomplished using cameras to capture a person’s image and compare it with a stored template. Templates are data used to represent the measurements and compare subsequent images [40]. These template systems include the top of the lip, the bottom of the nose and the distance between the eyes. This method has been used commercially since the 1990’s but gained more attention after the 11 September 2001 terrorist attacks [41].

**Fingerprint Recognition:** The fingerprint is the most commonly known biometric [42]. Fingerprint recognition first became popular because fingerprints are unique, static and easy to check. The propagation of fingerprint recognition helped in solving and providing evidence for criminal cases around the world. The Biometric Institute [43] defined it as “the use of the ridges and valleys found on the surface tips of a human finger to identify an individual”. By placing a finger on a scanning device that acquires an image of the fingerprint, it is then stored for future use.

**Hand and Two-Finger Geometry:** Hand and two-finger geometry is used primarily to verify utilizing measurements such as three dimensional size, shape and angles in conjunction with a pin number for a one-to-one match. This geometry is unique in that the person presents his number or data card while squeezing the pins. Since 1995, Disney World theme park in the United States has been utilizing this solution [44] in order to increase the security of annual membership passes for individuals over the age of 10 [45]. Clearly, there is need for durable, reliable and quick solutions like finger geometry systems. [46] claimed that since the implementation, Disney has had over 20 million transactions.

**Iris Recognition:** The National Center for State Courts theorized in the 1930’s that iris patterns were unique and suggested that they can be used for recognition. After capturing an image of the iris, a hundred points of the iris are compared with a database for identification. The system is very easy to use: it involves looking into a camera for a few seconds while the system captures the iris. The iris recognition system does not require any additional identification cards. The system is reliable and fast enough to do one-to-many matches with a high probability; it can even detect coloured contacts, eye surgery and can monitor pupil movement to enhance security.

## DISCUSSION

Theories of disaster management assume that events move through several stages until they reach the final disaster. [47] found seven stages, while [48] identified four. These stages can be summarized into three broad categories of pre-disaster, disaster and post-disaster. At the pre-disaster stage, the aviation industry can implement preventive measures to ensure maximum safety and security and these should become standard operating procedure.

Biometric technologies can increase emergency preparedness and security, while reducing the probability of terrorists using false names and stolen passports to board planes. Passengers have to be near the airport gates approximately one to two hours before domestic departures and two to three hours before international departures. This is ample time to check all passengers using biometric technologies. Airports may use face recognition, fingerprints and iris recognition to identify the passport holders who want to travel. This gives more accurate and reliable matches.

Governments should use these biometric technologies when issuing passports and uploading them onto the Interpol network. All organizations related to aviation companies and airports should be interconnected. Biometric technology may be part and parcel of future security for these organizations. Furthermore, utilization of biometric technologies may exceed the expert's imagination.

Considering all scenarios, aviations and airports did not follow international law to install biometric technologies to reduce the chance for passengers to travel with stolen or fake passports. Nor did they mitigate the effect of any possible terrorist activities. Cameras could be used at the entrance of airports to capture the facial images of the passengers and these could be sent to databases to verify their profiles. At check-in, passengers could present their passports and place their fingers on a scanner that captures fingerprints. At the same time, a camera could capture their iris patterns and facial characteristics. Finally, when entering the plane, another camera could capture their iris patterns and a hand scanner could capture their fingerprints. This can be used to ensure that the passengers are carrying the correct passports, with the appropriate documents that allow them to fly.

These procedures may sound like science fiction, but the application of biometrics in the aviation industry is indeed viable. Biometric technology will enhance security and increase efficiency. Using biometric technologies may enable the local and federal agencies to combat crime and terrorism with watch lists [49]. For example, governments and Interpol may distribute terrorist biometric details to all airports and aviation companies. Passengers would be 'red-flagged' if they attempt to travel using fake or stolen passports.

## **CONCLUSION**

Airline emergencies and safety procedures have become a highly topical issue in recent years. Biometric technologies have gained high acceptance and consideration with the growth of security threats. Several types of biometrics are now available in the market and many could be used in the airline and aviation industry.

Disastrous events have affected this industry. The Malaysian Airlines flight with 239 passengers and crew that suddenly vanished from radar screens received considerable media attention. Even though the pilot was well-qualified and the aircraft was a well maintained

Boeing 777, the cause of the disappearance is still unknown. This case resulted in discussions recommending biometric technology be used in the airports to identify real passengers using legitimate passports.

There are man-made disasters known as socio-technical disasters and can occur in four types: technical disasters, transport failure, stadia failure and productivity failure [50]. Aviatiions also face a constant threat of travel accidents involving aircraft, generally with regard to the nature of the operating systems. Airline crashes or accidents are mainly due to technical or human failure, or a combination of the two. Since 11 September 2001, aviatiions have not used biometric technology when dealing with scheduled flights. Some can argue that it is infeasible to use when booking the flight and buying the ticket; however, it could certainly be used in airports, especially at departure gates.

In the pre-disaster stage, the airlines can implement preventive measures to ensure maximum safety and security. This should be the ongoing standard practice for civil aviation. Using biometric technologies could increase emergency preparedness and security, thereby reducing the chance of terrorists using false names and stolen passports to board planes and pursue their terrorist activities. Governments should use biometric technologies when issuing passports and uploading it on the Interpol network and eventually connect it with all related organizations, aviation companies and airports.

Airlines must plan for emergencies and install necessary technologies to secure passengers and crew. Biometric technology should be the future security of aviation companies and airports. Biometric technologies and its usage may exceed the expert's imagination. There should not be a single flight where security does not check every single name and simple procedures can be taken to reduce error. Media plays a crucial role in the communication process since media distributes information about the event. However, airlines involved in the disaster should convey a positive image through the media, to subdue doubt and tension. All things considered, airports should follow the international law to install biometric technologies to reduce the chance for passengers to travel with stolen or fake passports and mitigate the effect of any possible terrorist activities.

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