Professional Doctorate - Policing, Security and Community Safety
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A review of hijack events by airline employees; with a particular reference to Pilot Suicide Using an Aircraft (PSUA) - An analysis of the triggering factors and current mitigation.

Submitted as part of the requirements for a Prof. Doc. in Policing, Security and Community Safety at London Metropolitan University

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Abstract

When Andreas Lubitz crashed German wings flight 9525 killing all on board, the event refocused public attention on Pilot Suicide Using Aircraft accidents or (PSUA), the term used throughout this thesis.

The Lubitz event led to the introduction of procedures that called for an in-flight minimum of two crew members in the cockpit and pilots psychometric testing. However, the new measures were not flawless. A terrorist posing as a cabin crew could easily access the cockpit, and the still debated effectiveness of psychometric screening.

To prevent another PSUA; the research reviewed relevant events that lead into a potential or actual PSUA and the triggering factors behind it. The research also examines existing measures and related literature covering suicide, psychology, terrorism, aviation security and international organisations views. The available information was widely scattered and heavily cluttered. Hence, it was decided to compile an academically accredited and professionally filtered reference that lists relevant events, establish PSUA triggering factors, identify an effective mitigation and immediately bridge the current measures identified gaps.

The research findings, short and long term recommendations are backed up by the author's 30 years of aviation experience and are validated by recognised aviation experts. To address PSUA risk; the research suggests to temporarily maintain the "two in the flight deck" procedure, subject to reducing cabin crew risk by limiting in-flight cockpit access to the two senior cabin crews and immediately implementing the research gap bridging recommendations in term of crew specific procedures and training.

PSUA long term solution is achieved by addressing the personal factor, that could reduce the risk by 50% through the combination of the following measures; enhanced crew security background checks, enhanced psychometric screening by an aviation experienced company psychiatrist, awareness campaigns and effective crew support programs, along with job security campaigns, real just culture implementation and suicidal behaviour recognition training.

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http://www.upgradetravelbetter.com/feeling-safe-armed-pilot-discharges-pistol-in-cockpit

Glossary

ALPA	Air Lines Pilots Association (USA)
AME	Aero Medical Examiner
ASP	Airline Security Program
CEO	Chief Executive Officer (Airline accountable-manager)
CIA	Central Intelligence Agency (USA)
COO	Chief Operations Officer
CRM	Crew Resources Management
CS	Cabin Senior (Onboard Cabin Crew Manager on narrow body and Deputy Manager on Wide Body Aircraft occupying the Left Forward Door Seat)
CSD	Cabin Services Director (Onboard Cabin Crew Manager occupying the Left Forward Door Seat)
CVR	Cockpit Voice Recorder
DoD	Department of Defence (USA)
EASA	European Aviation Safety Agency (EU)
EU	European Union
EU-OPS 1	European Aviation Regulations for Aircraft Operations
FAA	Federal Aviation Administration (USA)
FBI	Federal Bureau of Investigations (USA)
FD	Flight Deck
FRAeS	Fellow of the Royal Aeronautical Society (UK)
GI	Ground Instructor
GW	German wings (Airline)
IAT	Initial Assessment Team (High-profile airline risk assessment team)
IATA	International Airlines Transport Association
ICAO	International Civil Aviation Organization
ISARP	International Standards and Recommended Practices
ISIS	Islamic State in Iraq and Syria (also known as Islamic State in Iraq and Levant, ISIL or DAISH[1])
LBA	German Civil Aviation Authority

[1] *https://www.trackingterrorism.org/group/islamic-state-iraq-islamic-state-iraq-and-sham-isis*

LI	Line Instructor
LMU	London Metropolitan University
MAS	Malaysian Airlines System
MSc	Master of Science
NASA	National Aeronautics and Space Administration (USA)
NCASP	National Civil Aviation Security Programs
NOP	Normal Operating Procedures
NTSB	National Transportation Safety Board (USA)
PAT	Psychometric Assessment Test
PILPAT	Pilot Psychometric Assessment Test (Student Pilots Stage)
ProfD	Professional Doctorate
PSA	Pilots Safety Assessment (Psychometric Test)
PSUA	Pilot Suicide Using an Aircraft
R&D	Research and Development
SFE	Synthetic (Simulator) Flight Examiner
SFI	Synthetic (Simulator) Flight Instructor
SIA	Singapore Airlines Limited
[sic] [2]	'*sic eras scriptum*' meaning 'thus it was written'.
SME	Subject Matter Expert
SOP	Standard Operating Procedures
TRE	Type Rating Examiner
TRI	Type Rating Instructor
UAE	United Arab Emirates
UK	United Kingdom
US	United States of America
USD of T	United States Department of Transportation
VPFO	Vice President Flight Operations
V/S	Vertical Speed (vertical rate of climb or descent in feet per minute)
WHO	World Health Organisation

[2] *https://proofreadmyessay.co.uk/resources/academic-blog/the-word-sic/.*

1.0 Introduction

> *"Most babies cry when they receive their first set of vaccines. Mothers know that they must go through this to ensure a healthy future. Like a vaccine, the development and execution of a good security policy will help prevent danger and intrusion later. Being one step ahead of the virus is half the battle; it's the development and implementation that will essentially win the war".* (Ecumarine, 2009, p. 1)

The opening statement is very much in line with the current global security situation. It is also explicitly applicable to aviation security, which is known to consistently employ a pro-active approach to risk management, similar to that of the medical field.

In aviation, procedures are designed to anticipate emerging threats and formulate efficient measures to place the industry (at least) a step ahead of the perpetrators. That could eventually mean winning half the battle; it is the continuous development of procedures, measures and correct implementation that are required to win the war on terrorism. Moreover, targeting the elimination of emerging threats to neutralise relevant risks is also similar to a vaccine's objective of eliminating viruses to prevent illness. Nevertheless, the statement carries a small difference, as well.

Contrary to aviation, in the medical field, there are no cosmetic vaccines. Doctors will not prescribe a new medicine to 'tick a box', or as an immediate reaction to a newly discovered epidemic. Conversely, doctors will first research the new vaccine effects, side effects and efficiency in fighting the disease. Doctors would also run several real-time trials on lab animals, as well as volunteering humans; mainly, to collect data and feedback from the end-users. Of course, an essential part of the process is calculating the cost involved to produce the vaccine in reasonable quantities to meet public demand.

In the aviation security world, the process is very similar. However, ticking a box to comply with a particular rule or a regulatory requirement is not an alien to the industry as aviation has seen an uptrend in this practice over the recent decade. The cosmetic processes did affect procedures efficiency, as witnessed by the unnecessarily complicated procedures and the growing size of procedures manuals as compliance became the focal point of airlines.

The cosmetic compliance 'trend' was driven by airlines desire and competition for an endorsement by prestigious international organisations and major regulatory bodies.

Examples of the top accolades include passing IATA's Operational Safety Audit (without findings), becoming an EASA compliant airline or wining the prestigious 'Airline of the Year' award. Similar endorsements, in addition to their professional value, are viewed as excellent marketing tools. The glowing titles could reassure passengers that are concerned about airline security. (Due to global unrest, riots and terror attacks news, which are spread by satellite TV channels and social media the second it happens), mainly when the event coverage includes fatalities and victims images.

This research investigates hijack/suicide by airline employees with particular reference to Pilot Suicide Using an Aircraft (PSUA[1]) in airline working environment. It also aims to identify crew suicidal behaviours, factors that trigger crew hijack/suicide and possible mitigation.

In that context, the objective of this research is to produce simple, practical and cost-effective recommendations to bridge any gaps in the researched procedure. The procedure designed to address the 'insider threat' and the possibility of crew hijack or suicide using an aircraft risk.

Other research objectives include the following;

- Academically research and document airline employees hijack/suicide events in chronological order while filtering each event's collected data (both academically and professionally), to present an accredited, factual and unbiased reference of the events.
- Identify pilot suicide triggering factors through the study, analysis and unbiased interpretation of each event.
- Suggest simple, practical and cost-effective mitigation for the identified triggering factors.

The research also aims to validate the identified factors by comparing the data collected from 12 interviews, including the two partial and nine completely anonymous participants (Subject matter experts, managers and pilots). Some of the interviewees worked for an airline, which had a hijack/suicide event or knew/met the pilot of a known event. Also, a pilot's survey was completed by 514 pilots, who used the security procedure designed to protect against PSUA for more than two years (at the time of preparing this research). The analysis of the survey data and the collected comments were also used in gap identification and measures development.

The questionnaire sent to the pilots included 15 questions with the first question being designed to establish the participating crew data including rank, gender, ethnic origin and religion. The second to fifth questions were intended to scrutinise the security procedures example. In contrast, the sixth to eighth questions checked the crew perception of psychometric screening tools used by airlines to screen pilots for mental disorders. The ninth and tenth questions were used to identify factors that could trigger pilot hijack/suicide. Additionally, questions 11 to 13 were designed to explore hijack/suicide risk mitigation and possible working environment improvements that could reduce the overall risk.

The effects of culture and religion on the interpretation and application of procedures, especially in a multicultural working environment, similar to the case study and other big airlines, are investigated through the analysis of questions 14 and 15. The two questions are specifically designed and included in the pilot's survey for this purpose.

[1] PSUA is the acronym used throughout the research to describe 'Pilot Suicide Using an Aircraft', as an aircraft is not willingly assisting a pilot to commit suicide; it is actually used by a pilot to commit suicide.

The outcome of this research is expected to identify the 'other than psychological' root causes which could trigger suicidal behaviours and possibly turn it into homicide actions in pilots. It will also suggest some pro-active measures to mitigate the identified root causes (factors), to prevent the recurrence of pilot suicide using aircraft events.

The research is structured over six chapters and found below is a brief synopsis of each chapter.

Chapter 1 opening statement reflects the risk management similarities between aviation and the medical field, and the possibility of copying efficient concepts from other paradigms and learning from the successful models. The introduction chapter reviews some current airline security measures that are designed to address the insider threat and relevant pilot hijack/suicide risk. Measures reviewed included ALPA's[2] suggestion to arm pilots with firearms, as cited in Amos (2018). Air Marshals, which is criticised by Leff (2019) and possible security applications of remote control technology to civil airliners (Helton, 2014). Mainly, as aircraft manufacturers such as Boeing, are already working on a similar remote control project (Reid, 2019).

The chapter details the research objectives, layout and includes a brief synopsis of each chapter. After discussing some of the reasons behind targeting the aviation sector by terrorism, the chapter also contains a short description of the historical development of measures and procedures designed to counteract terrorist plans and activities. Reviewed as well are some highlights of the researched security events that dominated the media and affected public opinion, deriving some past and present policy changes in aviation security.

Human factors effects on procedures application is also discussed as a contributing factor in flight LAM 470, based on the findings of the accident investigation report (Kaboyakgosi, 2003, p. 45).

Chapter 2 Literature review lists the reviewed qualitative data sources highlighting the academic debate regarding the insider threat and motives behind suicidal behaviours and homicide, in addition to the factors believed to trigger such behaviours. Included in chapter 2 as well, is a preview of the issues discussed and the relevant author's hypothesis and opinions.

In doing so, the chapter reviews the most recent security events such as the loss of MH370 (BBC, 2014), MH17 (MAS, 2014 b), German wings 9525 (BEA, 2015, pp. 1-29) and the impact of these accidents on the aviation industry. The chapter briefly reviews China Airlines flight 334 (OMICS, 2012) as an example of pilot hijack events and FedEx flight engineer attempted suicide (FSF, 1994 b). The financially motivated Silk Air pilot suicide (BBC, 2000), Air Botswana medically grounded pilot suicide (BBC, 1999) and Egypt Air 990 pilot suicide driven by multiple factors (NTSB, 2002, p. 65) are also covered. The review highlights each event's relevance to the research subject.

[2] *Air Lines Pilots Association*

In the same context, 9/11 is briefly covered while discussing the historical development of terrorism and the targeting of aviation by terrorists.

Covered in this chapter as well, is the relevance of some global visions to the research subject such as Apple's co-founder, Steve Jobs comments about design simplicity (Love, 2011) and the national research and development plan for aviation safety, security, efficiency and environmental compatibility (USDofT, 1999, pp. 8-14). Additionally, the chapter visits some useful qualitative data covering suicide contributing factors, as cited in Skerrett (2012)**.**

Chapter 3 explains the author's position as a researcher, including background experience as an aviation entrepreneur and the effect of this experience on thesis production. The chapter lists the methods and techniques used and explain the reference for rules and procedures employed. As cited in London Metropolitan University**,** School of Applied Social Sciences and Humanities, Doctor of Policing, Security and Community Safety, course handbook (2012).

Also described in chapter 3, are the selected case study airline and the security procedures example, which is designed to address the insider threat. The chapter explains the reasons behind the procedure selection while discussing the process and objectives of the planned personal interviews and pilot's survey questions. The chapter highlights the author's approach to handling the encountered logistic, ethical and sampling strategy issues as highlighted by Malterud (2001, p. 483), Cohen, Manion and Morrison (2007, pp. 121-141). In addition to the methods and techniques used to overcome the issues mentioned such as 'Triangulation'[3] for example.

In chapter three, an example of the media clutter that was encountered while researching hijack/suicide events is reviewed. Such as Nati (2015) who referred to JAL 350, DC 8 aircraft suicide attempt while he used a picture of Sudan Airways B707 that crashed on approach at the White Nile. Additionally, the chapter covers some of the reviewed regulatory literature, which included; ICAO Annex 17 'Security' and the National Civil Aviation Security Program (NCASP). The NCASP is issued by the regulatory body of the case study airline state. Its application to the airline security procedures was also checked. Specifically reviewing the airline operations manual chapter 10 'Security' against the case study airline 'security management manual', and comparing the two references to other operations manuals for consistency, compliance and applicability.

The chapter highlights the reviewed and compared accident investigation reports and databases used to authenticate the collected data. The United States National Transportation Safety Board (NTSB) database and the aviation security international magazine database are examples of the consulted databases.

[3] *"[...] attempt to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint"* (Cohen, Manion, & Morrison, 2007, p. 141)

Reviewed in this chapter as well, is a research relevant perspective of the insider threat by Price and Beckman (2016) and the FAA vision cited in the aviation security research and development document (2014, p. 1). The document explains the agency's commitment to research as a long-term investment and a crucial tool for development, setting an example for the entire aviation industry.

Chapter 4 is the core of the research which provides a review of the historical development of hijack/PSUA. It lists all known airline employees-related hijack/suicide events in chronological order, followed by a brief analysis of each event to identify suicidal behaviours (whenever present) and possible triggering factors of the individual hijacker/suicidal pilot actions.

This chapter also reviews the development of terrorism in more details, explaining why airlines represented an attractive target for terrorists over the years. In this context, the chapter covers the Japanese Kamikaze pilots (BBC, 2014) that pioneered PSUA, a historical hijack and trend statistics (FSF, 2019). The first documented hijack event (GWR, 2015) and the 1950 first synchronised hijack of three military aircraft (CAF, 2011) are also covered. The 1950 synchronised hijack might have inspired Khalid Sheikh Mohammed (BBC, 2012), the assumed mastermind of 9/11 attacks.

Discussed in chapter 4 as well, is aviation's worst disaster 'September 11th attacks'. The event referred to as 9/11 throughout the research, involved a group of terrorists that synchronically hijacked four jetliners. The hijackers used the first three in attacks against the Pentagon and the World Trade Centre twin towers in Manhattan, New York. The attacks claimed thousands of lives and caused massive economic damage. The fourth plane crashed short of achieving its mission, assumed to be attacking the White House or the US Congress.
The geopolitical situation, deteriorating global economy and financial strains on both individuals and criminal organisations are visited as possible catalysts behind the surge in hijack events in the early 1970s. Followed by a brief review of the Hague convention (ICAO, 1971), purposely developed to combat the unlawful seizure of aircraft.

The chapter includes a review of all hijack/suicide by employees events in a Phenomenological[4] approach, with the data sources used to collect the relevant information for authentication purpose listed below under each airline/event to achieve the research authenticity objective. However, some of the following data sources are not listed in the literature review chapter. The relevant data were used to inform the reader about a particular event and were not used to formulate the research findings and recommendations. However, all data sources are referenced in the bibliography.
Pacific Airlines (Pacific, 2011) witnessed the first hijack attempt in the United States of America (Aylworth, 2011). While Pacific Airlines Flight 773 (Time, 1964) hijacker, Gonzales, became the

[4] *"An approach particularly concerned with understanding behaviour from the participants own subjective frame of reference". (Collis and Hussey, 2003, p.52) cited in Dr Ian Stanier Research Methods Presentation, LMU, London, 2013, p.32*

first person to commit murder/suicide using an airliner. The fatal event caused an amendment to civil aviation regulations. (CAB, 1964, pp. 5-8)

Sudan Airways (Sudan, 2016) Flight, Khartoum to Malakal PSUA attempt. (FSF, 2016)

Japan Air Lines (JAL, 2004) was a legacy carrier that drifted into bankruptcy (Time, 2010), experienced one PSUA attempt (FSF, 2017 c) and (Stokes, 1982). It blamed the pilot who had Schizophrenia (Mayo, 2016). The event re-focused public attention on Pilot's mental health issues. (Time, 1982)

China Airlines (CAL, 2014) had several accidents, and the airline managed to recover (Stanley, 2007), Flight 334 is the airline only reported pilot hijack event (OMICS, 2012) and (WHE, 2014 a).

Pacific Southwest Airlines event (Renga & Mentges, 2010, pp. 7-8), (Trinkle, 1995), Flight 1771 became the first PSUA by non-flying employee. (Infogalactic, 2016)**,** (FSF, 2017 b), (Magnuson, 2001), (King & Malnic, 1987), (Cummings, 1987), (Gransden, 2011) and (Kilroy, 2013 a)

Xiamen Airlines (Xiamen, 2015) Flight 8301 (Kilroy, 2013 b)

Federal Express (FedEx, 2017 a), (FedEx, 2017 b) Flight 705 (CVR, 2015)**,** (Bellows, 2012)

RAM Flight 630 (FSF, 1994 a), (AP, 1994 a), (AP, 1994 b), (AP, 1994 c) and (Blair, 2015)

Kish Air Flight 707 is the first hijack by a cabin crewmember (Fouman, 1995). The Hijacker was identified as Rida Garari (WHE, 2014 b), while another report named the 36 years old, as Reza Jabari. Another example of media clutter and data authentication difficulties (Cockburn, 1995)

Silk Air (SilkAir, 2015) Flight 185 PSUA (BBC, 2000), with a detailed profiling of Captain Tsu by Paddock (2001)

Air Botswana (Kaboyakgosi, 2003, p. 5), (FSF, 2012 a) ATR 42 confirmed PSUA accident (IOL, 1999), (BBC, 1999), (James Chilisa and Pienaar, 1999) and (FSF, 1999)

Egypt Air (EgyptAir, 2019) had a previous hijack event, a Boeing 737 (BBC, 1985) to Malta. However, Flight 990 was the airline's first PSUA event (NTSB, 2000, pp. 3-8). Wald (2002) claimed that the motive behind the suicide was revenge.

9/11 Attacks (Kilroy, 2001) the most significant aviation disaster ever, with financial damages estimated to be in the range of 3.3 trillion US dollars (Carter & Cox, 2011)

Mozambique Airlines (LAM, 2015) Flight MT 470 (The Herald, 2013) was the airline's first PSUA event (Namibia, 2016)

Ethiopian Airlines (Ethiopian, 2015) had several accidents and hijack events (FSF, 2017 a). Flight ET 702 is the airline's first hijack by an employee event (Kashyap, 2014)

Malaysian Airlines (MAS, 2015) 1977 B737 hijack was the airline first (Mohsin & Boykoff, 2014), the 1983 A300 (Kilroy, 1983) and 1995 Fokker 50 crashes (Livesey, 2014) were both fatal with no survivors. The airline most recent accidents were MH17 that was shot down by a missile, while the fate of MH370 (MAS, 2014 a) remains unknown.

German wings Flight 9525 preliminary report (BEA, 2015, pp. 1-29) confirmed deliberate pilot suicide. However, the German interior minister said Lubitz *"had no known association with*

terrorist groups" (Reuters/AFP, 2015). Based on Lubitz girlfriend comments (AFP, 2015 a) and his medical records, Lubitz was flying while he was confirmed to be mentally ill. (CBS, 2015)

Chapter 5 opening statement focuses on complacency concerns (Du Bedat, 2014, p. 18), as complacency could turn an effective security measure into a useless procedure. Meanwhile, IFALPA (2015) and the Federal Association of German Air Transport (BDL) opposition to flight deck minimum-occupancy procedure reflect some major insider threat concerns. (Sputnik, 2017)

The chapter starts the data analysis process by looking at the pilot's survey produced data, followed by a review of lessons learned from researching chapter 4 events and the relevant literature review.

Harrison (2004, pp. 83-88), in addition to Azani, Lvovsky and Haberfeld (2016, pp. 1-21) were consulted to establish the motives behind the targeting of civil aviation sector by terrorists, explore further the insider threat and to investigate the economic effect of 9/11 attacks. Kaspersen (2016) views on aviation security vulnerabilities, in addition to her opinions about the way terrorists could exploit the vulnerabilities and her recommendations to mitigate the relevant risks, were inspiring. Her theories helped this research define some possible measures and mitigation strategies.

The research reviewed the available data on employees related hijack events to establish the hijacker's motives (15 out of the reported 1073 airline hijack events) spanning the period between 1942 and 2016 (FSF, 2012 b). The research established and categorised hijacker groups using Hudson (1999, pp. 15-61) and Olson (2014, pp. 1-5) psychological and sociological perspectives. In this context, the research also reviewed Durkheim's sociological and Baumeister's escape theories. Additionally, Leenaars's multi-dimensional model, Joiner's interpersonal and Beck's hopelessness theories, along with Linehan's emotion *'dysregulation' [sic],* and Shneidman's *'Psychache' [sic]* hypothesis, were enlightening and beneficial to the research subject.

Meanwhile, the chapter lightly reviews Kulbarsh (2014) theories that supported the research hypothesis of the psychological factor as a constant in employees related hijack/suicide events.

The chapter also includes the analysis of the collected data, both qualitative (reviewed literature and conducted interviews), and Quantitative (pilot's survey and databases produced statistics). The chapter lists the findings and suggest risk mitigation (both short and long term). The mitigation is designed to bridge the identified gaps in the researched procedure and address the crew related insider threat, hijack and suicide using an aircraft risks.

Applicability of Hudson's (1999, pp. 15-61) profiling theory to airline crewmembers is discussed in this chapter. Otterbacher (2016, p. 3) (operational) terrorist age hypothesis and the relevant statistics that support it (Statista, 2015) / (UN, 2004) are also covered. The case study airline pilots and cabin crew numbers are also listed in the chapter (Ferreira, 2017, p. 3).

The chapter visits the industry's search for alternatives such as suicidal behaviour detection, which proved to be efficient on Jet Blue flight 191 (Avila, Hosford, & NG, 2012). The vigilant Jet Blue first officer intercepted his captain's suspicious behaviours and locked him out of the cockpit until he landed safely. A discussion of suicide awareness programs, such as the 'Applied Suicide Intervention Skills Training (ASIST) on suicide prevention' (JSNA, 2017), presents a borrowed mitigation example that can be copied from the medical paradigm.

The effectiveness of some currently used security tools such as psychometric testing in combating PSUA is challenged as cited in Henley (2015). However, Grey (2017) and Atherton (2016, p. 30) who quoted Feijo, Luiz and Camara (2012) suicide statistics amongst pilots, are raising concerns about the pilot's mental health and current tools efficiency. Additionally, Saad quoted Naushad Anjum, a psychologist and an airline pilot, who said that *"Job loss is a pilot's greatest fear"*, confirming one of the significant pilot's stressors and possible PSUA contributing factors. (2015)

Meanwhile, another reviewed tool is the security background screening that was not capable of guarding against a less complicated situation on its own. The heated argument between a Saudi airlines captain and a male cabin crew, escalated into a physical confrontation, with both crew members sustaining injuries as they engaged in a fistfight. The fighting crewmembers could not cope with the airline work environment extra stress. (Kitching, 2014)

The chapter includes a comparative analysis of PSUA data in general aviation to validate the identified triggering factors of suicidal behaviours in airline pilots. The researched data by Johnson, Lewis, Whinnery and Forster (2006, pp. 1-16) and Lewis, Forster Whinnery and Webster (2014, pp. 1-14) revealed a total of 24 general aviation PSUA events.

On the other hand, Zupp (2015) confirmed the research hypothesis that identifies three main factors behind PSUA and the suicidal pilot's objective of making a statement by their actions. Meanwhile, FOX 8 news highlighted the personal sub-factor (divorce) effect on a pilot's mental state, as evidenced by United Airlines pilot erratic actions (2017). In the same context, Kotil (AFP, 2015 b) and Kulbarsh (2014) voiced the benefits of marriage in reducing exposure to depression and the consequent suicide ideation. While German wings final investigation report (BEA, 2016, p. 103) highlighted the importance of pilot support groups in mitigating mental health issues.

Chapter 5 also visited adherence to procedures as witnessed during a foiled hijack attempt. The Airbus 330 landed safely using the protection provided by the flight deck armoured door[5], on another Malaysian Airlines flight, MH128 (Hanrahan, 2017). Reviewed as well in this regard, is the

[5] The bulletproof door which separates the cockpit of an aircraft from the cabin area where passengers are seated, it is designed to prevent unauthorised access to the flight deck. The door could only be opened from inside the flight deck or from outside through a keypad by entering a special code that is only known to the operating crew.

possible human factors effect on security procedures implementation, that could render it ineffective at times, as evidenced in Egypt Air flight 181 (Hackman, 2016).

Chapter 6 is devoted to the research conclusion. It confirms the research hypothesis regarding the co-existence of the psychological and at least another factor (most commonly personal) in employees related hijack/PSUA situations. Recommendations are listed to bridge the identified gaps in the 'Minimum crew in the flight deck' procedure while proposing phased risk mitigation for the identified PSUA triggering factors. The recommendations also present a pro-active process to eliminate the personal factor and enhance the current psychological factor mitigation.

Bibliography is listed after chapter 6, followed by appendixes which include the research planning document, that describe the timeline and process of preparing the research, suicidal behaviour indicators list, the pilot's survey form and personal interviews questions.

Anti-hijack security procedures development and risk mitigation examples

As an airline pilot for the last 27 years, the author experienced and lived through the transformation of security measures and procedures across the aviation sector, especially, post 9/11 attacks.

September 11th was the event that opened a new chapter in the use of commercial aeroplanes as a weapon of mass destruction. The overwhelming and unprecedented number of causalities became the driving force behind some significant changes in aviation security, including the introduction of armoured flight deck doors and the implementation of tighter flight deck access procedures.
The newly introduced procedures limited the flight deck presence to the operating crewmembers only and provided minimal access to a few other categories, such as FAA inspectors for example, but only under stringent conditions.

Other examples of the security measures used by some airlines after 9/11 includes training cabin crews on the use of martial arts, in addition to other measures, some of which are discussed below.

A large number of pilots working for US airlines were allowed to carry guns in the cockpit after *'Arming Pilots against Terrorism Act'* was approved one year after 9/11. Training a pilot to carry and use a gun would only cost an airline 17 USD, compared to the 3000 USD incurred to carry an air marshal according to ALPA. The pilot's association said, *"The armed pilots are another layer of protection and a cheaper one"*. However, the majority of airlines did not consider this option, as a firearm in the hands of the wrong pilot could represent a higher risk, for example,*"[...] in 2008, a pilot shot a hole in the cockpit while trying to stow his gun"* (Amos, 2018). Additionally, pilots are trained to land an aircraft as soon as a hijack threat is apparent. Crew members are not supposed to engage in a firearms battle and the possible high-risk consequences.

Nonetheless, armed US pilots do exist and have an association called the 'Federal Flight Deck Officers Association'. The members are exclusively identified to the airlines they work for, according to the association's rules. (Amos, 2018)

Instead of arming pilots, some airlines hired air marshals. According to Leff, only a few air marshals previously served in the military or police forces as armed officers; the majority did not. Air marshals typically travel in casual clothing or airline uniform, and they would usually handle the security search of the aircraft and passengers at high-risk airports. In addition, Air marshals handle other security threats that might arise, such as unruly passengers or hijackers. (2019)

Nonetheless, the majority of airlines did not hire air marshals due to the high risks involved in case of an onboard engagement with terrorists. Mainly because some air marshals are allowed to carry a firearm, while their possession of the skills required to handle such a situation cannot be confirmed. Another reason air marshal option was not an airline favourite, is the cost involved versus the results achieved, as the presence of air marshals did not prevent hijack events such as Egypt Air flight 181 which is covered in more details in chapter 5. (Leff, 2019)

Additionally, Leff (2019) heavily criticised US air marshals. He claimed that inadequate training led some of them into leaving their loaded guns in public areas like aircraft and airport toilets. Teenagers found the firearms at times, in other occasions air marshals have erroneously discharged their weapons in hotels and bars. Leff added

> *"No air marshal has ever stopped a terrorist or hijacker since the service was founded in 1962". Although an air marshal did shoot and kill a US citizen in 2005. If something really bad did happen on a flight and an air marshal was onboard they lack the training to do anything about it.* (Leff, 2019)

Most of the airlines started training cabin crewmembers after 9/11 on restraining unruly passengers, including the case study airline. It is remarkable how effective teamwork can be when observing a small group of average-sized females restrain a muscular 6 feet tall male in a few minutes. This option was perceived by some airlines as an acceptable and cost-effective alternative for air marshals.

Remote control technology was also considered as possible crew hijack/PSUA mitigation, as the technology has already existed for some time. It first became known to civilians when a Boeing 720 was used by the *'Controlled Impact Demonstration'* project, sponsored by NASA and the FAA in December 1984. The aircraft was remote-controlled from take off to a controlled crash during landing to test specific fuel-burning parameters. (Helton, 2014)

More aircraft remote-control technology applications are used in the military sector, for example, the Unmanned Air Vehicles (UAV) program, with applications such as surveillance, reconnaissance, bombers, aerial photography and including the aerospace sector.

The technology is starting to see a rapid expansion into the civilian use of drones. Experts continue to explore this option to remove the human risk element from the security equation. Nonetheless, the lengthy process of development, certification and implementation, on current civil aeroplane models was not favoured as an immediate solution. Also, the travelling public is not ready yet to board an aeroplane without pilots. Moreover, the possibility of cyber-attacks on the remote control or navigation systems, both airborne and ground-based, cannot be ruled out completely. Therefore, the risk involved rendered the proposed measure ineffective for the time being.

However, ground-based control and remote-controlled aircraft option remains a strong competitor for future aircraft design and implementation in commercial air transport. It could become a reality soon and help eliminate PSUA risk, with news starting to surface about aircraft manufacturers like Boeing working on similar projects (Reid, 2019).

Post 9/11 rules and procedures also witnessed a significant revamp. Governments introduced national regulations and procedures governing access control and mandatory security search checklists for flight decks, cabin and cargo compartments. The newly proposed rules made it compulsory to complete the lengthy and detailed checklists before each flight.

Apart from creating psychological barriers and being effective deterring techniques (based on the sharp decline in the number of terrorist attacks using an aircraft since 9/11 and the introduction of measures such as the armoured flight deck doors), the security measures also reassured the concerned passengers. However, most of the new procedures also included a certain level of nuisance to the crew, staff and passengers.

Passengers are required to queue for hours (at times) to pass through security screening channels before boarding their flights. Some trips are even shorter in duration than the time required to pass through security screening channels at some airports.
Another critical element and a bi-product of the new procedures was the cost involved; the accrued cost reflected as a noticeable surcharge on the ticket price. Nonetheless, and despite the ticket price and nuisance levels being essential factors in the highly competitive aviation industry, unsurprisingly, the travelling public accepted both in exchange for safe and secure air travel. This fact is confirmed by the steady growth in global passenger's traffic.

The procedures and measures currently in place are capable of preventing most of the known risks. However, it is complacency and non-adherence by humans that are responsible for implementation errors which creates vulnerabilities and renders a procedure ineffective. A relevant example of this argument is the failure of LAM 470 crew to adhere to the 'Minimum crew in the flight deck' policy that was in force at the time. The non-adherence was considered a primary contributing factor by the accident investigation report of the confirmed pilot suicide event. (Kaboyakgosi, 2003, p. 45).

2.0 Literature review

Safety and Security are the two sides of the same coin as one could not exist without the other. Mainly when aiming for improved efficiency, reliability and setting higher operating standards for the aviation industry; therefore, a review of selected visionary concepts from either paradigm would benefit the other.

The US Transportation Security Administration (TSA) adopted a new concept after 9/11 based on the fact that most of the travelling public does not represent a threat. Consequently, the agency started expediting the physical security screening process using a risk-based and an intelligence-driven security model at the more than 450 airports across the country, which facilitated a smoother flow of almost 2 million passengers a day without significant issues to date. The TSA concept influenced the author's thought patterns while preparing this research in terms of simplifying security procedures to enhance efficiency and reduce the nuisance level for passengers. (2014)

Applying TSA vision to airline employees (pilots and cabin crews in particular for this research), the TSA vision matched the research hypothesis that vast majority of airline employees pose little or no threat when it comes to PSUA risk. The TSA model also confirms that adopting risk-based, intelligence-driven methods could help airlines move closer to efficient procedures design.

Airlines could measure the efficiency of a newly introduced procedure in terms of practicality and cost-effectiveness, given that variables such as local threats, culture and available resources are considered, this could be achieved by using data from subject-specific academic-research and experienced entrepreneurs for data analysis, gaps identification and to suggest suitable mitigation.

On December 17, 1903, the first powered flight by the Wright brothers lasted 12 seconds at 20 feet at Kitty Hawk, North Carolina. (History, 2003)

> *"How did two men, working essentially alone and with little formal scientific training, solve a problem so complex and demanding as heavier-than-air flight, which had defied better-known experimenters for centuries?*
>
> *Certainly the brothers were talented, but the true answer also lies in their background and early experiences".* (Smithsonian, 2017)

Therefore, practitioner-researchers are the way forward for the development of all industries, including aviation. This claim is not an assumption. It is an evidence-based fact. According to Wilbur Wright own words he said: *"It is possible to fly without motors, but not without knowledge and skill"*. (NPS, 2017)

Knowledge and skills are the two vital tools for development and efficiency. Tools that is only available to professionals with many years of hands-on experience in a particular field, people that are referred to as Subject Matter Experts (SME). Aviation security is not an exception.

The Middle Eastern legacy carriers along with several other airlines in the world introduced (almost simultaneously) the minimum flight deck occupancy procedure which is under scrutiny by this research. The objective of the procedure was to mitigate the in-flight risk of having an unaccompanied pilot in the flight deck and the relevant possibility of pilot hijack/suicide using an aircraft. The newly introduced procedure required the presence of one cabin crewmember in the flight deck until the other pilot return. The rule was initially introduced by airlines in the US and shortly followed by some European and other international airlines. (Nelson, 2015)

The introduction of this procedure by the case study airline was a consequent reaction to the unexplained vanishing of Malaysian airlines flight MH370 and the ensuing assumptions that the B777 disappearance was deliberate pilot suicide. Moreover, following German wings accident, the procedure was widely implemented by more airlines to immediately tackle the pilot suicide possibility and reassure the deeply concerned passengers.

Under the circumstances (falling passenger numbers and the subsequent financial losses), writing the procedure, risk assessing and approving it, did not require a long time. Nonetheless, and shortly after the procedure's implementation, several managers who are responsible for handling the line-flying reports, which reflected the end-users (pilots and cabin crews) feedback regarding the procedure implementation, were among the first to realise that the new policy had some gaps.

A pro-active procedure design should have called for independent and collaborative risk assessments in parallel by all departments involved, not only, flight operations, safety and security departments. The drill should have included technical services (subject matter experts of the flight deck door operation), human factors and cabin services department, as all are directly involved, and the revised procedure would affect their daily work routine.

According to the 'safety management international collaboration group (SMICG)'[6] paper on 'Risk-based decision-making principles', which describe hazard identification methods and tools, a more detailed discussion of a proposed procedure, in a tabletop (brainstorming) environment by all stakeholders, could benefit the production of an effective policy. This argument is evidenced by the growing opposition to the rushed introduction of the 'Minimum crew in the flight deck' policy. The

[6]*The purpose of the SM ICG is to promote a common understanding of Safety Management System (SMS)/State Safety Program (SSP) principles and requirements, facilitating their application across the international aviation community.*
The current core membership of the SM ICG includes the Aviation Safety and Security Agency (AESA) of Spain, the National Civil Aviation Agency (ANAC) of Brazil, the Civil Aviation Authority of the Netherlands (CAA NL), the Civil Aviation Authority of New Zealand, the Civil Aviation Safety Authority (CASA) of Australia, the Direction Générale de l'Aviation Civile (DGAC) in France, the European Aviation Safety Agency (EASA), the Federal Office of Civil Aviation (FOCA) of Switzerland, Japan Civil Aviation Bureau (JCAB), the United States Federal Aviation Administration (FAA) Aviation Safety Organization, Transport Canada Civil Aviation (TCCA) and the Civil Aviation Authority of United Kingdom (UK CAA). Additionally, the International Civil Aviation Organization (ICAO) is an observer to this group. (2013, p. i)

opposition is voiced by respected organisations such as IFALPA and the Federal Association of German Air Transport. An opposition that is also validated by the procedure end-users feedback as explained later in Chapter 5, Analysis and findings. (2013, p. 12)

When it comes to policies that could affect both safety and security and to close the loop while producing an efficient and pro-active procedure, it is vital to conduct and audit a real-time, hands-on trial or a test run of a new procedure, as collecting and analysing end-users feedback is considered paramount to the procedure development and success. The outcome of this process should then go to all stakeholders for comments before deciding to implement, revise or sometimes totally withdraw the suggested procedure.

For those who would argue that 'desperate times call for desperate measures' and that specific decisions cannot afford the luxury of time required to conduct a (picture perfect) pro-active risk assessment, the counter-argument would suggest that catering for such a scenario is achieved by adopting a top management Initial Assessment Team (IAT). Such a team is a known feature of most modern airlines emergency response plans, which may be titled differently depending on the individual airline.

The IAT is usually made up of the organisation accountable-manager (i.e. CEO), heads of security, safety, commercial and flight operations departments with optional attendance of financial, technical, public relations and subsidiaries managers, depending on the nature of the situation in hand. The exact structure of the IAT is usually explained in the relevant airline documentation, and it could vary according to the airline size, structure and type of operations, for example, the case study airline IAT structure, responsibilities, activation and protocols are explained in details in the airline's Emergency Management Manual[7], chapter 4.
Handling time-critical and urgent situations, the IAT members are jointly making an instant decision based on the best available information, while taking the severity and probability of all possible consequences into account (risk-based approach). The outcome of such a process is deemed effective until an appropriate risk assessment process is completed to validate the IAT decision(s) or amend it accordingly if considered necessary.

Security procedures that are complicated, not practical and inefficient are inviting the end-users to deviate from it. Introducing such procedures involves higher risk because, after some time, it becomes acceptable to deviate from or ignore such procedures. The repetitive deviation could affect the working culture and reflect negatively on other (possibly) more sensitive security procedures. Therefore, dire consequences of non-adherence to procedures could become inevitable, similar to what happened on LAM470 when the crew ignored cockpit occupancy policy.

[7] Based on guidelines from ICAO document 9859 'Safety Management Manual', Appendix 3 to Chapter 5, Emergency Response Planning and IATA Emergency Response Best Practices Handbook

Supporting the significance of simplicity in procedures design, previous practitioner studies made by the author during a master's degree research, in addition to many evidence-based training procedures design workshops, safety presentations prepared and delivered during training sessions, seminars and conferences that focused on safety management system applications to threat and error management in evidence-based training and similar studies by others such as IATA's evidence-based training implementation guide and ICAO's manual of evidence-based training or similarly, the visionary statement by a prominent leader like Steve Jobs who said

> *"Simple can be harder than complex: You have to work hard to get your thinking clean to make it simple. But it's worth it in the end because once you get there, you can move mountains."* (Love, 2011)

All of the above conform to the following guidelines regarding standard/normal operating procedures design, with Standard Operating Procedures (SOP), also referred to as Normal Operating Procedures (NOP), defined below from a flight safety perspective.

SOP/NOP is a set of guidelines and operational practices, actions, call outs and patterns designed by the manufacturer of an aircraft. The operator of an aircraft (i.e. airline) could modify such procedures to optimise task sharing, hence, reducing the workload and increasing the situational awareness and safety margins during the different phases of operating an aircraft.
Careful design of SOP/NOP must take into account several factors, most important of all: 'KEEPING IT SIMPLE AND PRACTICAL'.

The similarity and affiliation between safety and security procedures design is evident in the given definition as the two parallel disciplines share the following pre-requisites to achieve efficiency

- Adherence to procedures, and
- Awareness of the diverse cultures and backgrounds of the procedure end-users and the possible effects of such factors on the working environment.

Non-adherence could render a well-designed procedure useless, while robust and disciplined culture could bridge some unidentified gaps and turn a simple procedure into a highly effective measure. Using this approach previously contributed to the implementation of many flight safety operational and procedural changes, proposed and devised by the author, which reflected positively on the overall safety performance indicators (and eventually on security) of the company. A good example to mention here is a procedural change to the B777 and B787 that was later extended to B747 and all Airbus models, by combining the opening of landing checklist with lowering the landing gear[8] step, the simple but efficient change saved the company millions of dollars in direct fuel costs (cost-effective). At the same time, it reduced the risk exposure due to the lower number

[8] The checklist required to be completed before landing to make sure the aircraft wheels are down and the surfaces that produce more lift and allow lowering the speed for landing, are extended.

of missed approaches (Risk management), and that was achieved by moving one item in the checklist one line up (simple and practical based on practitioner experience).

On the other hand, an excellent example of undisputed efficiency in security measures is the armoured flight deck door which became a standard feature in almost every modern airliner flying around. However, twelve years after 9/11, the same armoured door designed to protect pilots from terrorists worked in favour of hijackers/suicidal pilots, exposing a serious vulnerability as evidenced by the following examples.

Mozambique Airlines Flight LAM 470 accident investigation report revealed that the pilot had intentionally crashed the aeroplane (Ensor, 2013). Three months later, Ethiopian airlines flight ET702 first officer locked his captain out of the flight deck and hijacked the aircraft destined to Rome, Italy and landed in Geneva, Switzerland, where he applied for political asylum (Register, 2014) and recently, German wings flight 9525 crashed into the Alps killing all on board in a confirmed pilot suicide.

The Ethiopian airlines hijack, MH370 disappearance and Mozambique airlines PSUA, were the driving force behind the introduction and expedited implementation of new procedures and revised measures, focusing this time on the armoured flight deck door, perceived to have partially contributed to the vulnerabilities that were exploited by pilots of the mentioned events to execute their plots. However, the sophisticated procedures and strict measures did not prevent German wings first officer from using his aircraft to commit suicide shortly afterwards.

Lubitz success in evading the procedures could probably be (at least partially) attributed to the inadequate identification of the root causes that trigger a pilot's decision to take the lives of innocent colleagues and trusting passengers in the process of committing suicide, instead of quietly taking own life alone, an assumption that prosecutors generically admitted during German wings investigation, saying that despite Lubitz known mental disorder (depression) and suicidal tendency, he was still allowed to fly. (CBS, 2015)

Airlines looked for alternatives and saw in psychometric screening a solution for the pilot's mental health issues and an acceptable measure to reassure the concerned passengers. Nonetheless, before discussing the efficiency of psychometric testing, it is necessary to highlight some academic and professional literature that was reviewed to formulate a better understanding of the problem.

Security procedures and guidelines are stipulated in ICAO annexe 17 'Security', which defines the international aviation security standards and recommended practices. It provides guidance material on areas such as the screening of persons other than passengers, landside security, behaviour detection and unpredictability. It also sets the standards for regulatory bodies of member states that

in turn, use the standards and recommendations to develop their own security plans. Experts consider annexe 17 as an essential aviation security reference book.

Additionally, IATA's security manual 'ninth edition', the individual countries National Civil Aviation Security Programs (NCASP), along with individual airports and aircraft operators security programs (based on annexe 17 standards and guidance material), are all listing systematic and detailed security procedures which are considered efficient in combating most security threats, except for 'PSUA' so far. Again, this is not an assumption, as German wings first officer Lubitz proved this hypothesis to be a fact.

Specific measures to handle an insider job were never appropriately addressed in the literature mentioned above, at least not until after German wings event, and the reasons behind a pilot becoming suicidal or homicidal remains the subject of a never-ending debate.

Shortly after German wings event, IATA recognised the insider threat and highlighted some of the circumstances that could turn a loyal employee into a latent threat. The organisation noted that

> *"Due to changing circumstances in their lives, every person may potentially become vulnerable to being an insider, and if so, their attitudes or behaviours are significantly affected. Such circumstances range from stressful personal crises to deliberate targeting and recruitment by malicious third parties"*. (IATA, 2015, p. 3)

IATA's paper lightly touched the subject and suggested some generic solutions. It did not specify a methodology or a process to establish the suicidal pilot's motives and behavioural indicators. Moreover, the paper also recognised the financial and personal factors (family and work-related pressures) as triggers that could lead to an insider job.

On the other hand, McCoy (2014) had a valid hypothesis regarding the existence of PSUA, which focused on general aviation pilots and was found to apply to airline pilots as well. McCoy said

> *"While incredibly rare for a pilot to kill himself -and everyone else on a plane- there is both national and international precedent for what experts call "aircraft-assisted pilot suicides"*. (McCoy, 2014)

Researched statistics supports McCoy's theory that it is rare for a pilot to kill himself in general and more specifically, to kill everyone else on board in the process. A review of the FAA general aviation (so-called) aircraft assisted pilot suicide reports covering the period from 1993 to 2012, along with the 1993 to 2002 report by Johnson et al. (2006, pp. 1-16) in addition to the 2003 to 2012 report by Lewis et al. (2014, pp. 1-14) revealed a total of 24 PSUA events.

The 24 events represented 0.37% of the 6406 fatal general aviation accidents over the same period. The reports also reflected a 50% drop in PSUA events, for the period from 2003 to 2012 (eight events) versus the 16 events from 1993 to 2002. The NTSB which investigated the events included

in the two FAA reports mentioned above reaffirmed the findings and noted that *"The frequency of these suicides has declined sharply in recent decades, the NTSB said"*. (Zupp, 2015).

Additionally, the FAA noted that

> *"[...] for every 1,000 pilots tested, only eight are denied certification for medical reasons, and only two of those for psychoneurotic disorders"* (Time, 1982)

On other occasions the FAA continued to downgrade the significance of pilot's mental disorders, saying that psychological screening of airline pilots is not required. (AP, 2016), the FAA also said

> *"[...] the Federal Aviation Administration has ruled out requiring psychological testing for airline pilots in favour of enhanced mental health support programs"*. (AP, 2016)

Conversely, Atherton (2016, p. 30) quoted Feijo et al. (2012), who claimed that 23.7% common mental disorders was found in a sample of 807 Brazilian pilots, which is very similar to the 1 in 4 general population lifetime mental health risk that is found in the UK for example.

Similarly, cited in Grey (2017), researchers surveyed 1,850 airline pilots who reported anonymously about their mental health and discovered the presence of suicidal ideation and depressive symptoms in pilots, the research revealed the following figures

> *"12.6% of them met the depression threshold, while a further 4.1% reported having suicidal thoughts"*. (Grey, 2017)

The statistics mentioned above prove the existence of the psychological factor and suicidal ideation in some pilots.

Boeing released a report in 2016 indicating the requirement for 617,000 pilots between 2016 and 2035, as more pilots are needed to meet the increasing air travel demand. The report also stated the need for 814,000 cabin crew, almost 32% more than pilots for the same period. (2016)

Similarly, the numbers of the case study airline crewmembers increased, since the beginning of the research writing (April 2017), pilots numbers increased by 7% and cabin crew by 18%[9].

Meanwhile, the geopolitical conflicts in the region also multiplied, and so did the terrorist motives plots and consequent security threats, including the insider threat, making airline crew members a possible target for recruitment by terrorist organisations and increasing flying crew 'insider-threat' risk exposure and mandating immediate action to eliminate or at least reduce the risk.

Applying Feijo et al. (2012) above mentioned percentage of (23.7%) to Boeing's forecasted numbers could translate into approximately 339,147 crew members flying around in the next 16 years (with different levels of mental disorders), including 58,671 (the 4.1% reported above by Grey) crew members who could have suicidal ideation. These mentally ill crew members could gain access to an airline flight deck, increasing the risk of encountering another PSUA, CSUA (Crew Suicide Using an Aircraft) or perhaps ESUA (Employee Suicide Using an Aircraft) event.

[9] *As of September 2018 (17 month period)*

However, when applying the percentages to pilots, as the mentioned researches did not cover cabin crew, the alarming results would still reflect as 146,229 mental disorders and 25,297 suicidal pilots.

However, for most suicidal people (pilots or not), once the decision is made, a suicidal person would usually commit suicide alone and in privacy to prevent others from interfering to stop the suicide attempt. Therefore, this research is mainly concerned about investigating suicidal pilots that become homicidal, and the factors that trigger them to do so.

Listing some of the academics that support the mentally ill hijacker theory, Hudson quoted Ferracuti (1982), who claimed that *"[...] there is "no such thing as an isolated terrorist - that's a mental case."* [...] *Mentally unbalanced individuals have been especially attracted to airplane hijacking"*. In the same context, Hudson also quoted Hubbard (1971), *"...* [Who] *... conducted a psychiatric study of airplane hijackers in 1971 and concluded that skyjacking was used by psychiatrically ill patients as an expression of illness"*. Ferracuti and Hubbard comments suggest that hijackers are mostly mentally ill people. (1999, p. 27)

On the other hand, in his multi-causal approach to terrorism analysis, Hudson repeatedly noted that

> *"Terrorism usually results from multiple causal factors-not only psychological but also economic, political, religious and sociological factors, among others". [...] "Because Terrorism is a multi-causal phenomenon, it would be simplistic and erroneous to explain an act of terrorism by a single cause, such as the psychological need of the terrorist to perpetrate an act of violence".* (Hudson, 1999, p. 15)

To support this theory, Hudson also quoted Margolin (1977:273-4) who said

> *"[...] much terrorist behaviour is a response to the frustration of various political, economic, and personal needs or objectives"*. (Hudson, 1999, p. 19)

Another academic theory that was cited in Hudson and found applicable to many hijacker/PSUA perpetrators in general and Lubitz actions, in particular, was Knutson (1981), in her opinion *"[...] terrorists engage in terrorism as a result of feelings of rage and helplessness over the lack of alternatives"*. Like most of the researched pilots, Lubitz felt helpless about losing his job and saw no other alternatives, he was full of rage, and he even told his girlfriend about it. (1999, p. 20)

Cited in Hudson as well, were Post, Crayton and Pearlstein, who also supported the 'terrorist as a mentally ill person' theory. Their narcissism-aggression hypothesis almost describes what Lubitz and most of the reviewed pilots did, for example, Crayton (1983:37-8) said

> *"If the psychological form of the "idealized parental ego" is not neutralized by reality testing, it can produce a condition of helpless defeatism and narcissistic defeat can lead to reactions of rage and a wish to destroy the source of narcissistic injury".*
> (Hudson, 1999, p. 20)

Therefore, by crashing the A320, Lubitz destroyed what resembled the source of narcissistic injury in his mind, which is the airline that defeated his dream of becoming a long haul airline pilot (by

medically grounding him before and possible ensuing grounding based on his deteriorating health), and that left him feeling helpless about it.

Similarly, speaking about Lubitz and his category of terrorists, Goode said

> *"[...] studies over the last decades have begun to piece together characteristics that many who carry out such violence seem to share, among them a towering narcissism, a strong sense of grievance and a desire for infamy"*. (Goode, 2015)

Goode's views also suggest that a certain level of mental illness or personality disorders must exist in a pilot to carry out a PSUA. Goode also quoted Stone, who studied 228 mass murderers, most of which ended up killing themselves. Stone noted that *"The typical personality attribute in mass murderers is one of paranoid traits plus massive disgruntlement"*. (2015)
Disgruntlement was present in most of the researched crew related hijack/PSUA events.

In her article, Goode (2015) refers to Lankford, who similarly researched mass killers that took their own lives, Lankford found that *"a significant number of cases where they mention a desire for fame, glory or attention as a motive"*. Just another statement that closely describes many PSUA pilot's actions and particularly Lubitz comments to his girlfriend. He told her *"One day I'm going to do something that will change the whole system, and everyone will know my name and remember."* (AFP, 2015 a).

Supporting Hudson, Goode and cited in Olson (2014), is Shneidman (1993, p.51) who claimed that *'Psychache' [sic]* is the main factor behind all suicides, he defines *'Psychache' [sic]* as

> *"[...] hurt, anguish, soreness, and aching psychological pain in the mind". It is "[...] the pain of shame or guilt, or humiliation, or loneliness, or fear, or angst, or dread of growing old"*. (Olson, 2014, p. 2)

However, Goode also reviewed theories by some accredited psychiatrists who worked on mass murder-suicide cases and suggested that mental disorders such as suicidal ideation and depression alone were not enough to trigger the statistically rare murder-suicide, she wrote

> *"People want an easily graspable handle to help understand this, to blame something or scapegoat," said Dr. James L. Knoll, the director of forensic psychiatry at the State University of New York Upstate Medical University. But to zero in on depression is "a low-yield dead end," he said, adding, "There's something fundamentally different here, aside and apart from the depression and that's where we need to look"*. (Goode, 2015)

Knoll inspiring words are closely linked to the objectives of this research as it highlights the importance of researching and identifying the other than psychological factors that could trigger PSUA.

On the other hand, Goode lists the findings of a particularly relevant study by Friedman and Kenedi about 85 aircraft suicide events that occurred since 1965, which highlights the other than psychological and possible PSUA contributing factors

> *"Not all of them had a history of mental illness", Dr Hatters Friedman said of the pilots. "What keeps coming up is family stresses, relationship stress, work stresses, financial stresses". [...] "In several cases, the pilots, all men, seemed to be acting on grievances".* (Goode, 2015)

Additionally, Zupp (2015) quoted the NTSB which specifically said that *"[...] factors involved in aircraft assisted suicides may be depression, social relationships, and financial difficulties, just to name a few problems".* Goode and the NTSB concurred with Friedman's theory naming the same factors identified by IATA, academics such as Hudson, Margolin and this research.

It is essential to stress that this research is security-based academic research of PSUA events and related triggering factors; it is not a psychological research. However, a balanced reading that helped the author explore the subject from a different perspective was Stanton (2004).

Nonetheless, the author disagrees with Stanton's hypothesis that *"[...] criminals choose to commit crimes", [...] "Crime resides within the person and is "caused" by the way he thinks, not by his environment" ...* [and] *... Criminals think differently from "responsible" people",* particularly when applying Stanton hypothesis to chapter 4 researched pilot's profiles. It is evident that most of the pilots involved behaved and were perceived as responsible citizens until shortly before their events. (2004, p. XXI)

Stanton also said that factors such as poverty, divorce, and media violence (Environment) do not cause criminality, this is also disputed when considering the researched pilot's profiles and specific events triggering factors in addition to the relevant scholar's theories discussed earlier in this chapter. (2004, p. XXI)

Moreover, in a review of PSUA events from a medical perspective and even though it was relatively generic, Vuorio, Laukkala, Navathe, Budowle, Eyre and Sajantila (2014, p. 845) opposed Stanton's theory, and they joined other experts in highlighting the other than psychological, suicide contributing factors, Vuorio et al. said

> *"Social, cultural, and occupational aspects, individual psychological factors, and contributory and explanatory factors all contribute to suicides. All these factors should be considered in investigations in suicides in general and aviation-related ones in particular".* (Vuorio, Laukkala, Navathe, Budowle, Eyre, & Sajantila, 2014, p. 845)

An inspiring recommendation to adopt a holistic approach in investigating PSUA, therefore and after carefully considering all of the researched theories, and based on the analysis of actual, probable and potential PSUA events, it is noted that a combination of two or more factors (one of which is usually psychological), could turn a suicidal pilot into a homicidal person, who could kill others in the process of taking own life.

Supporting the 'psychological factor as a constant' hypothesis, Kulbarsh, referred to statistics by the World Health Organization and the American Foundation for Suicide Prevention that said: *"90% of people who commit suicide have one or more diagnosable mental illnesses"*. (2014)

On the other hand, scholars such as Skerrett (2012) explained some of the suicide contributing factors in the general public that mostly match the research-identified factors. The highlighted factors apply to pilots as well as cabin crew members in the same way it applies to the general public. Despite the different circumstances surrounding each suicide event that could be as variable as the differences between the personalities of the people involved, the common thing between suicide events is a strong sense of *"anger, despair, hopelessness, or panic"* that could aggravate suicidal ideation to become actual suicide, Skerrett listed some of the conditions and situations that could trigger suicide, such as

- *an episode of depression, psychosis, or anxiety*
- *a significant loss, such as the death of a partner or the loss of a job*
- *a personal crisis or life stress, especially one that increases a sense of isolation or leads to a loss of self-esteem, such as a breakup or divorce*
- *loss of social support, for example, because of a move or when a close friend relocates*
- *an illness or medication that triggers a change in mood*
- *Exposure to the suicidal behaviors of others, such as friends, peers, or celebrities* (Skerrett, 2012)

Skerrett (2012) said that these conditions and situations are common in most people. However, the pain and hopelessness experienced while going through a similar situation could leave the individual suffering from suicidal ideation without hope and generate the perception that the only alternative to relieve the unbearable pain is to commit suicide, making Skerrett's argument similar to Shneidman's earlier discussed *'Psychache'* hypothesis.

Nonetheless, to identify the triggering factors that lead into PSUA and measure the accuracy of factors mentioned in the reviewed academic literature, the research investigated the employee-related hijack events available data (the information was scattered and heavily cluttered). It also used a survey to produce an end user's (perspective) quantitative data to validate the findings.

Pilots are the end-users of all new security procedures, and their feedback regarding efficiency and practicality is vital to the procedure's success. Pilot's feedback helped shape the outcome of this research and scrutinised the findings and recommendations for validity and applicability.

One last source that confirms the co-existence of the psychological and other identified factors in suicide events, although it is mainly addressing suicide in the military, is Bartone. He lists the psychological factor under what he called formative-causative factors that add up to precipitating (personal) factors, background factors (sex, age and race) and in the presence of

enabling factors such as alcohol, drugs and easy access to drugs, Bartone claims that the combination of these factors could lead into suicide. (2013, pp. 299-306)

The outcome of the reviewed literature collectively confirms PSUA three major triggering factors to be; Political, Psychological and Personal. However, when assessing the current psychological factor mitigation tools, academics such as Bor and Teichmuller supported the 'Minimum crew in the flight deck' procedure and challenged psychometric testing effectiveness in combating PSUA, as cited in Henley. Commenting on German wings accident, Bor said *"We concluded that nothing could have prevented that incident from happening"*, he also confirmed that the best available screening tools are not capable of predicting a pilot's behaviour or stopping a PSUA event. (2015)

In the same context, Teichmuller said

> *"[...] no amount of testing could ever be completely effective."A pilot who intends to do something like this could be skilful enough to pass as a well-structured person, even if they were in danger of suicide", he said. "Even with an examination process, you wouldn't have 100% safety".* (Henley, 2015)

The research compared different opinions regarding the 'Minimum crew in the flight deck' procedure, including IFALPA's (2015) opposition based on the latent risk of a terrorist posing as a cabin crew to gain access to the flight deck, and the insider threat concerns as highlighted in EASA's recommendation. EASA supported the procedure to cater for the possibility of a suicidal pilot becoming homicidal and crashing another aircraft (EU, 2015, p. 1).

Supporting the 'Minimum crew in the flight deck' procedure as well, were the interviewed subject matter experts, as manager (A) from the case study airline and the independent aviation safety expert, who expressed their confidence in the procedure as an insider threat mitigation tool that proved to be robust and efficient based on several years of real-time application.

During the research preparation, the author also reviewed the application of some security visions by major international security players such as the FAA, TSA and the USD of T, including the effects of these visions on the regional and global aviation sector with specific attention to security procedures design. The objective of this review was to learn and explore the possibility of duplicating some of the methods used by these well-resourced organisations.

A good example of these visions is the national research and development plan for aviation safety, security, efficiency and environmental compatibility, which is prepared by the research and special programs administration of the United States Department of Transportation. (1999)

The plan sets up a road map to the development of the four aviation sectors, particularly relevant to the research subject, a review of 'security as a strategic goal' revealed that the US department of

transportation is significantly concerned about implementing the appropriate mitigation to eliminate the risks involved with acts of terrorism and the relevant possible consequences. The department stressed on the historical and recurring targeting of aviation by terrorism, and even though the department applauded the current aviation security status, it highlighted the importance of continuous monitoring, research and development of security measures, the plan noted that

> *"Historically, transportation has been among the most visible and frequent targets of attack. Thanks to concerted efforts over the past two decades, the security posture of commercial aviation has been significantly improved. However, as the nature of the threat evolves the effectiveness of the security program needs continual re-assessment".* (USDofT, 1999, p. 8)

The US Department of transportation, security development plan is built around the following three thrusts that are considered as the pillars of security as a strategic goal and efficient procedures design for both safety and security paradigms that complement each other. Procedures design is like a building, and if one pillar is knocked down, the entire structure would immediately collapse.

The first thrust heading is about the knowledge base, which is both academic and professional as mandated by this research to mitigate PSUA risk successfully. The three security vision thrusts are;

- ***Knowledge Base and Risk Management****:*
  Research that supports comprehensive monitoring of terrorism trends (including intelligence reports and performance of aviation security systems) to enhance understanding of current and emerging threats and countermeasures needs
- ***Incident Prevention****:*
  Development and application of advanced technologies and improved practices and procedures to enhance the ability to prevent security incidents in aviation environments
- ***Mitigation of Consequences:***
  Development and application of advanced technologies and improved practices and procedures that can reduce casualties, increase survivability and minimize system disruption and damage in the infrequent aviation-related incidents that do occur.
  (USDofT, 1999, p. 8)

Although the strategy is generic, it is highlighting the similarity and common objectives of safety and security sectors, as indicated earlier in chapter 1. The plan also stresses the importance of research, reliable resources and organisational cooperation to achieve effective security, and the plan concluded that the transportation system which is a significant component of any country's infrastructure is vulnerable to acts of individuals or organised terrorism that hope to inflect the maximum possible damage or target the destruction of the system. (USDofT, 1999, p. 8)

The plan discussed the elements of effective security including procedures design, recruitment and staff training; measuring and monitoring staff performance, the use of latest available technologies, intelligence use in threat identification and the importance of inter-agencies cooperation and coordination with other government agencies such as the FAA, NASA research and development

programs, US Customs, US Postal Service, Federal Bureau of Investigation, Central Intelligence Agency, the department of defence and other related agencies. (USDofT, 1999, p. 8)

The plan also listed the white house security committee recommendation of the FAA to lead the efforts of mitigating the emerging threats and focus on aviation security research and development. NASA was asked to provide all the necessary technical support and the department of defence to provide the latest military technology and support, to collectively produce effective security solutions. Highlighting the significance of academic/professional research and human performance (factors) effect on security applications, the department of transport plan added

> *"Continuing research is critical to improving effectiveness in all of these areas, and in achievement of necessary technological advances, particularly in detection systems (including human performance in these systems), aircraft hardening, and identification of future technological threats and countermeasures".* (USDofT, 1999, p. 14)

The strategy indicates that it is mandatory to implement continuous re-assessment of the effectiveness of the introduced procedures to help achieve the plan's objective of having efficient security, as the threats are continuously evolving. (USDofT, 1999, p. 8)

A suitable tool to achieve that goal is the effective use of academic research, by analysing the collected data from areas of concern (such as PSUA in this research); to establish the root cause behind such events, which could lead into the proposal of appropriate risk mitigation.

In the same context, a good example of the application of advanced technologies targeting security incidents prevention is to implement the "Total Quality Management" concept (borrowed from the parallel safety paradigm as well) on pilot's recruitment process. By checking an applicant's data against the available global security databases and if an applicant is found to represent a viable threat, an automatic rejection is affected or at least, further screening is initiated to establish the level of risk such an applicant could represent. Simply, use the technology to do the right thing from the start, to get the right result at the end, at a minimal cost using the best available resources.

However, this process could only be efficient in discarding candidates for a crewmember position (flight deck or cabin) who are registered as active members of a terrorist or criminal organisation. Nevertheless, the process will not be as effective when handling crewmembers that are newly recruited by radical factions or terrorist organisations. Logically, a newly recruited terrorist will join an airline with no previous criminal record to guarantee the candidate is off the criminal databases radar. He or she would typically be 18 years old, fresh out of high school and after 3 to 4 months of intense airline training, that person could be flying an aircraft as a cabin crew member, which is a perfect profile for the task that matches the requirements of any ambitious terrorist organisation.

The discussed above recruitment screening process is not expected to be useful in detecting mentally ill perpetrators and suicidal crewmembers that could become homicidal when agitated by psychological, financial or personal factors.

Considering the three thrusts proposed by the US department of transportation when designing security procedures, this could enhance the efficiency and practicality of the final product, especially, when the person or team that is in charge of designing or writing the security procedures, clearly understands the three thrusts, the applicability of Skerrett identified factors to pilots and cabin crewmembers and its relevance to PSUA. When it comes to PSUA, the appointed person or team should favourably be a pilot or include one respectively, a pilot who should be familiar with the factors that could turn a healthy or mentally ill suicidal pilot into a murderer.

Familiarity with the specific crew functions (pilot or cabin crew) related factors, which could aggravate minor level, common psychological disorders such as stress or depression, turning it into lethal suicidal/homicidal ideation is paramount. Additionally, a thorough knowledge of these factors could help in defining the appropriate mitigation of the relevant risks by identifying measures and solutions to address the root causes behind the crew specific triggering factors.

Good knowledge of the history of PSUA events and a clear understanding of present challenges facing pilots in their personal and professional daily lives, along with cultural awareness of how pilots from different ethnic origins and backgrounds would react to the same triggering factors, are similarly crucial for creating effective procedures and identifying practical mitigation.

Incident prevention is dependent on the individual company's available resources and the level of its leadership commitment towards addressing the triggering factors and supporting the implementation of the proposed mitigation.

A realistic and achievable approach is necessary, as promises that are not deliverable could seriously damage the working environment and negatively influence employee's trust, especially when addressing factors such as 'job security'.

To address the job security element and due to the sensitivity of mental health issues and its possible impact on pilot's fitness and ability to perform flying duties from a regulatory, corporate or legislative perspectives, an alternative job security solution mandated by the airline's corporate responsibility towards its employees is required.

For example, a contractual commitment by the airline, to assign a crewmember (that is identified as having such a condition) to a ground-based duty as an alternative job/financial security, could be a suitable solution. The new assignment could either be temporary (until the employee regains flying status) or if the employee is assessed as unfit for flying duties for a long term or permanently, then,

a process to re-designate the employee with the necessary contractual adjustments should be mutually agreed. This proposal is addressed in more details in later chapters of this research.

In conclusion, during the research process, it was not possible to locate a single source that contained all airline employees related hijack events which led into actual, probable or potential PSUA events. A finding that mandated another research objective which is; 'to collect, filter and authenticate all available data to produce an accredited academic and professional account of the relevant events, for use by future and further research into the subject'.

Despite the extensive and valuable suicide literature produced by many accredited scholars from different paradigms, another clear finding was the diverse and conflicting (at times) academic opinions about the reasons behind suicide in general and suicide/homicide in particular. Additionally, certain academics generically supported the research hypothesis regarding the existence of more than one factor and the psychological factor as a constant in PSUA events.

The academics that identified other than psychological, suicide contributory factors were generic in their findings and did not particularly study airline pilots. However, the two academics that did so only lightly touched on selected examples and did not thoroughly investigate all the related events. Hence, the outcome of most of the reviewed literature was either generic, incomprehensive or reflected the specific writer's perspective without careful consideration of real-time pilot's perspective or other scholar's opinions.

As the current security measures are effectively handling the political factor and its associated risks, while the psychological factor risk-mitigation measures are not perfected yet, therefore, the research is focusing on producing a process to bridge the current procedures that address the psychological factor, mitigate the personal factor and sub-factors more effectively because personal factors are easier to identify and manage. However, the possibility of a politically driven PSUA should not be ignored, and efforts to enhance the factor mitigation must continue.

The triggering factors and behavioural markers are listed in chapters 4, 5 and 6 of the research along with findings, recommendations and a prioritised implementation process while explaining how the pilot's survey produced data validates the research outcome.

Until all the findings of the research are resolved, and the recommendations are implemented, it is therefore recommended to maintain the use of the 'Minimum crew in the flight deck' procedure with an immediate implementation of the proposed gap bridging recommendations as listed in chapter 6, to address the insider threat gaps in the current set of measures and prevent the occurrence of another PSUA.

3.0 Research methodology

> *"A researcher's background and position will affect what they choose to investigate, the angle of investigation, the methods judged most adequate for this purpose, the findings considered most appropriate and the framing and communication of conclusions".* (Malterud, 2001, pp. 483-484)

Researching security procedures within the aviation industry is perceived by most airlines as trespassing. A perception that usually depends on the nature and sensitivity of the researched data; therefore, airlines are keen to maintain confidentiality over topics that are considered as highly sensitive and classify such information as a privileged access restricted area, mainly to guard the airline brand, projects or unique products against sabotage, espionage or undesired public exposure.

The leak of a certain type of information could harm the brand reputation and corporate image of an airline, and this is particularly true if the researched data is under dense media coverage at the time, similar to the Malaysian airline's situation following the disappearance of MH370.

Another important reason that airlines are reluctant to share security information and data is the concern about jeopardising the procedure's effectiveness should it become known to the public.

A clear understanding of this research dilemma is vital to overcome any consequent research hardships and facilitate the achievement of the research objectives.

A detailed review of the methodologies used in preparing this research while explaining the difficulties experienced in collecting and processing the required data are included in this chapter. Discussed in the following pages, are the expertise and techniques used to overcome some of the highlighted difficulties, along with some of the global security visions that influenced the author's thought patterns and had an impact on the process of preparing the research.

Considered as a working tool that enabled a clear and an in-depth understanding of the research subject, and one of the most valuable assets used during this research, is the author's diverse aviation practitioner experience, spanning almost 31 years., the author has accumulated more than 14,000 flying hours in the last 27 years spent working as an airline pilot, instructor and examiner on many airliner heavy jets, including currently flying the prestigious Boeing 747-8 Jumbo and holding several management roles with major airlines across the globe.

The author holds a master of science in air-safety management from a leading UK university, and additionally; is an IATA approved auditor and had worked (part-time) for regulatory bodies as an examiner, test pilot and an author of aircraft type rating technical examination papers.

Licensed by all three major aviation regulatory systems, namely; ICAO, EASA and the FAA, while being experienced on both Airbus and Boeing, modern as well as classic aircraft types., the author

also operated several other aircraft types in different aviation sectors, allowing a level of exposure that facilitated the author's diverse technical knowledge, skills and standards, a quality that is important for a holistic approach to accurate technical and professional processing and filtering of the collected data.

The author's experience in the introduction of several safety and security procedures, directly as the author of the procedure or in-directly by providing the necessary approval after conducting the relevant risk assessments, will ascertain the simplicity, practicality and cost-effectiveness of the research recommendations.

Cultural, ethnic and religious awareness were consolidated through the author's mixed origins and backgrounds. The author as an American immigrant, from mixed African, Arab and Muslim roots, who lived in different parts of the world and worked for various airlines, gained the insider level of understanding of the geopolitical, cultural and religious elements that contributed towards the aggravation of the triggering factors and caused crew related (mainly pilots) hijack/suicide events.

International exposure through interaction with major regulatory and political bodies, such as the US FAA, Chinese CAAC and EU, while representing airlines in direct negotiations or conferences, enriched the author's understanding of the importance of a realistic approach to security risk management. As the possible reason that security events are still happening despite the industry's continuously updated manuals and revised measures is the tick-in-the box cosmetic procedures that failed to prevent PSUA, or the media's so-called *'Aircraft Pilot Assisted Suicide'*.

The term preferably used to describe pilot suicide throughout the research is 'Pilot Suicide Using an Aircraft', with the acronym PSUA used for short reference, the justification behind the use of this term is that an aircraft is not willingly assisting a pilot to commit suicide; instead, an aircraft is being used by a pilot to commit suicide.

While researching data for a research subject relevant course work, it became apparent that academic references listing hijack events that led to PSUA accidents were not readily available.

The available information was mostly scattered over the internet, magazines and newspapers articles, media and personal interpretations heavily cluttered the data. Some of the available information lacked integrity and cultural awareness. In contrast, some information was not factual, either technically or professionally. At times, the only available data were nothing but mere speculations as witnessed by some of the published articles that covered MH370, for example.

One of the primary research objectives is to research all known hijack events that involved airline employees and list them in a chronological order, to create one academically and professionally accredited reference. This objective is achieved by scrutinising the event's information sources,

authenticity and accuracy to present an academically and professionally filtered data to serve as a reliable, factual, unbiased and authentic reference to help further research into the subject.

Data collected from the available open sources, complemented by data extracted from the analysis of a case study airline security-procedures example and supplemented by the unwitting testimonies recorded during interviews with some senior managers and experts from the aviation industry, were all validated through a comparative analysis of the data extracted from the pilot's survey responses.

The pilot's survey was specifically designed to assess the threats and procedures related to PSUA. It also aims at collecting pilot's comments to help identify and bridge gaps in current and related airline security procedures to mitigate the insider threat and prevent future PSUA events.

Findings and recommendations are formulated and supplemented by the relevant data collected from the researched technical, professional and academic literature including articles, documents and other available resources.

The author's entrepreneur aviation experience is utilised to analyse and filter the collected data and mould it together to produce simple, practical and cost-effective recommendations to address the insider threat and relevant pilot hijack/suicide risk.

Moreover, it is about time for airlines to explore further, the benefits that academic research could bring into pro-active security risk management. Perhaps the main reason most airlines do not have academic research departments, or at least an academic research team, is the airline's dependency on generic data that is readily available through third-party providers at a lower cost. However, some airlines are starting to sponsor employed professionals for academic research studies in areas requiring specific professional skills such as flight operations, safety and security disciplines, motivated by the critical role played by academically qualified professionals and the significant impact of their research skills and produced work on the development of the airline business.
Academic research when combined with professional expertise, could lead into simple, practical, efficient and cost-effective solutions, becoming a key component in the development of not only safety and security but also all other aviation sectors.

Employing evidence-based approach to answer the questions tackling PSUA topic and develop effective mitigation, the research methodology premised on researching and analysing the history of all crew related hijack encounters, paying particular attention to actual, probable and potential PSUA events. The research also lists the reviewed cases in chronological order and identifies the factors that triggered the event's specific crewmember behaviours and led to the suicide event.

Explained below are some of the adopted methods, techniques and reasons behind the selection of triangulation (mixed methodology, both qualitative and quantitative) to prepare this research.

Additionally, numerous open sources were reviewed to collect authenticated data that are related to PSUA events and long hours were spent filtering the non-relevant information (media clutter) to produce an accurate account of each event.

An example of the media clutter encountered while researching hijack/suicide events was Nati. In his article, Nati referred to JAL 350, DC 8 aircraft suicide attempt and used the picture of a Sudan Airways B707 that crashed during approach at the White Nile. (Nati, 2015)

Some of the security literature reviewed throughout the research process included ICAO Annexe 17 'Security', which is the 1944 Chicago convention annexe adopted in March 1974. It lists the standards, recommended practices (ISARPS) and guidance material for aviation security matters, the National Civil Aviation Security Program (NCASP) issued by the regulatory body of the case study airline's state laying out the rules and standards to follow for all air operators based on annexe 17 guidelines. The review objective was to facilitate compliance monitoring of the airline security procedures, and specifically, the airline's operations manual chapter 10 'Security' alignments with the Airline Security Program (ASP) and the NCASP.

Additionally, a thorough review of the case study airline 'security management manual' was carried out, comparing it to other security-related operations manuals for compliance, consistency and applicability to guard against the earlier mentioned 'tick in the box' procedures and resultant gaps.

The research also reviewed the analysis and interpretation of some of the listed events actual accident investigation reports. It supplemented the process by a review of several accident investigation databases that listed the same events to compare and authenticate the available data.
Some of the databases used included the United States National Transportation Safety Board (NTSB) and the aviation security international magazine databases along with several other sources as listed later in the bibliography section.
This process was also used to establish an idea of the development of suicidal behaviours and factors triggering such behaviours over time and to compare the perspective of different authorities.

One other method that was used to achieve the authenticity objective included tracing all possible used sources origins (websites, newspapers, magazines or books). Moreover, the methodology also included the tracking of the effects of incidents and accidents on flight deck crew specific security procedures and the resultant developments in the aftermath of each event to establish the efficiency level achieved through such development and learn from the process.

Eventually, it became apparent that the end-users of any policy or a procedure are the best judges when it comes to practicality, efficiency and simplicity. In this research, the security procedures example end-users are the pilots of the case study airline. Therefore, a gap analysis of the

procedure using quantitative data from the analysis of feedback collected from the pilot's survey would enable the answering of the following research questions:

- Is the current anti-insider threat security procedure working?
- Is it making airline pilots suicide proof?
- Does it consider the security threats embedded in the currently implemented procedures? If not
- How to mitigate the risks involved and prevent the reoccurrence of PSUA events?

Answering these questions is considered an audit of the design and implementation of the procedure and it is also a platform to measure the procedure's efficiency.

Therefore, a Middle Eastern legacy carrier considered as one of the best airlines in the world (actually won the title several times) was chosen as a case study airline. The 'Minimum crew in the flight deck' procedure was also selected as the security procedures example under scrutiny. The reasons behind this selection are explained in more details later in this chapter.

After establishing the research questions during the early stages of the research preparation, a specially designed survey and key manager's interview questions were developed to trigger discussions and generate answers, that could challenge and measure the reliability of the current procedures, and the research produced findings, conclusions and recommendations.

To improve the research data validity, Mays and Pope (2000:89-101) as cited in Malterud, suggested procedures and principles such as triangulation, respondent validation, precise detailing of methods of data collection and analysis, reflexivity, attention to negative cases, and fair dealing, Indicating that relevance can be increased by the use of detailed reports and sampling techniques. (2001, p. 483)

As the pilots survey questions are specifically targeting the pilot's community of the case study airline only (the sampling frame), a non-probability sampling method was used while considering data collection strategies. Purposive and expert sampling methods were considered during personal interviews questions preparation and interviewees selection due to the higher level of aviation experience required to answer the highly specialised questions. The non-probability method was favoured over random sampling for the reasons mentioned above and despite the following Cohen et al. comment, as triangulation would be used to measure the validity of quantitative versus qualitative collected data and vice versa to guard against bias.

> *"A probability sample will have less risk of bias than a non-probability sample, whereas, by contrast, a non-probability sample, being unrepresentative of the whole population, may demonstrate skewness or bias".* (Cohen, Manion, & Morrison, 2007, p. 110)

The case study airline flight-operations management was approached for the necessary approval to send out the survey questionnaire to pilots. A copy of the survey questions along with the link to the electronic survey was made available to flight operations senior management.

After the published survey closing date, data analysis started, and findings were compared to the data produced from the study of past PSUA events; as a result, findings, conclusions and recommendations began to materialise.

Later in this chapter, a description of the pilot's survey is included, while questions[10], answers, data analysis, the proposed mitigations and gap-bridging measures are listed in chapters 5 and 6.

Planned interviews were scheduled according to the research-planning document[11], and personal interviews were planned with four pilots that previously worked for Egypt Air, Ethiopian Airlines, Mozambique Airlines and Singapore Airlines (Silk Air), each of whom directly knew a pilot who was involved in an actual hijack/PSUA event. Other interviews were also planned with some aviation safety and security experts, to share their visions and shed light on the latest developments in the researched area. Including the senior vice president of security in a mega airline to consult on security procedures and profiling issues, the flight operations manager to be consulted regarding operational applications and implications of security procedures, the company psychologist to consult regarding psychometric screening and company perspective of suicidal behaviours identification and pilots mental health, a civil aviation authority senior manager to verify the regulatory aspect of the discussed issues, and to avoid being bias, an independent aviation safety expert from another airline from a different continent was also selected. An aviation medical examiner was also planned to explore the research topic from a medical perspective.

The interviewees (being experts in the aviation industry) were exposed on a daily bases to security events and risk-based decision-making. This exposure, complemented by access to the latest security intelligence data (it is not possible to share sensitive data in the published research due to the non-disclosure agreement, signed by most interviewees), would render their advice beneficial to the authenticity and validation of the conclusions and recommendations of the research. However, some ethical issues were encountered with some of the planned interviews, as explained later in the 'Research ethics' part of this chapter.

Finally, the research would like to emphasise on the importance of academic research role in general and the research led by subject matter experts in particular, for the development of aviation security future as evident in the following FAA's aviation security research and development document which explains the agency's commitment to research as a long-term investment

> *"The FAA's vision of an integrated aviation security system for the twenty-first century incorporates the strengths of a variety of technologies that are continuously being monitored and upgraded to respond to changes in the threat environment. This future system will enable aviation security professionals to perform at maximum levels of effectiveness"*. (FAA, 2014, p. 1)

[10] *Appendix 4*
[11] *Appendix 1*

According to the FAA's vision, commitment to research and development is a vital tool to support a better understanding of present and evolving security threats.

Nevertheless, it is equally important to measure the efficiency of the revised procedures through regular security drills and exercises while adopting and filtering the carefully collected feedback from the procedure's end users to help achieve simplicity and practicality.

The case study airline

Selecting a case study airline was not an easy decision. The author required in-depth knowledge and familiarity with the airline's structure, procedures and documentation. Another challenge as highlighted earlier in the chapter, was the managers (subject matter experts) planned interviews and how it did not work as expected, as some planned interviewees kept deferring the interviews to the last minute. While others asked for extreme anonymity as a condition for taking the interview and some of the interviewees withdrew at the last minute without expressing a reason or giving enough notice to identify a replacement.

It is fair to say that, as the research progressed, the reasons behind this unexpected interviewee's change of attitude became clear. It is not only the sensitivity of the discussed topics or job security concerns (due to the signed non-disclosure agreement), it is also the agitated geopolitical situation in the entire Gulf region causing a rising tension between countries that play host to the legacy airlines and the close interaction between them (Bahrain, Qatar, Saudi Arabia and the UAE).

Moreover, some of the citizens of the conflicting states worked as managers for the airlines of the other countries. Some of these managers became deeply concerned about the dire consequences including being jailed, paying a hefty fine or both, for giving a statement that could be misinterpreted as an unacceptable criticism by one of the involved states.

The selected subject airline is a Middle Eastern mega carrier, operating a big fleet both regionally and internationally, with flights covering the five contents and Australia. The airline employs pilots and cabin crews from more than 125 different nationalities[12], rendering it an excellent example of diverse workforce and environment in terms of technical experience, cultures, backgrounds, ethnicities, religions and age groups.

From a security perspective, it is not easy for an airline to be based in the Middle East. It meant a daily exposure to security-related threats resulting from the heated geopolitical situations in the region, including; Iraq, Israel, Libya, Syria and Yemen armed conflicts, and the relevant rising tension involving political and radical factions such as ISIS/ISIL, Hezbollah and Houthis[13].

Armed conflicts like these are fertile soil and a potential source of terrorism. Organisations such as those mentioned above (and many more) could target airlines for fast and easy publicity or as a sort of bargaining tool for extortion purposes, or for objectives that are common for terrorist organisations groomed by this kind of conflicts and under similar conditions as witnessed in past aviation security events such as the 1985 (assumed) Hezbollah hijacking of TWA flight 847.

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[12] *Most recent count as per CRM class presentation on December15, 2017*

[13] *Iran and Hezbollah backed rebels led by the late Hussein Al-Houthi that fought the late dictator Salih for a Shiite independent state in Yemen in the early 1990s and later against the Yemeni government backed by the Saudi/UAE led coalition that is supported by the USA.*

Another reason behind terrorists targeting most of the Middle Eastern states, which is the home base of the Gulf mega carriers, is the lasting impression of those wealthy Gulf States, being close allies of the United States of America and the western countries.

The US and the west are known to have strong financial ties and common interests in the Gulf region. Therefore, an act of terror against any of the Middle Eastern states or its corporations (airlines for example), is considered a direct attack on the American and the so-called western block interests, as perceived by terrorist organisations and the world.

For the case study airline, working in such a security-sensitive environment, while operating direct flights connecting several American and western European cities, with some primitive airports in certain parts of the world with limited or even nonexistent security standards, represents a serious challenge, especially when considering the safety and security of flights that operate in and out of the several airports that are located within high-security risk countries (such as Afghanistan, Iran and Iraq), and regularly crossing their hostile airspace.

Having the appropriate resources, including access to accurate and reliable intelligence which is required to achieve the safety and security standards is a costly process, but money is not the only issue. Political influence and mutual interests linked to the major players in aviation security are paramount to ensure the latest and most reliable information is made available to the airline in a timely manner to guarantee the most effective use of such information.

Meanwhile, the selected airline is also witnessing a rapid expansion, similar to most of the legacy carriers in the region, with orders for hundreds of aeroplanes that are scheduled for delivery within the next decade. Consequently, these airlines are expected to hire thousands of pilots and cabin crew members soon, making them vulnerable to the earlier discussed 'Insider threat'.

Price and Beckman (2016) interestingly discussed the threat, questioning the aviation sector preparedness to face what they called a *'too familiar enemy'*, they wrote

> *"The 1979 horror movie when a stranger calls includes one of the most terrifying moments in movie history - when the victim discovers that the murderer who has been terrorizing her all night is already in her house.*
>
> *Realizing someone has penetrated our security measures, and is among us, is also one of the most terrifying forms of attack"*. (Price & Beckman, 2016, p. 34)

Explaining the possible mitigation in a similar way to the USD of T and FAA discussed concepts, Price and Beckman (2016) stressed on the importance of a layered security system, focusing on employees background checks including random inspections to prevent terrorists and criminals from slipping through the system, accurate behaviours assessment and monitoring, in addition to adopting a healthy, practical and realistic security culture.

Price and Beckman used a Hollywood inspired example to make their point, quoting the lines of actor Robert De Niro, who starred in the 1995 movie 'Casino', to simplify and generically explain how the behaviours monitoring and detection process should work

> *"In Vegas, everybody's gotta*[14] *watch everybody else. Since the players are looking to beat the casino, the dealers are watching the players, the box men are watching the dealers, the floor men are watching the box men, the pit bosses are watching the floor men, the shift bosses are watching the pit bosses, the casino manager is watching the shift bosses, I'm watching the casino manager and the eye-in-the-sky is watching us all".*
> (Price & Beckman, 2016, pp. 34-35)

Price and Beckman discussed process is very much applicable to airline security measures that are required to combat PSUA. Another possible last line of defence against a pilot, cabin crew or any other employee, who tries to take control of an aircraft and use it to commit suicide or as a weapon of mass destruction, is when every employee is effectively monitoring and profiling other colleagues and immediately reports any abnormal behaviour to the concerned manager. The manager will then pass that information without delay, to the company psychologist and security management for further analysis and subsequent actions.

Of course, it is not as simple as it sounds. The practical application of this proposal requires the employees to have a minimum level of knowledge about the kind of suspicious behaviours to look for and the infrastructure to support the proposed process.

The knowledge part could be achieved through attending a simplified 'basic suicidal behaviours recognition course', that would enable the employees to recognise verbal or behavioural markers, similar to those identified in appendix 2 which are based on the analysis of past and recent employee-related actual and potential PSUA events.

The case-study airline security slogan reads 'Security is Everyone's Responsibility'. The Slogan is on display in most of the airline base offices, and it is used widely across company manuals and documents. It reflects a healthy security culture, making it easier to align the current procedure example with the proposed enhancements, allowing an effective implementation of the suggested changes covered at the end of the research.

The financially strong carrier could also afford to invest in acquiring the required resources and build or bridge the supporting infrastructure including tools such as; the latest technology psychometric testing programs, or obtaining the required (accurate) intelligence and the equally important hiring of the appropriately qualified and usually expensive, psychology professionals. Company employed psychiatrists are not a luxury; conversely, psychiatrists are a must in airlines that are building a futuristic safety and security management system to face the most subtle of evolving threats, which is the mentally ill crew member.

[14] *American slang for [Got to]*

Psychiatrists are required to filter, process and action the massive flow of information coming from pilots and cabin crews to identify potential PSUA threats and provide the necessary mitigation to it. During an interview[15] with a senior flight operations manager (A), he said

> *The airline's leadership commitment to safety and security development is not only reflected in company manuals and security slogans, it is actually evident in its day to day operations, by delivering safe and secured air transport to our destinations despite the surrounding security threats while maintaining an immaculate safety record to date.*

The airline employs a strong workforce of more than 3,500 pilots and over 10,000[16] cabin crew members. The numbers are expected to double over the next decade to meet the ambitious expansion plans and staff the more than 100, already ordered jets scheduled for delivery over the coming few years. The senior manager (A) also added

> *To cope with the tight security requirements, the company employed the services of a third party psychometric testing provider and currently, it is an integral part of the recruitment process for pilots. It is also introduced as a mandatory pre-requisite for internal promotion to captain, instructor or any management position.*

The case study airline was one of the first to introduce the 'Minimum crew in the flight deck' procedure. The new security measure required the presence of another crewmember (pilot or cabin crew) to occupy the flight deck jump seat whenever an operating pilot leaves the flight deck. The procedure was introduced to guard against having a single pilot in the flight deck at any time.

Therefore, the 'Minimum crew in the flight deck' was selected as an example of airline security procedures, for gap analysis, gap bridging and scrutiny for being 'Simple, practical and cost-effective' in combating the insider threat.

Another reason that encouraged the selection of the case study airline was the proven safety and security record and the airline's reputation of having robust procedures that meet and sometimes exceed the highest industry standards.

[15] *Held on April 3, 2017*
[16] *As of May 2017*

Security procedures example

'Minimum crew in the flight deck procedure'!

In the aftermath of German wings flight 9525, the case study airline felt the hard impact of the catastrophic event on load factors, reflecting as a sudden drop in passenger's numbers per flight across the entire route network, a typical passenger's reaction after such a massive loss of lives and the intense media coverage that surrounded it.

As immediate mitigation and on the following day, a flight operations action group was formed in coordination with the airline's safety and security management, and the group was assigned the task of drafting a procedure, to ensure the safety and security of the carrier flights and passengers.
The main objective of the proposed procedure was to restore public confidence in security measures which is implemented by the airline to protect the travelling public from the reoccurrence of events similar to the German wings scenario.

Although standard risk assessment and threat analysis procedures were followed, two elements shadowed the performance of the highly trained, professional and experienced team of subject matter experts that worked on the task.

The first element was the urgency to find an immediate and reliable solution to convince the public that the risk has been mitigated and at the same time, deter any potential suicidal pilot.

The second element was corporate. It was not only the financial department pressure due to the resultant losses (although it was a significant factor), but also the corporate determination to protect the brand, a brand that was very hard to build and was now in jeopardy. Moreover, the management had the well to demonstrate to its customers (and of course shareholders), that the airline is capable of sustaining business during the hardest of times.

The following day and only 48 hours after the event and even before the preliminary accident investigation report of German wings accident was released, the drafted new policy was approved and sent for publication and implementation with an immediate effect.

The newly implemented policy called for having at least two persons on the flight deck including an operating pilot at all times, making it forbidden to allow a single pilot to be alone in the cockpit.

During most of the flights operated by the airline, usually, two pilots occupy the flight deck, and an existing policy permits a brief absence of one of the operating pilots from the flight deck to stretch legs or use the toilet.

Stretching legs is a recognised health requirement that needs to be observed at regular intervals recommended not to exceed two hours and particularly on longer flights to prevent pilots from

developing blood clots, muscular and orthopaedic problems, which is common among pilots due to setting for longer hours.

Applying the new policy meant that a cabin crew member is required to replace the pilot leaving the flight deck and must remain there until the pilot returns to the flight deck. The policy is also applicable to flights operating with more than two pilots, such as augmented crew flights that include a third relief pilot on longer flights. With augmented crew, the procedure is still applicable whenever two pilots are leaving the flight deck at the same time or whenever one of the three pilots is gone for scheduled in-flight rest.

The procedure is also applicable to double crew (4 pilots usually including, two captains and two first officers, which are required for ultra long haul flights that are typically longer than 18 hours; however, double crew complement is used by the case study airline for flights longer than 14 hours and sometimes on flights longer than 12 hours based on crew feedback through the fatigue reporting and risk management system to enhance safety and crew performance), whenever the relief set is resting, and one of the operating pilots needs to leave the flight deck.

The shortage of time affected the quality of the produced procedure, in terms of its ability to consider future application consequences while academically exploring the threats that could evolve because of gaps arising from the rushed implementation.

Rush rendered the procedure vulnerable to other latent risks that were not immediately recognised, as the relieved public welcomed the news and passenger numbers started picking up again, which created a temporary sense of satisfaction with the new procedure. However, it was not long before all realised the potential risks involved with granting more flight deck access to the cabin crew.

The opening statement of chapter 1 reads, *"It's the development and implementation that will essentially win the war"*. The statement highlights the importance of gap analysis as a necessary tool for the continuous development of procedures to cope with the dynamic aviation environment and evolving threats while finding a way to measure the correct implementation is viewed as the key to the procedure's success and sustainable existence.

The procedures example gap analysis is covered in chapter 5 and results are compared to the outcome of the pilot's survey data analysis to measure the validity of the research findings and recommendations while utilising the valuable end-users feedback regarding the procedure based on more than two years of hands-on implementation to bridge any identified gaps and enhance the procedure's effectiveness and agility.

Interviews

During the research planning stage, a list of planned interviews was put together along with questions specifically designed and approved by the research supervisors to support findings and recommendations. At the same time, the interviews produced data would also validate the correct interpretation of the identified gaps in the procedure's example. Fulfilment of this objective is achieved through discussions with subject matter experts representing safety, security and flight operations departments from the case study airline.

Additionally, a regulatory body safety manager, an aero medical examiner and the case study airline psychologist were among the planned interviewees listed on the research-planning document.

As the research progressed, the lead research supervisor initial concerns regarding the number of planned interviews proved to be correct. It was not easy to find employees who would accept to discuss a high profile topic such as airline security and the relevant procedures. Out of the planned 24 interviews, only the retired ex-Sudan Airways Captain Musa agreed to be interviewed without conditions, 2 of the subject matter experts requested partial anonymity. In contrast, 9 of the interviewed pilots approved the use of the information provided by them in this research but subject to granting them total anonymity, especially those who provided information about PSUA events in their previous airlines.

For a sensitive research subject like aviation security, employees are usually sceptical about being interviewed, for the several reasons explained earlier in the chapter. However, most of the interview invitations that were sent out along with a copy of the planned questions, offering a wide range of available dates for the interviews (to accommodate the busy schedule of all invited), were not rejected; actually, some invitations were responded to and confirmed availability.

Unfortunately, as days passed, several interviewees deferred their agreed interview dates for a reason or another.

Even the flight operations senior manager (A) (who is the only case study high-level senior manager being interviewed) requested complete anonymity despite agreeing to record the interview for authentication and credibility purposes.

Several other sources from the less senior managers and regular staff members agreed to be interviewed under the condition of total anonymity and refused to record their interviews. Nonetheless, personal phone numbers of those interviewed were kept for authentication purpose.

Planned external interviewees that deferred and then avoided being interviewed were either removed from the planning document or replaced by a similarly qualified subject matter expert

from another operator in the region. The replacement SME agreed to be interviewed, subject to similar anonymity conditions to those stipulated by the case study airline senior manager (A) as highlighted above.

Some of the questions meant for a particular interviewee were removed based on their requests. Whenever the removed question affected the integrity of the research, that question was redirected to the finally interviewed SME.

Some of the colleagues approached, who previously worked for Egypt Air, Ethiopian Airlines, Malaysian airlines and Mozambique airlines, which are currently working in the Middle East, were extraordinarily defensive and refused to discuss any details of their ex-airlines PSUA events. The only exception was the long retired from Sudan airways, Captain Yousif Musa who agreed to the disclosure of his identity without any restrictions.

It is fair to extend full respect and appreciation of the compelling reasons of the conditionally interviewed SME's reservations and to those whom could not be interviewed due to the sensitivity of the discussed security topics and the signed non-disclosure agreements.

Questions asked during the conducted interviews are included as an appendix at the end of this research, and some selected quotes from the SME's answers were used whenever appropriate.

Voice recordings of the relevant interviews are available for authentication purpose by LMU and external examiners only.

Pilot's survey[17]

A fifteen questions survey was compiled to explore the perception and views of the case-study airline end-users (pilots) regarding the 'Minimum crew in the flight deck' procedure. The returned data and comments were analysed to measure the practicality, simplicity and efficiency of the subject security procedure based on over two years of hands-on experience.

The first question was designed to dissect the participants in terms of rank, position, gender and ethnic origin, to establish if any of these elements would influence the responses received and if so, to which extent. Data gathered from the first question would later be linked to answers of other questions to signify the effect of cultural differences, depending on ethnic origins or religion and explore if that could affect the interpretation and application of the discussed procedure.

The survey questionnaire was created on August 21, 2016, in its draft version, after consulting the research supervisors and applying several modifications to meet the ethics committee and LMU research regulations, the final version was produced according to the sampling strategies mentioned earlier in the chapter.

The final approved version was distributed online using an electronic platform link, which was emailed by the subject airline flight operations management to all 3431[18] pilots on January 2, 2017. The closing date of the survey was preset to January 31, 2017, as per the research planning document approved by the research supervisors and the university ethics committee.

The survey collected 514 responses. Representing 15% of the total pilot's workforce at the time of the survey and more than double the 200 pilots target set by the research supervisors.
The number of responses sampled all sectors, ranks, ethnic origins, religions and even gender as proven by data analysis.

Captains represented 53% of the responses as they enjoyed a higher sense of job security, while the remaining 47% is shared between senior first officers (10%) with minimum three years in the company, most of whom are approaching upgrade to captains, first officers (34%) and second officers (3%), which is a small but appreciated participation by the newest addition to the workforce as they dedicated time to contribute towards the safety and security of the airline.

This almost equally divided participation between captains and flight officers (in their three different categories) is a healthy indication of the airline's progress towards achieving a matured just culture and job security, where all pilots would not hesitate to express their opinions regarding rules and procedures that could affect the safety and security of their daily working environment.

[17] *Appendix 4, Survey form*
[18] *Flight crew headcount report as of January 31, 2017*

It is also understandable that first officer's participation was three folds the senior first officers, as the number of first officers is almost four times the number of senior first officers whom usually upgrade to captains soon after being promoted to senior first officer rank.

Second officer's participation is seen as a positive indication of the changing airline culture and the increasing sense of job security. The change is evident in the airline's encouragement of all pilots to participate in a survey that addresses such a sensitive topic, which is also a live display of the importance of the understanding and awareness of the young generation of security issues facing the aviation industry today.

It is essential to emphasise on the new generation's role in finding solutions to the safety and security challenges facing the aviation industry, especially the emerging security threats targeting the youth domain of cyberspace and its various aviation applications.

Management pilot's representation of 3% of the total responses reflects the strong commitment to the research of possible solutions and gap bridging of current policies and security procedures. It also proves that the survey results sampled the perception of the airline's entire pilot's community.

The participation of 46% of the flight operations management pilots in the survey is seen as a substantial commitment, especially when compared to the planned interviews participation. However, this is attributed to the higher level of anonymity offered by the survey.

Training personnel participation is also vital to guarantee the success of any procedure, or for policy development and implementation, as instructors are usually the most knowledgeable and experienced pilots in an airline by virtue of their selection criteria, the feedback and suggestions produced by instructors is the concentrated outcome of human factors, threat-based error analysis, long hours of monitoring pilots apply procedures and years of observing errors developing patterns. Instructors witness the differences in perception and interpretation of policies and procedures from one trainee to the other on regular bases, and their training allows them to assess the effects of culture, background and human factors on a pilot's performance.

The core of an Instructor's job is to facilitate or counsel (de-brief) a trainee after a training session in a classroom, an aircraft or a simulator to explain how and why an error had happened and how it could be avoided. However, an instructor's main objective is to guide the trainees into identifying the root cause that led to an error and find the proper mitigation for it.
Consequently, it is not possible to bridge a procedural gap or identify a safety or security mitigation without consulting this vital group of subject matter experts in the pilot's community.

With an almost equally distributed participation from the different categories of the airline's training personnel, it is evident that instructors (at all levels) are committed to helping the industry

research solutions to mitigate the emerging threats. Some of the most valuable suggestions derived from the survey comments naturally came from instructor pilots.

Type Rating Examiners (TRE) are the most senior among the instructor's cadre, and they topped the number of responses with 35%, another evidence that supports the assumption that better job security encourages pilots to provide transparent and constructive feedback.

Participation by gender reflected 2% female (12 out of 514 responses) versus 98% male, a fairly reasonable percentage when considering the total number of female pilots in the subject airline.

The numbers of female pilots is steadily increasing in the case study airline, not only the non-Arab expatriate female pilots but also the Middle Eastern and local female pilots, which is in line with a global uptrend in the number of female pilots joining the once dominated by males profession.

Participation by ethnic origin data reflected the vastly diverse cultures working for the airline. Despite the European domination of survey responses with 44%, other ethnic groups were well represented, even though the participants did not reflect the exact ethnic structure of the total pilot's workforce.

When discussing the ethnic group's participation, and for the sake of magnifying the differences in cultural backgrounds and its effects on procedures application and implementation, Asian, Caucasian and Hispanic ethnicities were further subdivided by region, for more specific profiling.

Second and third participating groups were respectively, Asians at 11% followed by Arabs at 10% while South Americans and others accounted for 8% each of the submissions.

New Zealand participated with one response that is reflected as 0% as the figures were rounded to avoid cluttering the presentation with lengthy fractions.

For practicality and simplicity, the identified groups were not subdivided into individual countries, as the subject airline employs pilots from over 125 nationalities.

The participant's religions were as diverse as their backgrounds, enriching the cultural mix of the airline pilots group.

Although Buddhist participation is reflected as 0% for the same reason mentioned earlier, two Buddhist pilots responded to the survey while there was no participation from Jewish pilots. Having said that, some Jewish pilots could be working for the airline, and none of them responded to the survey, or perhaps it could be the Jewish pilot's perceived sensitivity of working for a Middle Eastern airline that is based in an Arab and Muslim dominated society.

Perhaps the reason behind such a perception is the case-study airline base country, which is considered a relatively conservative society, where drinking alcohol is not allowed in public (although it is allowed in five stars hotels and nightclubs). However, the fact is that religious practice complexes for Buddhist, Christian, Hindu and even Jewish residents coexist.

Residents regularly practice their religions both freely and openly, with the standard security measures being applied to protect the worship sites against any possible threat.

Pilot's perception of the 'Minimum crew in the flight deck' procedure, based on regular practice after more than two years of application is considered as a reliable tool to measure the procedure's simplicity, practicality and efficiency. Therefore, questions were designed with several objectives in mind; in addition to the statistic use of the produced data to support the findings/recommendations of the research and project pilot's opinions regarding the procedure efficiency, the questions were also designed to collect feedback and suggestions for each specifically discussed area, in the form of comments after each question.

During the analysis stage, collected comments were used for gap analysis and identification. The comments included, as well, some innovative and challenging suggestions that inspired some of the findings and recommendations. Selected comments are quoted accordingly whenever found relevant, as each question and its collected responses are discussed in chapter 5.

Survey error margins are usually the bi-product of misinterpretation, rush, level of English, lack of interest, distraction and some other factors as highlighted in Cohen et al. (2007). The electronically calculated survey platform 3% error margin used the lowest possible confidence level of 80%, which is a conservative but appropriate level for such a diverse group of pilots.

Originality

During the 27 years spent flying for several airlines across the globe, three of the airlines that employed the author experienced serious security events that included hijack and bomb threat events. Fortunately, all events were concluded without damages to either souls or property, except for one, the 1971 Sudan Airways accident that involved a Fokker 27 aircraft and the death of some of its occupants during the event which is covered in more details in the next chapter.

The author's aviation experience also included personal exposure to serious safety and security encounters, during one of the events the author was acting as the first officer on a flight that received a bomb threat 40 minutes before landing at destination, fortunately, the flight was concluded with a safe landing, and all on board were disembarked safely.
Post-event search of the aircraft revealed the received warning to be a hoax. Nonetheless, lessons learned from that event contributed to the development of bomb threat procedures through direct feedback to the concerned departments. The lessons learned were also shared with other pilots during training sessions conducted later by the author as an instructor.

Continuous involvement with various levels of safety and security investigations as a member of fleet management and later on, flight safety management is also considered as an essential asset to the research when reviewing security procedures and measures.

Procedures design of safety and security operational procedures including the writing of standard operating procedures and re-writing operations manuals and company documentation for both the airline and regulatory body (civil aviation authority) according to new regulations (JAR at the time), additionally, designing, writing and implementing training programs and materials for regulatory-required training and operational courses for ICAO, JAA and EASA approved airlines was the working domain of the author for a little over a quarter of a century, including direct involvement in the design and introduction of new security procedures in the aftermath of MH370 and German wings 9525 events that targeted the elimination of the insider threat and PSUA.

Academic research skills gained by the author while studying for a master of science in air safety management (MSc) in one of the United Kingdom's leading aviation research universities could also add an academic weight to the research findings and recommendations.

Previous work experience for regulatory bodies by the author included the development and writing of technical exams and standard operating procedures for some airlines that either directly employed the author or used his services as a consultant. Moreover, hands-on experience as an IATA certified and practising auditor would facilitate gaps identification in the procedure's example covered by this research.

The combined privileges mentioned above would allow the proposal of some practical remedies that is acceptable by both airlines and regulatory bodies and the drafting of an easy to understand and simple to apply procedures aimed at bridging most of the identified gaps.

Attending safety and security conferences, seminars and working groups, also improved the author's ability to challenge and defend own as well as other's ideas, guarding against drifting towards bias judgement.

The author's access to active airline security professionals (staff, management and pilots); with access to unwitting testimonies from primary sources both regionally and internationally are some of the factors that motivated the author to select this specific research area. The outcome of this privileged access is expected to reflect positively on the originality of this research findings and recommendations.

It is now more than ever that the technically proficient and academically qualified professionals are required to contribute towards the research and development of different skill-based fields, especially in the aviation industry, as academic research was identified as a key factor in achieving the FAA strategic security goals as highlighted earlier.

Unfortunately, not so many pilots are qualified as academic researchers; hopefully, this research would motivate more pilots to pursue an academic research path, similar to the 12 peers who were motivated by the author's MSc research and joined different MSc programs in the same university.

Graduated already, three of the pilots/researchers mentioned above are already working for their airline's management in the Middle East, sharing their academically acquired knowledge with their peers and applying that knowledge to their daily professional work disciplines.

Shortly afterwards, the case study airline sponsored a group of its pilots for postgraduate research studies, indicating the airline's recognition of the importance of having qualified pilots both academically as well as professionally. This young and small group of pilots is expected to drive the company's development into a futuristic model airline, cope with the latest industry trends as the fresh ideas of these potential managers finds its way into boardrooms, ensuring growth, sustainability and help the airline achieve the highest possible standards in every aspect of its business.

In conclusion, qualitative data reviewed in the literature highlighted in chapter 2, covered the triggering factors behind a pilot's switch from a suicidal to a murderous character, the reviewed literature reflected the perspective of several paradigms. Additionally, the divided academic and professional community opinions about the nature and origins of the identified factors and the effectiveness of the "Minimum crew in the flight deck" procedure designed to prevent PSUA, were

quite contradicting at times. Thus and to avoid being biased, the research turned towards conducting interviews with accredited subject matter experts who validated the research findings. At the same time, the quantitative data extracted from the pilot's survey analysis and other statistical data found on some of the reviewed literature were also used to measure the validity of the research findings and conclusions as explained later in chapters 5 and 6.

Sharing the research conclusions and recommendations (after the successful completion of the dissertation) with the aviation industry through specialised conferences or publications could also help to enhance the efficiency of global aviation security in general and procedures designed to combat the insider threat and PSUA in particular.

Finally, all quoted sentences are written in italic and indented font (in case of long quotations), as copied from the original source including uncorrected spelling or grammar errors. Moreover, the term [*sic*] is inserted into the main research text after any quoted words that do not conform to UK English spelling or grammar.

Research ethics

Safety and security are considered as a highly restricted (if not prohibited) areas by almost every airline in the aviation industry as bad publicity touching any of the two disciplines could have a serious impact on the airline's image and reputation. The outcome of negative public perception could immediately reflect as a downtrend on the airline stock markets value, in the long term, this could be the difference between the sustained existence and the extinction of the airline.

A good example to support this argument is the Malaysian airline's situation in the aftermath of MH370, and MH17 accidents, the consequent steep dive in the company's share prices, hit directly in the wake of the fierce media exposure of the airline management shortfalls. A poor public perception of incapable management, lead by a weak airline CEO (at the time) as portrayed by the media, was another contributing factor to the share price sharp drop.

The struggling and almost bankrupt airline had to be saved by a massive cash injection from the Malaysian government that rushed to bail out the (used to be) legacy carrier, and the airline's CEO had to resign because of the airline's ailing situation.

Researching these two areas could involve a significant risk to any person who is willing to discuss a safety or security topic, offer information or even accept an interview without permission.

Ensuing results of being identified as a source (depending on the sensitivity of the topic discussed and its expected impact) could sometimes end up costing an employee the loss of his/her job, getting demoted, receiving a disciplinary action or at best, being harassed by superiors for what is perceived in certain cultures as a lack of loyalty.

Due to the (explained earlier) sensitivity of safety and security, the case study airline requires all employees to sign a non-disclosure agreement as part of the recruitment process. It is mainly to protect the company against any leak of sensitive information to competitors or other parties outside the organisation by employees irrespective of the drive or motive of such leak.

Job security concerns are among the reasons why, most of the employees with access to this kind of information are reluctant to share it, or even express a personal opinion when discussing topics that are considered as company sensitive data.

The author is not an exception to the above, and even though the purpose of researching such data is purely academic and the organisation itself could benefit from the research outcome, a very conservative approach was adopted, that is both culturally aware and acceptable at all corporate levels of the organisation.

The author treated the research topic as sensitive research which is defined by Lee (1993: 4) as cited in Cohen et al. and followed the valuable guidelines regarding the ethics of educational and social research in chapter 2 of the same book to ensure the ethical compliance of the interview and survey questions. The application to the ethics committee included a research proposal along with the suggested survey and interview questions. (2007, p. 120)

To cope with the protocol mentioned above and well before starting the research, a research proposal copy along with a research ethics brief as stipulated by the university's ethics rules were all presented to the subject airline flight operations senior management for approval. Once the permission was obtained, data collection started in the form of personal interviews, survey submission and survey responses data analysis.

The author's approach to data collection was based on granting anonymity to the interviewed individuals and sources of sensitive information, with the only exception being, when an explicit anonymity waiver is agreed and documented, either in writing or by voice on a mutually agreed recording of an interview.

During interviews, if an interviewee objects to the publication of a whole or part of a provided statement, the objected paragraph(s) or data were either deleted or edited to the interviewee request.

In such cases, the effect of the removed or modified statement on the objective and quality of the final draft was assessed. If the effect was found to be significant, the entire chapter was re-written to exclude that source and the relevant statements. At times, and not to undermine the integrity of the research, an alternative source had to be considered.

Some of the documents studied and cited as a reference during the production of this research might have been confidential or are still considered security-sensitive. Such documents will be available to the internal and external examiners for examination during the dissertation upon request. This measure is introduced to protect information that could be used to evade existing procedures or could pose a threat to public safety if accessed by an inappropriate person.

It is worth mentioning that by adopting a similar approach during the preparation of the author's Master's degree research, not a single request for source identification was received from the case study airline. This process helped maintain the level of anonymity even though the research was mainly quantitative, employed a survey and collected a reasonable number of returns from primary sources that contained safety-sensitive information.

The highlighted previous research experience in combination with the fact that the organisation implemented some of the master's degree research safety recommendations is among the reasons that sources identities remained anonymous until today.

As the author has served as a manager, previously in charge of running the biggest fleet of a major legacy airline and later on as the fleet safety manager, the situation could sound as advantageous when researching such a sensitive topic. However, for academic integrity and credibility purpose, it is fair to say that data and comments collected from subordinates could be bias at times, due to the authority gradient between the author and the person interviewed or the expected management interpretation of comments provided by a source.

Although the exact reason was never established, perhaps the highlighted authority gradient was the reason some of the proposed and approved interviewees deferred their interviews to a later date and cancelled it later without prior notification or declaring a reason.

Some of the withdrawals took place very close to the research submission date after deferring the interview date several times.

The other possible reason (given the circumstances in the region) is the previously highlighted concerns of being held accountable for releasing security-sensitive information and the ensuing job security possible implications.

Finally, at the end of the research, a bibliography lists references, highlighting other author's contributions to the subject and articles cited during the research preparation. The bibliography is presented in Harvard APA style.

The bibliography is also used to authenticate the information found in open sources by enabling the tracking of original data sources, making the research an accredited and factual document containing validated and relevant PSUA events information in one place.

In conclusion, this research was prepared following guidelines, rules and procedures as cited in London Metropolitan University**,** School of Applied Social Sciences and Humanities, Doctor of Policing, Security and Community Safety, course handbook (2012), the research ethics policy, procedures and code of good research practice.

4.0 Events that reshaped the aviation security world

The use of an aircraft by a pilot to attack a target and willingly kill himself in the process is nothing new to the aviation industry, and perhaps the oldest and most famous of examples (before 9/11) was the Japanese Kamikaze pilots.

The Kamikaze pilots, motivated by patriotism or driven by just being soldiers and following orders, they were perceived by the Japanese people as heroes, on the other hand, the families of those who were killed in the attacks, saw them as war criminals. Nonetheless, how people saw the Kamikaze pilots do not matter anymore, what matters now is that Kamikaze pilots did set an example and pioneered the fanatic and extreme trend of using aeroplanes as a weapon of mass destruction. The Kamikaze pilots had a clear intent, which is to inflect the most significant possible damage to property, if not destroying it, to score the highest number of fatalities for their cause, coincidentally, or perhaps not, modern-day terrorists still think the same.

Kamikaze pilots did inspire several military pilots from other parts of the world, and many years later, they continued to inspire other pilots. Unfortunately, this time they inspired civilian pilots both in general aviation and airlines, pilots who wanted to re-live their experience for a reason or another.

For the modern version of Kamikaze pilots, motives were quite diverse, ranging from ideological to simple revenge and from being mentally ill to a twisted plot with an evil execution and outcome, justified at times (at least in the suicidal pilot's mind) by what they perceived as the noble objective of financially securing their left-behind families.

During times of war, soldier's actions could somehow be justified, but to hijack a civilian plane and use it as a weapon of mass destruction, killing innocent people both onboard and on the ground in the process, cannot be justified irrespective of the reasons behind such an act.

The aviation industry started investing in the development of security measures and procedures long before that. However, the real big leaps, significant changes and improvements always came as a reaction to an event, in what is known in the aviation world as 're-active measures' or in ordinary people's words, 'writing procedures with victim's blood'.

In this chapter, a review of the historical development of PSUA is followed by listing the crew related hijack/PSUA events in chronological order, including a detailed analysis of each event. This process in combination with the analysis of the perpetrator's profiles would lead into the identification of factors that triggered the suicidal behaviours and turned some average ordinary people from being mentally ill patients into the ruthless homicidal criminals they became.

The next chapter will also discuss the development of terrorism, explaining why airlines represented an attractive target for terrorists over the years while analysing and discussing some of the terrorist motives, in an attempt to categorise hijacker groups while exploring the lessons learned from the studied events.

The expected outcome of this research could help in designing a process to identify and intercept suicidal behaviours at an early stage and keep flight decks free from potential PSUA candidates.

To start with, airline security as we know it today could be categorised into two eras, namely, pre and post 9/11th attacks. Additionally, a couple of repeatedly mentioned terms in this research are explained based on ICAO Annex 17 definitions to complete the picture.

Firstly, what is airline security? Annexe 17 defines security as a combination of measures, human and material resources, intended to *"safeguard* ... [airline resources (including but are not limited to) personnel, equipment, corporate image and business interests] ... *"against acts of unlawful interference"*.

Secondly, Unlawful interference as defined in annexe 17 includes but are not limited to acts or attempted acts that could jeopardise the safety of civil aviation, unlawful seizure or destruction of aircraft in service or using it as a weapon to cause death, injury or damage to the property or the environment, the introduction of hazardous device or material for criminal purpose or hostage-taking on board an aircraft or at an airport and the communication of false information to jeopardise the safety of an aircraft, crew, passengers, staff or the general public on board an aircraft, at an airport or any civil aviation facility. (ICAO, 2011, pp. 1-1)

Unlawful interference is directly related to the subject of this research, which focuses on the use of an aeroplane to cause injuries, death or severe damage, by an airline employee in or out of service, with particular attention to crew related hijack events and Pilot Suicide Using an Aircraft (PSUA).

Looking back at the history of civil aviation and even though aviation did not exist for so long, as the Wright brothers first flight took place on December 17, 1903, the first documented hijack event took place on February 21, 1931, in Arequipa, Peru. When Byron Rickards

> *"[...] a pilot from the United States was flying a Ford Tri-motor aircraft from Lima, Peru to Arequipa. Once landed, he was surrounded by soldiers and told he had just become the prisoner of a revolutionary organisation, but was later released on 2 March of the same year"*. (GWR, 2015)

Nineteen years later, three Czechoslovakian CSA airlines McDonald Douglas DC 3s were hijacked in a perfectly synchronised plot

> *"The biggest and most spectacular escape from Communist Czechoslovakia took place on 24 March 1950, when three CSA Dakota DC3 passenger aircraft were hijacked in a pre-*

> *planned escape by eight ex-RAF airmen, seven of whom were the aircrew of these aircrafts, and flown to the US airbase at Erding in the American Zone of Germany".*
> (CAF, 2011)

This event might have been the scenario that inspired Khalid Sheikh Mohammed, the mastermind of 9/11 attacks, or perhaps it was just another coincidence.

Since then, hijacking an aeroplane started popping up more often in the news while increasingly attracting public attention as flying became more popular, with hijack events numbers rising gradually to a record high in 1969 (86) and then maintaining a minimum of 10 hijack events a year until 2002 when the numbers started declining to reach a record low average of 2 hijack events per year for the last decade, accounting for 0.3 fatalities per year compared to the (9/11) record high of 268 fatalities in 2001 (FSF, 2019). The data mentioned above indicates a significant improvement in hijack counter measures efficiency, given the increasing numbers of flights, crew members and geopolitical conflicts around the globe.

Hijack attempts continued, and so did the industry efforts to mitigate the growing threat. Nonetheless, in the aftermath of the tragic loss of Malaysian Airlines flight MH370, speculations that surrounded its disappearance and the inability of all joined efforts to establish its location forced the airline industry to react by implementing new security measures.

The newly implemented measures varied from one airline to the other, as explained earlier in previous chapters, the only thing in common between the newly introduced procedures was the objective, which is 'to prevent pilots from taking over the control of another aircraft and using it to commit suicide, irrespective of the pilot's motive'. However, the question that remains unanswered is; did the measures actually work?

Whatever the measures that were implemented, a few months later, it did not stop German wings first officer Andreas Lubitz from taking control of his aircraft after locking his captain out of the flight deck (when the captain was visiting the lavatory) and using the plane to commit suicide, killing all on board.

Even though MH370's fate remains unknown until the writing of these lines, this specific accident along with German wings crash helped shed light on the not as famous and almost forgotten, previous airline accidents that were either suspected or categorised as pilot suicide events.

Pre - September 11th Era

Regardless of the number of security events that involved attempts to take over the control of airliners for one reason or the other, security measures and procedures failed to stop hijackers from gaining access to the vulnerable flight decks of commercial airline jets and allowed them to take control of the aeroplanes and use it for their own agendas during this era.

Motives varied from one hijacker to the other, the one thing in common amongst all reported hijack events was a growing concern and alarming insecurity that was sensed by the travelling public.

These concerns were especially true during the late 1960s, when the hijack events saw an uptrend because of the global socio-political situation including the cold war, between the two superpowers (USA and the back then Soviet Union). Some localised tensions also affected the global security scene especially in the Middle East, such as the Israeli-Palestinian conflict and the Lebanese civil war in addition to some separatist or (so-called) freedom movements in other parts of the world such as Euskadi Ta Askatasuna (ETA) in Northern Spain, the Irish Republican Army (IRA) in Northern Ireland and the Muslim led Moro National Liberation Front in Southern Philippines.

Some or all of the mentioned situations motivated the so-called, cause believers and radical thinkers (viewing themselves as freedom fighters) to hijack airliners to support their cause somehow.

Detailed reasons and motives behind hijack events in general and motives that are related to the subject of this research are explained further while discussing each event, with lessons learned from researching the subject summed up in the next chapter.

Meanwhile and in parallel with the geopolitical situation, the deteriorating global economy and relevant financial strains caused by the consequent recessions had its toll on both individuals and criminal organisations. Weak global economy became the catalyst for some of the hijack plots, and consequently, the world witnessed a surge in financially motivated airline hijack rates.
The peak in hijack event numbers attracted the attention of the media and eventually, the international community which necessitated a firm deterring action.

World community efforts materialised by signing the Hague convention (ICAO, 1971), aimed at the suppression of unlawful seizure of aircraft. The convention came into effect by October 1971, under the United Nations, International Civil Aviation Organization's (ICAO) umbrella.

The Hague convention supplemented the provisions of the 1963 Tokyo convention measures for restraining and taking custody of offenders, as the original Tokyo provisions did not specify guidelines for offenders punishment, rendering Tokyo convention as ineffective in putting an end to the continuously evolving risk of an aeroplane being hijacked.

To this date, none of the internationally signed conventions did discuss PSUA and the triggering factors behind it or tried to identify and agree on suitable measures to combat it.

Studying the suspected Hijack/murder (by employees) events through a phenomenological approach would lead into the identification of common factors that triggered the suicidal behaviours and lead some of the crewmembers into using an aircraft as a suicide/murder tool.

The correct identification of suicidal behaviours of pilots planning to commit such an act could help effectively in the identification of such pilots by their peers, family or friends and perhaps getting them intercepted by aviation medical examiners during a routine medical check (if routine psychometric screening ever gets mandated by the regulatory bodies of the ICAO member states).

The research will focus on hijack events that involved personnel, either employed or were employed by an airline to achieve the objectives mentioned above. The only exception is Pacific airlines flight 773 that is reviewed below, the reason behind including flight 773 is the significance of this event to the research subject from a hijacker profile, behaviours and triggering factors perspective and being the first suicide using an airliner event, even though the hijacker was not an airline employee.

The research will then scrutinise events that involved pilots, to explore the research objectives highlighted earlier in the research methodology chapter, namely, 'to identify the factors that trigger suicidal behaviours specifically among pilots.

Factors identified through the process could be used by airlines to develop pro-active procedures to mitigate the risk of having a hijacker/suicidal pilot slipping through the current screening processes during recruitment procedures to find a way into airline flight decks. Trained personnel could also use the identified factors and suicidal behaviours efficiently during induction training, routine checks or random spot checks to identify affected pilots.

Identification of the triggering factors that could agitate the suicidal behaviours and working to eliminate, prevent or at least reduce, the accumulation of such factors, could help avoid another pilot suicide using an aircraft event. At the same time, corporate responsibility and commitment are considered vital elements for the success of this process.

To achieve the research objective of producing an academically and professionally accredited reference of crew related hijack/PSUA events with authenticated facts gathered in one document, listed below in a chronological order are all known events (both confirmed and suspected). Each event description starts by a brief airline profile review and includes the event details and the involved pilot profile, with a brief triggering factors discussion after each event.
A more specific factors and proposed mitigation discussion will follow in chapters five and six.

Pacific Airlines flight 773, May 7, 1964

Pacific airlines started operations in 1941 as Southwest airways. It became the *"largest training contractor in the United States and trained over 20,000 pilots from over two dozen countries"*, the airline started scheduled services as a regional operator in December 1946 using an ex-military C-47 (similar to the civilian DC 3 aircraft). In March 1958, the airline was rebranded as Pacific Airlines. (Pacific, 2011)

Pacific Airlines continued to exist until 1968 when fierce competition forced it into several mergers, and in 1980 it became 'Republic Airlines'.

The first hijack attempt in the United States of America occurred on July 31, 1961, at Chico Municipal Airport in California, when a 40 years old welder named Bruce Britt Senior tried to hijack a Pacific airlines DC-3 aircraft using a gun and a knife. Britt's motives were a mixture of Financial, problems with his wife and alcohol. Britt shot the Captain and a ticketing agent before the co-pilot and passengers managed to restrain him, the entire event took place while the aircraft was still on the ground. (Aylworth, 2011)

Less than three years after the Chico event and on the morning of May 7, 1964, a

> *"[...] Pacific Airlines Fairchild F27A Friendship crashed near San Ramon, California. The crash was probably the first instance in the United States when airline pilots, were shot by a passenger as part of a mass murder"* (Time, 1964)

The 27 years old, Francisco Paula Gonzales shot himself after shooting the two pilots and consequently, the 44 passengers on board perished in the crash.
Gonzales came to the US as a member of the Philippine's sailing team to participate in the 1960 summer Olympics; he lived in San Francisco and worked in a warehouse. Gonzales was suffering from depression because of financial and marital issues while substantial debt and loan payments were consuming half of his monthly income. (CAB, 1964, pp. 5-8)

The immense pressure aggravated Gonzales suicidal ideation, so he bought a gun and a life insurance policy for USD 105,000 before the flight. He repeatedly mentioned to his friends and relatives that he *"would die on either Wednesday the 6th of May or Thursday the 7th of May"*, unfortunately, none of his acquaintances took him seriously at the time. (CAB, 1964, pp. 5-8)

> *"Shortly before boarding the flight to Reno, Gonzales displayed the gun to numerous friends at the airport and told one person that he intended to shoot himself [...] Mr Gonzales gambled that night and one casino employee asked how he was doing to which Gonzales replied, "... it would not make any difference after tomorrow".* (CAB, 1964, p. 5)

Although this accident took place way before the armoured flight deck doors introduction, preventing Gonzales from gaining access to the Fairchild flight deck that morning could have prevented the tragic event, similarly, if 'Security is everyone's responsibility' culture did exist back then, or if people were trained to interpret suicidal behaviours, perhaps one of the people that

interacted with Gonzales could have intercepted his erratic behaviours and reported it to someone who could have stopped him.

Gonzales was a 27 years old male, and he was subjected to a combination of factors at the same time, namely; Psychological problems (deep depression), family problems (relationship break-up) and financial problems (deeply in debt). This combination made Gonzales the first person to have caused a plane crash and a mass loss of life as a direct result of using an aircraft to commit suicide.

Even though Gonzales was neither a pilot nor an airline employee, his personal and psychological profiles could easily be matched with the suicidal pilots who got involved in all PSUA events.

At least one of the factors that triggered Gonzales actions, namely, psychological, financial and personal, were identified in most of the PSUA events that followed. Being the pioneer of using a civil airliner to commit suicide is another reason Mr Gonzales event was included in this research.

Identified factors that triggered Gonzales behaviours could be linked to factors and behaviours identified through the analysis of other PSUA events covered in this chapter. Such factors could be used to construct a suicidal pilot profile and design a suicidal behaviours basic awareness course.

The course could be used to train pilots, cabin crews, and pilot's family members on how to interpret such behaviours, identify potential suicidal pilots and report to the appropriate person who could take preventive actions on a timely manner to prevent further development of the situation.

One of the lessons learned from this event was the severe consequences of delaying the implementation of corrective measures, and the accident investigation report actually contained an emphasis on the amendments to civil aviation regulations parts 40, 41 and 42 that became effective on August 6, 1964. The amendment required that *"[...] the door separating the passenger cabin from the crew compartment on all scheduled air carrier and commercial aircraft must be kept locked during flight"* (CAB, 1964, p. 8)

This amendment was way ahead of its time, unfortunately, correctly implementing the change had to wait for almost 37 years, perhaps the amendment implementation could have prevented many unauthorised flight deck access events, including 9/11 attacks.

Personal behaviours and interaction markers in the form of verbal comments made by Gonzales during the days preceding the accident and actions such as showing the gun to one of his colleagues are all considered significant suicidal behaviours.

Triggering factors identified in this event are further assessed for applicability through a comparison with other PSUA events and the analysis of data extracted from the pilot's survey.

Sudan Airways flight, Khartoum to Malakal, December 6, 1971

Sudan Airways is the flag carrier of Sudan. It was established in 1947 by the British Overseas Airline Corporation (BOAC). It started services using the eight seats De Havilland Dove aircraft. The airline was the first in Africa to acquire the Fokker 27 turbo propeller-powered aircraft and one of the first in the continent to introduce Jet transport, using the Comet 4C aircraft. Boeing's 737 and 707 jets followed into service by the 1970s while Airbus 300, 310 and 320 entered the service by the 1990s (Sudan, 2016).

The airline saw several accidents and some serious incidents throughout its existence, and it rapidly deteriorated after the United States of America imposed tough economic sanctions on the African nation in the wake of the country's listing as a terrorism-sponsoring state under the rule of the oppressive regime of President Omer El Bashir that took power in 1989 after a military coup.

In March 2010, the European Union banned the airline along with all Sudanese registered carriers. The EU ban still stands until today, with no Sudanese airline allowed to fly over or land in Europe.

Over a lengthy phone-interview, the now-retired Sudan Airways Captain Yousif Ibrahim Mousa (who was the flight's first officer), provided a detailed recollection of the flight events, remembering the cold December day when he departed Khartoum. (Mousa, 2017)

Mousa was flying the airline's Fokker 27 with the call sign ST-AAY under the command of Captain Westwood, a Canadian citizen that occupied the left-hand cockpit seat, after departure, the aircraft headed towards Malakal in South Sudan, with 36 passengers and one cabin crew.

Reaching Malakal, the flight was unable to land due to poor visibility and had to divert to Juba further south and close to the Sudanese/Ugandan borders. Both Non-Directional Beacons (NDB) that served Malakal and Juba airports (which is very basic ground-based navigation equipment) did not provide precise navigation guidance by today's standards, and the aircraft drifted off route.

As the aircraft approached Juba according to the estimated time of arrival, the crew could not locate the airport, and the plane continued to descend in poor visibility in an attempt to find the airport. The junior first officer Mousa realised they were way off track, as he saw small hills that were not a usual landmark of the route that he had flown before, the few times he landed in Juba.

Low on fuel with the sun about to set and still uncertain of their location, Mousa proposed to captain Westwood to land on a dirt road that he could see on his right.

Before Mousa finished his words, the right engine flamed out as it ran out of fuel and without warning, Westwood pushed the control column of the Fokker 27, diving towards a straight-ahead hilltop, Mousa tried to take over but could not overpower the well-built captain. Westwood suddenly released the controls, covered his eyes with his hand and started screaming. Mousa

managed to pull the aircraft out of the steep dive, barely clearing the hilltop trees. He tried to find a place to land the crippled plane, with the captain weeping amid a nervous breakdown. Suddenly, the left engine also failed as the aircraft completely ran out of fuel. Without enough altitude and barely able to see through the fading dusk light, the plane crashed into the thick jungle close to the southern city of Kapoeta; an infant instantly died because of the impact while the infant's mother sustained severe injuries.

Mousa was knocked unconscious by the impact and broke his left arm, passengers pulled him out of the wreckage and as they pulled out the unconscious, badly injured and bleeding captain, Mousa realised that Westwood had lost both his eyes during the crash.

Dark already, as the night has fallen over the thick jungle, Mousa and the survivors gathered near the wreckage, they tried to attend to the injured with whatever they managed to salvage from the badly damaged wreckage. Extremely exhausted and suffering from post-crash traumatic stress, the survivors went to sleep in a circle around a fire that they managed to light using dry wood collected from the jungle.

The next morning, South Sudan People's Liberation Army (SPLA) soldiers (considered as rebels, fighting for the independence of South Sudan at the time), captured the crash survivors. The mother of the infant that perished during the crash died in her sleep because of her crash induced wounds, while random gunfire of the approaching SPLA soldiers killed her husband. Before taking the captured survivors to their camp, SPLA soldiers relieved (the now in a coma, unconscious and still bleeding) Westwood from his pain and shot him dead.

The survivors remained in SPLA custody for 24 days, SPLA soldiers generally treated them well, fed them and provided them with clothing and blankets (initially they were all, men and women, stripped of their clothing and remained naked while tied to a rope for the first few days).

Finally, survivors were handed a white flag and released near a bridge leading to Juba, they were found by the Sudanese government military post at the city, which arranged a flight to take them back to Khartoum. Nevertheless, several passengers were unaccounted for but were found later and handed over to the government forces that transported them back to their hometowns.

Sudan Airways internal investigation revealed that the apparent motive behind Westwood's suicide attempt was a severe depression due to family problems. Westwood became aware of an affair between his wife and a fellow Australian captain (that married Westwood's wife after his death) just a few days before the flight.

After the investigation was completed, Mousa returned to flying for Sudan Airways and later became a Captain, instructor, and examiner on the Fokker 27, Boeing 737, Airbus 320, and Airbus

300. Additionally, Captain Mousa also held several managerial positions, including the airline's safety manager.

Captain Mousa retired from Sudan airways a few years back and joined Sudan civil aviation authority as flight operations manager for some years. He is currently working as a part-time consultant for several companies based out of Khartoum.

Available references (FSF, 2016) mostly conform to Captain Mousa's account of the events, with some minor differences in the number of passengers and fatalities. One of the references mentioned the crew complement was five crewmembers, while Captain Mousa confirmed that the crew was comprised of two pilots and one cabin crew, in line with the Fokker 27 usual crew complement that was used by the airline until the type was retired in March 1991.

The same source indicated the number of fatalities as 10 out of 42 occupants. In comparison, captain Mousa's recollection indicated four fatalities out of the 39 occupants. However, none of the available articles referred to captain Westwood's suicide attempt or him being shot by SPLA soldiers.

Identified factors in this event are led by the personal factor (marital issues), considered as the root cause of the problem while the psychological factor (severe depression) is perceived as secondary.

Japan Airlines flight 350, February 9, 1982

Japan airlines acquired an operating license to provide domestic scheduled services in May 1951, it merged with Japan Air Transport, and in October 1951, the airline started its first domestic route.

In 1954, Japan Airlines began its first international route from Tokyo to San Francesco, and in November 1960, JAL introduced the airline's first jet aircraft (McDonald Douglas DC 8) on Seattle route.

By 1965 Japan Airlines placed an order for buying the Concorde supersonic airliner; however, the order never materialised, as the aircraft production line ceased in 1976. In the mid-1970s, the airline started using the Boeing 747 jumbo jet over the pacific routes to the US. (JAL, 2004)

On March 31, 1970, Japan airlines encountered its first hijack when terrorists from the Japanese red army ordered the flight to proceed to Pyongyang city in the communist regime ruled North Korea. Upon arrival, the terrorists asked for political asylum, and it was granted to all eight terrorists.

The airline's second hijack was on July 21, 1973, when flight JAL 404 (Boeing 747) was hijacked shortly after takeoff from Amsterdam, the Japanese red Brigade members in coordination with Palestinian terrorists, supporting the Palestinian Liberation Organization (PLO) cause and fighting the Israeli occupation of Palestine, hijacked the plane.

The flight ended up landing in Benghazi (the coastal city overlooking the Mediterranean Sea in northern Libya) three days later, where a bomb explosion destroyed the aircraft with no fatalities reported, as both crew and passengers were released before the plane was blown up.

JAL was once considered the biggest international airline in the world and a legacy carrier, especially during the mid-1980s. It served 125 cities in 31 countries with 173 aircraft. JAL also owned several smaller airlines, including; JAL ways, Japan Air System, Japan Asia Airways, Japan Trans Ocean Air, JAL Express, J Air, and Ryukyu Air Commuter, a very similar profile to some of today's mega carriers around the world and the Gulf states based legacy airlines.

In January 2010, JAL filed for bankruptcy protection (Time, 2010). Nevertheless, JAL managed to restructure, bounced back, and continues to work as an active member of one world alliance. The airline had several major, non-security related accidents as well. However, the following event is the only encounter that is directly related to the research subject.

Japan airlines flight 350 was a domestic flight between Fukuoka in south Japan and Tokyo when shortly before landing at Haneda Airport the Captain switched off the automation and started a steep dive to crash the aircraft short of the runway, one report indicated that the captain selected two engines into reverse thrust to guarantee the success of his suicide attempt.

The first officer and flight engineer tried to subdue the captain and take over the aircraft control; unfortunately, their efforts were unsuccessful, and the aircraft crashed into the water short of the landing runway causing the death of 24 of the 166 passengers, the captain and his entire crew survived the accident. Reports that surfaced shortly afterwards started questioning the captain's mental health condition, with some reports claiming that he had schizophrenia. (FSF, 2017 c)

Schizophrenia is a form of mental illness, which is defined as

> "*[…]a severe mental disorder in which people interpret reality abnormally" Schizophrenia may result in some combination of hallucinations, delusions, and extremely disordered thinking and behaviour that impairs daily functioning, and can be disabling. Schizophrenia is a chronic condition, requiring lifelong treatment.* (Mayo, 2016)

The media addressed public concerns regarding the pilot's mental health and how pilots were medically and psychologically assessed for flying duty fitness, noting that Captain Seiji Katagiri was 35 years old (Stokes, 1982) and that he suffered from mental disorders including depression and hallucinations, indicating that he once called the police about his house being bugged, and someone eavesdropping him, the police searched the house and did not find any hidden devices.

Reports indicated that JAL management asked Katagiri three times to consult a psychiatrist, highlighting job security as a possible contributing factor to Katagiri's actions.

In November 1980, Katagiri took a month leave for *"psychosomatic disorder"*, and right after that vacation, Katagiri's wife started feeling concerned about her husband's mental condition and behaviours (Time, 1982).

The media also reported that the

> *"Federal Aviation Administration requires a commercial pilot to pass a rigorous physical examination every six months, as well as an assessment of his or her emotional stability. The failure rate is low, an FAA study showed that for every 1,000 pilots tested, only eight are denied certification for medical reasons, and only two of those for psychoneurotic disorders. Those who flunk are automatically grounded until they can pass the examination"*. (Time, 1982)

JAL indirectly apologised for not stopping Katagiri from flying; however, the apology was diplomatic as JAL only regretted allowing Katagiri to operate even though he was not current and did not meet the airline requirement of flying a minimum of 25 hours per month. (Time, 1982)

The similarity between this accident and the German wings event is stunning, although separated by 33 years, as both airlines are perceived as elite carriers (German wings parent company is the mega carrier Lufthansa) and both airlines held an impeccable safety record.

Nonetheless, the two companies allowed their mentally ill pilots to fly, ending up killing innocent people, because of the airline's inability to ground the pilot or identify the root cause of the problem in the first place.

The main factor in this event is psychological (Schizophrenia) with the possibility of job security effect. However, the psychological factor could be strong enough to trigger an event on its own.

China Airlines freighter flight 334, May 3rd, 1986

Established on December 16, 1959, *"China Airlines is the largest airline in Taiwan and the flag carrier of the Republic of China (Taiwan)"*... [It operates a fleet of 81 aircraft, including 60 Passenger Jets and 21 Freighters to 118 destinations in 29 countries and regions (as of September 30, 2014). In 2013, the Chinese carrier was the] *"[...] 29th largest airline in the world in terms of passenger revenue per kilometre and the ninth largest in terms of freight"*. (CAL, 2014)

China Airlines experienced several incidents and accidents since its formation. *"Between 1994 and 2002, China Airlines suffered four fatal accidents, three of which each resulted in more than 200 deaths"* (CAL, 2014). *"The accidents contributed to the airline having a poor reputation for safety, partly blamed on an air force influenced pilot culture"*, which created a poor working environment.

The airline's last fatal accident occurred in 2002 while the last major accident was in 2007. However, from 2002 onwards, the airline witnessed a significant improvement to its safety record after implementing some organisational restructuring and operational changes. The airline joined the Sky Team alliance in 2010. (Stanley, 2007)

The following security-related incident was the airline's only event in this category.

On May 3, 1986, a China Airlines pilot hijacked flight number 334, a freighter service using a Boeing 747-200 aircraft. The hijacker, Mr Wang Xijue, was flying en route from Taipei, the capital of the liberally ruled Taiwan to Bangkok in Thailand. (OMICS, 2012)

> *"Wang managed to subdue the two other crew members, changed course and landed the aircraft in Guangzhou the southern main land China city where he defected*". (WHE, 2014 a)

Researching Xijue's profile did not reveal much information regarding his background or personality. However, the motive appears to be ideological, as proven by Xijue's defect to the communist-ruled China from western ruled Taiwan.

No psychological or mental disorders were reported in this hijacker's case. However, Chinese political propaganda could not be ruled out as a reason, assuming that Xijue was a Chinese intelligence recruit or a spy, which in turn would point towards a political triggering factor. Nevertheless, the financial factor must be considered in this case, as well.

Pacific Southwest Airlines (PSA) flight 1771. December 7, 1987

Renga and Mentges (2010, pp. 7-8) described PSA history, how did the company started in 1949 and continued to operate until 1988 when US Airways took over the airline. Writing about PSA rise and demise, Trinkle said

> *"PSA was actually the first low cost airline in the United States and was one of four airlines that formed US Airways. The other three were [...] Allegheny Airlines, Piedmont Airlines* and *America West Airlines. US Airways later merged with American Airlines in 2014"*. (Trinkle, 1995)

Between 1969 and 1987, PSA had three non-security related incidents/accidents, in addition to the following security-related event.

Flight 1771 crashed near Paso Robles, California (FSF, 2017 b), *"on December 7, 1987",* when a discontent passenger shot his boss who was travelling as a passenger and then shot the pilots before turning the gun on himself and committing suicide. The remaining crew and passengers died instantly in the accident. (Infogalactic, 2016)

Former USAir Employee David Burke, age 35, was terminated after being caught stealing and was also a suspect in several other theft events within the airline.

Burke met Ray Thomson, his manager in PSA and tried to convince him to give him his job back. For Burke's disappointment, Thomson rejected his request. After the meeting, Burke bought a one-way ticket on flight 1771; the same flight Thomson was booked on from Los Angeles to San Francisco, as he regularly commuted to work using the daily shuttle service.

Burke used his unreturned company ID to access the aircraft and by-pass Los Angeles airport security screening with the gun that he borrowed from one of his colleagues. (Magnuson, 2001) However, US Air which bought PSA announced that Burke's ID was sized on the day he was fired and was destroyed later. Reports mentioned that a message written by Burke on an airsickness bag was found in the crash site, but it was not confirmed if Thompson read the message before he was shot or not (King & Malnic, 1987), the message read

> *"Hi Ray. I think it's sort of ironical that we end up like this. I asked for some leniency for my family. Remember? Well, I got none and you'll get none".* (King & Malnic, 1987)

As the BAE 146 aircraft reached its cruising level, the cockpit voice recordings indicated that somebody entered and then left the toilet which is located next to the flight deck (Cummings, 1987), the documentary series Mayday (Gransden, 2011), presented a re-dramatisation of the events based on the CVR data, which *"suggested that this was Burke entering the lavatory to draw his revolver discreetly".* The CVR recordings of routine in-flight duties by the crew were interrupted shortly afterwards by *"[...] the sound of two shots being fired in the cabin".* (Kilroy, 2013 a)

The scenario portrayed by the Mayday episode assumes that Burke shot Thomson two times, an assumption that was backed by the investigation report that indicated that the seat behind Thompson's was found in the crash site with two bullet holes assumed to be from the bullets that killed Thomson then penetrated his body, seat and the seat behind him. (Kilroy, 2013 a)

The last radio transmission from flight 1771 came from first officer Nunn as he reported the gunshots, then the CVR indicated that cabin attendant Debra Neil entered the flight deck and told the pilots *"We have a problem"*, and when questioned by Captain Lindamood about the nature of the problem, the sound of Burke shooting Debra could be heard and then he said *"I'm the problem"* before shooting two more bullets assumed to have killed or disabled the pilots. Shortly afterwards, the aircraft entered a steep dive after Burke pushed the controls of the aircraft forward according to the flight data recordings, crashing the aircraft into Santa Lucia Mountains and killing all on board. (Kilroy, 2013 a)

Describing Burke's troubled career and personality, Kilroy wrote

> *"He had previously worked for an airline in Rochester, New York, where he was a suspect in a drug-smuggling ring that was bringing cocaine from Jamaica to Rochester via the airline, although Burke was not officially charged, he relocated to Los Angeles to avoid future suspicions. Some former girlfriends, neighbours and law enforcement officials described him as a violent man before flight 1771".* (Kilroy, 2013 a)

Burke's apparent motive, was to take revenge from his unmerciful boss Mr Thomson, whom Burke perceived as the man who destroyed his life by rejecting his appeal, leaving him with no source of income to support his seven children or himself. Burke pioneered the application of Crayton

(1983:37-8) narcissism-aggression hypothesis, which Lubitz repeated many years later, he felt helpless about losing his job and saw no other alternatives, he was full of rage about it, and by killing Thomson, he destroyed what resembled the source of narcissistic injury in his mind.

Another factor that may be considered is Burke's financial situation, keeping in mind his theft history and being a drug-smuggling suspect, which implies Burke's need for money that was concluded by the theft case that lead to his termination from USAir.

The airline experienced three other hijack attempts between 1972 and 1980, resulting in either injury, death or both to people involved. However, none of the hijackers in the mentioned events was an employee. Consequently, these events were excluded from this research for irrelevance.

The stringent implementation of the federal law that required the immediate confiscation of airline employee's credentials upon the termination or resignation from an airline position and the FAA's adoption of a policy to mandate subjecting all airlines flight crewmembers to full security procedures that are similar to those of the passengers were measures that came into effect in response to this event. It is a good example of reactive measures and the significant impact of security events on developing and implementing measures and policymaking.

Xiamen Airlines flight 8301, October 2, 1990

Owned by the civil aviation administration of China and the Fujian provincial government, Xiamen Airlines started operations on July 25, 1984. The airline has a fleet of 114 aircraft flying to more than 220 domestic plus 30 international and regional destinations. The airline claims to be the only Chinese airline that has maintained profitability for 28 consecutive years. (Xiamen, 2015)

Xiamen airline's domestic flight 8301, operated by a Boeing 737 was flying from Xiamen to Guangzhou city, during the flight, the 21 years old hijacker informed the crew that he was carrying an explosive device and ordered the pilots to fly to Taiwan where he can request political asylum.

Not having enough fuel to fly to Taiwan, the captain suggested to land in Hong Kong, but the hijacker rejected the suggestion. After holding over Guangzhou city while the captain tried to reason with the hijacker, the fuel became dangerously low, and the captain was forced to land at the nearest available airport which happened to be Baiyun airport in Guangzhou. (Kilroy, 2013 b)

Suddenly and as the aircraft touched down, the hijacker who was in the first officer's seat started interfering with the flight controls causing the aircraft to exit the runway and hit a China Southwest airline Boeing 707, injuring the parked aircraft captain before hitting another China Southwest Boeing 757 that was preparing for take-off, killing 47 of its passengers in addition to 84 out of the 104 passengers on board the hijacked aircraft and a car driver that was hit by the burning rubble.

> *"The Chinese authorities, known to be reluctant to criticise their own procedures, admitted that it had been a serious mistake to allow an aircraft to taxi while the hijacked aircraft was attempting to land".* (Kilroy, 2013 b)

It was not possible to locate any more information about the hijacker, due to the level of anonymity and secrecy that are usually used by the Chinese authorities to surround similar events, mainly to display an immaculate safety record to the world. However, the ideological motive is the most probable cause in this event, based on the hijacker's intention to use the aircraft to transport him to Taiwan, where he could ask for political asylum.

Due to the lack of supporting evidence, psychological or mental disorder factors that triggered the hijacker actions after landing, causing the captain's loss of control and the resultant fatalities, could not be confirmed or discarded. However, the financial factor is also evident in this event, as the hijacker robbed 17,000 Yuan from the non-aviation, Chinese company that employed him at the time of the event. (Kilroy, 2013 b)

The hijacker was not an airline employee, and his motive seemed to be criminal, the drive behind his illegal actions and the root cause in this event appears to be financial. The hijacker's presence in the flight deck and interference with the flight controls from a pilot's seat which lead to the catastrophe was an act of unlawful interference; therefore, the event is included in this chapter.

Federal Express flight 705, April 7, 1994

Federal Express is the world largest all-cargo, American airline. It was established in 1971 and was rebranded as 'FedEx' in 1994. The airline main operations hub is in Memphis, Tennessee. FedEx group of companies employ more than 400,000 people across its global network and serve more than 220 countries across the world (FedEx, 2017 a).

FedEx operates 657 aircraft and has orders for another 36 Boeing 767 and 777 (FedEx, 2017 b).

The DC-10 hijack and suicide/homicide attempt is FedEx only security-related incident, despite being involved in several other accidents.

FedEx flight engineer Auburn Calloway was travelling off-duty from Memphis to San Jose; he managed to bring on board *"a spear gun, a hunting knife, and two other hammers"*.

While the aircraft was climbing towards its cruising altitude, Calloway who was seated in the courier area stormed the flight deck carrying the hammers and attacked the crew intending to kill them and then crash the aircraft. (CVR, 2015)

The shocked and seriously injured captain and flight engineer engaged in a deadly physical fight against Calloway and managed to push him out of the flight deck; meanwhile, the stunned first officer manoeuvred the aircraft violently in an attempt to tumble Calloway and allow his colleagues

to restrain him. The Martial arts expert was not an easy target, and the first officer had to engage the autopilot and rush to assist his colleagues in their fight to subdue Calloway, the first officer went back to the flight deck and landed the aircraft while his colleagues continued to fight Calloway until the aircraft landed, Calloway and the entire crew were badly injured. (CVR, 2015)

A note was found later, and it indicated that Calloway intended to commit suicide, should his plot has succeeded, Calloway's family would be entitled to a FedEx life insurance policy of two and a half million USD, while he would appear like an employee who was killed in an air crash while on duty and escape the humiliation of his upcoming fraud investigation. (CVR, 2015)

> *"Callaway's attack also occurred one day before a scheduled hearing with his superiors, regarding allegations of false information about his flying experience on his FedEx job application. Calloway expected that the hearing outcome would put an end to his career; he wanted to secure his family's future and at the same time take revenge from the company.* (CVR, 2015)

When researching hijackers/suicidal crewmembers profiles, there is no doubt that Callaway's profile is one of the most beneficial to the subject, he was 42 years old at the time. (Bellows, 2012)

Nevertheless, jury's decision that Calloway intention to commit suicide was a criminal act, without attributing his actions to a psychological or mental disorder, is not enough to discard the effect of the stress related to the fear of losing his job and the concerns he had, about his family's financial security, as both were strong triggering factors to his determination to crash that FedEx aircraft.

Shame and guilt, if he was convicted for 'flying hours' falsification, especially after the glory years as an elite navy pilot, federal express flight engineer and a martial arts expert, could not be ignored as factors as well.

Callaway's self-esteem and pride (which is common in pilots, particularly the ex-military), was hurt, and when combined with the previously discussed factors, it all made him fragile. He was unable to cope with the expected damage to his picture-perfect image or deal with the consequences. Callaway's profile strongly recalls Crayton (1983:37-8) narcissism-aggression hypothesis one more time.

The Psychological factor is not counted as a factor when assessing this event based on the court's decision to discard it. However, the financial, job security, revenge/hate and relationship factors are all present in this unique hijacker profile who failed to see his suicide plan succeed because of the other crewmember's courage and resilience.

Royal Air Maroc flight 630, August 21, 1994

Royal Air Maroc is the flag carrier of Morocco; it was established in 1953 and operated a fleet of 53 aircraft between 1958 and 2010. The company had 12 incidents/accidents, five of which resulted in fatalities. This event is the company's only security-related fatal event. (FSF, 1994 a)

During cruise at 16,000 feet, the ATR 42-300 aircraft entered a steep dive and impacted the ground. All 40 passengers and four crew members were killed instantly. (AP, 1994 a)

A report indicated that the commission which investigated the crash established that the captain disconnected the autopilot and deliberately crashed the aircraft (AP, 1994 b). The report added

> *"[...] co-pilot screamed "Help, help... The captain is ..." but the rest of her terrified cry was lost on the cockpit recorder of the Royal Air Maroc plane as it streaked toward the ground. Investigators today issued their grim conclusion of what the co-pilot meant: Pilot Younes Khayati was committing suicide by deliberately crashing the plane.* (AP, 1994 a)

The Moroccan pilots union strongly defended Captain Khayati and rejected the initial investigation finding regarding pilot suicide; the union claimed that the investigation committee did not present enough evidence to support its allegations. (AP, 1994 c)

In such a conservative environment and culture, the community is not expected to believe pilot suicide due to love life problems as the reason behind the accident, as claimed by the crash investigation committee.

Cultural awareness of the Moroccan, Muslim and Arab society and its structure, explains why it is tough to convince the public, that a failed love affair was the motive behind one of the society's elite and best-paid professionals (who was only 32 years old) decision to commit suicide in this devastating way. (Blair, 2015)

While dying in an aircraft accident is perceived in that society as martyrdom, allowing the deceased to enjoy eternal life in heaven, suicide in the Arab and Muslim culture is viewed as a shameful act and a sin that would bring shame to the entire family and cause the person to burn in hell for eternity, a belief that explains the aggressive denial by both, peers and family in such a case.

The established factor in this event and based on the available information is personal (relationship/marital issues).

Kish Air flight 707, September 19, 1995

Kish Air is an Iranian domestic, international and charter airline which started operations in 1989, it is operating a fleet of 12 aircraft, mainly from Kish island and Tehran's Mehrabad airports.

As the Boeing 707 carrying 173 passengers destined to Kish Island approached its destination, a discontent male cabin crew used a gun to hijack the flight.

> *"He demanded to fly to Europe. But the plane, which was short on fuel, arrived in Israel after both Jordan and Saudi Arabia refused its request to land. An Israel Air Force jet escorted the plane to the Ovda military air base near Eilat.*
> *The hijacker was taken into custody. He sought asylum to the United States but he was refused and had to stay in Israel for further proceedings".* (Fouman, 1995)

While the hijacker denied any political affiliations or motives, the media immediately focused on the politically sensitive event as Iran and Israel exchanged accusations with Iran calling the hijack event *"a terrorist act of the Zionist regime"* while the right-wing factions in Israel called for exchanging the plane, and its occupants for the Israeli navigator Ron Arad, who was shot down over Hezbollah controlled part of Lebanon while bombing a target in 1986 and assumed to be in Iranian custody. (Fouman, 1995)

The defected Iranian flight attendant was later identified as Rida Garari (WHE, 2014 b), while another report named the hijacker as 36 years old, Reza Jabari. (Cockburn, 1995)

The identified factors in this event are believed to be ideological/political reasons, which triggered Garari's actions, leading him to hijack the aircraft and use it as means of transportation to Israel, where he defected. Financial factor is also a possibility, given the socio-political situation in Iran at the time. However, it was not possible to establish enough evidence to support the financial factor.

Silk Air flight 185, December 19, 1997

Silk air was founded in 1976. It is a wholly-owned subsidiary of the award-winning Singapore airlines, the legacy flag carrier of the Asian state of Singapore. An award-winning airline on its own like its parent company, Silk air regionally operates a young fleet of 28 aircraft on behalf of Singapore airlines. (SilkAir, 2015)

The successful subsidiary enjoyed immaculate safety record except for the 1997 accident discussed below, unlike its parent company Singapore Airlines, which was involved in four accidents, including a hijacking event on March 26, 1991. The SIA hijack event was concluded by killing the Pakistani hijackers, with no fatalities among the crew or passengers.

Singapore Airlines maintained an excellent safety record since its establishment in 1972 up until October 2000, when the airline had its first accident.

The BBC (2000) covered the Jakarta to Singapore, Silk air Boeing 737-300 accident that killed the 104 people on board and reported that American investigators believed the crash was a deliberate pilot suicide as the aircraft had no technical issues, the CVR was *"intentionally disconnected"*, and Captain Tsu Way Ming did not take any corrective actions to pull the plane out of its lethal dive.

The American investigator's pilot suicide claims became the focus of media coverage despite the Indonesian final investigation report that declined the American claims based on lack of evidence due to the *"highly fragmented wreckage"* and the non-existence of a proof to support Tsu's *"Suicidal tendencies"* according to a statement by Singapore police and Indonesia's National Transportation Safety Committee. (BBC, 2000)

However, the NTSB investigation revealed that Mr Tsu (who was an ex-elite aerobatics team pilot with Singapore Air Force) had significant debt and that he had a disciplinary action, taken against him by the airline management shortly before the accident. (BBC, 2000)

> *"A separate report from the US board argued that the plane could not have done what it did without deliberate action from the pilot. It said the wreckage showed the plane's engines were set to high power and that controls were set to a "nose-down" position. The US board said it was disappointed the Indonesian report failed to analyse information about the pilot's financial debts".* (BBC, 2000)

The conclusion of all these contradicting statements is pointing towards pilot suicide, apparently triggered by a financial factor, with the possibility of a job security element based on Mr Tsu's rough career with Silk Air.

The similarities between Mr Tsu and Mr Calloway profiles could not be ignored, both men were ex-military fighter pilots in their early forties, both had job security concerns (despite the different reasons), and they were very concerned about financially securing their families.

As Silk Air and FedEx events were separated by almost two and a half years, it is a possibility that Mr Tsu's actions were inspired by Mr Calloway's attempted suicide, a hypothesis that mandates a more detailed investigation of Mr Tsu's profile.

Captain Tsu Way Ming

Paddock (2001) gathered some very comprehensive information regarding captain Tsu (who was 41 years old) which is found to be beneficial in establishing the triggering factors behind captain Tsu's actions and possibly, the other perpetrators as well.

Describing Tsu's life before the accident, Paddock (2001) mentioned that Tsu was a talented former Singapore air force fighter pilot who served as a member of the elite 'Black Knights' aerobatic team. He retired as a major in 1992 and preferred to join Silk Air over Singapore airlines due to the faster upgrade to captain position in Silk Air.

Tsu became a captain in 1996 and a Boeing 737 instructor seven months before the accident. Paddock also mentioned that Tsu was in line for a management position because of his background and experience. Describing Tsu's personality and family life, Paddock wrote

> *"A father of three, he was said to be a devoted family man. He was quiet, sometimes distant, colleagues said, but spoke his mind and was a leader among the airline's Singaporean pilots. He gained a reputation for doing things his own way and not always following procedure".* (Paddock, 2001)

Paddock pointed out that Tsu's professional problems started in March 1997, when Silk air investigated a rejected landing following an unstable approach by Tsu. Paddock added that four months later, when Tsu was flying with co-pilot Dittmer, (the first officer on the March flight, that Tsu assumed he was the pilot that reported him) and after an intense argument, Tsu switched off

the cockpit voice recorder (an extreme and unjustified action by all professional standards), as he wanted to preserve their discussion as evidence. (Paddock, 2001)

Describing Silk Air actions after they heard from Dittmer about Tsu's behaviours, Paddock wrote

> *"After the incident, Silk Air disciplined Tsu by taking away his newly won promotion to instructor. Mohan Ranganathan was a Silk Air captain who knew Tsu. A veteran 737 pilot, he said he warned his bosses before the crash that Tsu was an unsafe pilot. They refused to listen, he said".* (Paddock, 2001)

Exploring Tsu's financial situation, Paddock said that Tsu was struggling and *"His stock market trading account was suspended twice for non payment, once in August and again on December 4, two weeks before the crash".* (Paddock, 2001)

Paddock also quoted investigators who said that Tsu lost more than 1.2 million Singapore dollars in stock trading. Although Tsu was not bankrupt, his income was not enough to cover his expenses as per the police reports.
Interestingly, Tsu paid for a 600,000 Singapore dollars life insurance policy only three days before the flight and the policy became active on the day of the flight. (Paddock, 2001)

Based on the findings of the Indonesian final investigation report, Tsu's family received the life insurance policy full amount of $ 600,000. This finding alone was strong enough to highlight the financial factor as the motive behind captain Tsu's suicide, keeping in mind the earlier discussed financial situation of the family just before Tsu's death and the fact that he bought the insurance policy in a rush, for such a significant amount of money.

Nevertheless, job security and the working environment should not be ignored, as work-related issues including the removal from Tsu's newly acquired instructor position and being the subject of an internal investigation might have added to Tsu's frustration, depression and stress level, making him vulnerable for suicidal ideation and willing to seek revenge for his hurt ego.

On the other hand, cited in Paddock (2001), "*Thomas Oey, an American who lost his mother and brother"* in the 1999 Egypt air accident, suggested a mixture of measures, assuming that it could have prevented further PSUA events. Describing Oey's argument, Paddock wrote

> *"He believes a prompt finding that the Silk Air crash was caused by pilot suicide could have led to video cameras in cockpits and better psychological screening of pilots, perhaps preventing the 1999 Egypt Air disaster".* (Paddock, 2001)

Chapter 5 of the research will revisit Oey's proposal while discussing one of the survey pilot's comments, which proposed similar measures to combat PSUA. However, Oey's statement that *"better psychological screening of pilots could have prevented Egypt air disaster"* is debatable, with experts like Bor and Teichmuller rejecting Oey's argument, and especially after the screening in its current format, failed to prevent further events including German wings accident.

The failure of psychometric screening is not because of the irrelevance of the test; it is due to the irrelevance of the parameters collected by such commercially available tools like PAT, PSA and PILPAT when assessing pilots. Psychometric screening, in its current format, ignores the vital root causes of the problem, which are, the triggering factors behind a pilot's suicidal behaviours.

Air Botswana ATR 42-300, October 11, 1999

The domestic and regional airline was launched in 1972 and after several years of struggling to establish itself as Botswana's flag carrier. The airline was acquired by the government and restructured in 1988. (Kaboyakgosi, 2003, p. 5)

Despite the small size of the airline, it managed to remain profitable for the last decade. The airline had five non-fatal incidents apart from the accident described below. Nonetheless, the airline managed to pass the tough, International Air Transport Association (IATA) Line Operations Safety Audit (LOSA). (FSF, 2012 a)

Captain Chris Phatswe was one of the first native pilots to achieve a captain position. However, shortly after he was grounded for medical reasons, the 35 years old Captain was assigned a ground job as a flight safety officer. (IOL, 1999).

On October 11, 1999, Phatswe took off on an Air Botswana ATR 42 aircraft and after making two loops and flying around until the aircraft ran out of fuel; he crashed into two other company ATR 42 planes that were parked on the ground. Phatswe was the sole aircraft occupant, and he was killed instantly in the accident. (BBC, 1999)

The actual reasons behind Phatswe's medical grounding remains unconfirmed, despite a report by the South African website IOL that claimed he had AIDS, according to James, Chilisa and Pienaar (1999), the report did not present any evidence to support these claims.

Aviation Safety Network indicated in its accident review that Phatswe wanted to speak to his girlfriend before crashing the aircraft; additionally, he also wanted to speak to the country's president, the airline's manager, the police chief (FSF, 1999) and he told airport officials several times that he would commit suicide, which indicates a desire for attention as explained earlier by Lankford and cited in Goode (2015).

Apart from losing his pilot's license at the age of 35 after being the first native pilot to qualify as a captain, the frustration that Phatswe had to go through was much aggravated after his claimed diagnosis with AIDS. The ensuing love life complications were too much to handle. The mounting socio-cultural stress, combined with the damage to his pride and reputation was extremely hard on him that it triggered his decision to end his life in this spectacular way, which is Phatswe's way to express his illness according to Hubbard (1971) as cited in Hudson (1999) and mentioned earlier.

What remains unexplained is why did Phatswe crash his plane into the two parked aeroplanes? The only logical assumption is that he wanted to take revenge from the company that stopped him from flying, as he might have perceived the situation, displaying the same and common narcissism-aggression symptoms as explained by Crayton (1983:37-8) hypothesis which is covered in previous PSUA events and displayed by the pilots involved.

Egypt Air flight 990, October 31, 1999

The government-owned, Egypt Air is the flag carrier of Egypt; it was established in 1932 as Misr (the Arabic name of Egypt) Airlines. It is now operating a fleet of 66 aircraft over a vast network spanning the six continents. (EgyptAir, 2019)

The airline was seriously affected after the political changes that took place in 2011, as the removal of President Mubarak and the local unrest, with the chaotic security and political situation that followed, reflected negatively on the tourism industry which is the main pillar of Egypt's fragile economy.

Between 1951 and 2011 the airline had 13 accidents, including the 1985 hijack of a Boeing 737 while operating flight 648 to Malta. The Egyptian Special Forces stormed the aircraft, killing two crew members and 59 out of the 90 passengers in the process. (BBC, 1985)

Flight 990 departed Los Angeles to Cairo with a planned technical stop at New York JFK airport, where a crew change took place. The Boeing 767 took off from JFK crewed by Captain Ahmed El Habashy, First Officer Adel Anwar and due to the length of the flight, an additional relief crew was carried that included Captain El Sayed Nour El Din and First Officer Gamil El Batouty.

The cockpit voice recorder transcripts indicated that while flying at 33,000 feet, Captain El Habashy excused himself to the lavatory after agreeing to a swap of duty, allowing El Batouty to operate the first part of the flight instead of Anwar, as requested by El Batouty. It was clear from the recordings that Anwar was reluctant to accept the swap.

Shortly after that, alone in the flight deck, El Batouty said in Arabic what translates into *"I rely on God"*, and 48 seconds later the autopilot was disengaged, both elevators were moved to place the aircraft nose down, and then the throttles of both engines were reduced to idle. (NTSB, 2000, p. 4)
Now in a steep dive, El Batouty repeated calmly *"I rely on God"* several times until the captain managed to get back to the flight deck.

According to the investigation report, El Habashy shouted *"what's happening?"*, The flight data recorder indicated that the elevators then moved into a split condition, with the left elevator up and the right elevator down, a situation that results when the captain is pulling up while the first officer is pushing down on the control column of the aircraft. (NTSB, 2000, p. 5)

Realising that both engines were shut down, the captain asked in disbelief *"what is this? Did you shut the engines? Get away* [and El Batouty replied calmly], *"it's shut"*, according to the exact translation of the NTSB voice recorder transcript. The captain repeatedly said, *"Pull with me* [till the voice recording ended]. *There was no indication of an explosion on board and both engines operated normally* [until El Batouty shut them down. The aircraft] *crashed into the Atlantic Ocean killing all 217 people on board"*. (NTSB, 2000, pp. 6-35)

Another ex-air force pilot, El Batouty, was 59 years old, only one year away from the mandatory airline retirement age at the time. He was married and a father of five kids with his youngest daughter chronically ill. Interviewed colleagues gave contradicting statements about him. In conclusion, he was an average pilot who enjoyed the respect of his colleagues, as he was the most senior first officer on the Boeing 767 fleet at the time.

El Batouty was described by some of his colleagues as *"fun loving and used to drink alcohol discreetly to preserve the religious image he was portraying in front of the not very close peers"*, a kind of behaviour that is not uncommon amongst pilots from some Middle Eastern cultures.

El Batouty served as an army major before retiring from the air force to become the chief instructor of the Egyptian civil flight training school. Later, he managed to join Egypt air as a first officer, a position that he willingly decided to maintain, as he was not willing to take the necessary exams for the required licence to become a captain due to his English proficiency level.

Wald claimed that the motive behind El Batouty's suicide was revenge. He said that Mr Hamdi Hanafi Taha, a former colleague of El Batouty told American investigators that he crashed the plane to take revenge on Captain Hatem Rushdy, the Boeing 767 chief pilot who told him that he would be banned from US flights because of alleged sexual misconduct. Captain Rushdy was onboard flight 990 travelling as a passenger that night. (2002)

Only one year away from retirement, with five children (one of which is seriously ill), must have placed some heavy financial strains on the retired officer. In the Middle East, retired officers are not usually the best paid in the flying profession, forcing most of the retired senior officers to accept the available junior airline positions to continue supporting their families after retirement.

Job security concerns were also considered as a triggering factor in this event, especially when taking into consideration, Rushdy's threat to remove El Batouty from the lucrative US flights, a threat that represented multiple triggering factors on its own, because the sexual misconduct allegations (should it become known to his family and colleagues) could destroy El Batouty's image and family life.

To explain it further, in an Arab community, that is dominated by Muslims such as the Egyptian society, being accused of sexual misconduct could mean shame for life, not only to El Batouty but to his entire family as well. It would mean the destruction of his image and respect within his family and social circles, to the extent that he might have thought, that his daughters would never be able to get married because of their father's disgraced and ruined reputation.

One more string that could have aggravated the financial factor was the possible loss of Egypt air end of service benefits in case of his conviction of sexual misconduct, leaving his family, his sick daughter and himself without financial support.

Despite having direct conversations with several ex-Egypt air pilots whom personally or professionally knew El Batouty, most of them did not give consent to publish the verbally discussed information, for the few who did, they insisted on total anonymity, in what appeared to be a cultural taboo or perhaps an unofficial union, non-disclosure agreement.

September 11th attacks

Considered the worst aviation disaster in the history of aviation, 9/11 was not the first fatal security event, but for sure, it was the deadliest ever.

On the morning of September 11, 2001, a group of 19 terrorists from Middle Eastern origins executed a synchronised hijacking of two Boeing 767s flying from Boston to Los Angeles, namely, American Airlines flight 11 and United's flight 175. Additionally, two Boeing 757s were also hijacked, American airlines flight 77 from Washington to Los Angeles and American Airlines flight 93 from New York to San Francesco. (Kilroy, 2001)

> *"Flights 11 and 175 were used to attack and destroy the world trade centre at down town Manhattan while flight 77 was used to attack the pentagon and flight 93 was expected to destroy either the white house or the US congress in capitol hill"*. (Kilroy, 2001)

Instead, flight 93 crashed during what is believed to be a heroic but unfortunately, unsuccessful passengers struggle in an attempt to regain aircraft control from the hijackers.

The reported 9/11 death toll reached 4736 fatalities as of November 9, 2001, including passengers and crew of the four aircraft, 649 confirmed causalities in the World Trade Centre and the Pentagon, while 3822 people were reported missing. The exact number of people who perished that day might never be established, while the estimates of the financial damages are in the range of 3.3 trillion US dollars (Carter & Cox, 2011).

It is said that 'procedures are usually written in the victim's blood' when looking back at the history of aviation development; however, 9/11 was the most expensive of lessons.

Due to the massive publicity that surrounded the event, combined with public anguish and the lack of security perception, several firm security measures were immediately implemented to reassure the panicking public and regain the lost passenger's trust. Many of the introduced procedures, measures and regulations proved beneficial in making air travel safe again as evidenced by the steady growth in global air traffic and the declining number of hijack events.

However, the profiles of 9/11 terrorists were excluded from this chapter, as all hijackers were categorised as ideologically motivated terrorists, who pursued the cause of a fanatic political/ religious agenda. Nonetheless, the financial factor remained a possibility for certain individuals from the 9/11 hijackers group, due to their adopted non-religious lifestyle, which contradicted their projected ideology.

Additionally, despite some of the hijacker's possession of some light aircraft flying hours that was obtained while they were training to become pilots in some US flight schools, none of the 9/11 hijackers worked for an airline, rendering their profiles irrelevant to the research subject.

Post - September 11th Era

Mozambique airlines flight LAM 470, Nov 29, 2013

Mozambique Airlines (LAM) was established in 1936 as DETA (the Portuguese abbreviation for the department of railways); the name was changed in 1980 to the current one. The airline is the flag carrier of Mozambique, and it operates a small fleet of seven aircraft on domestic and regional routes. (LAM, 2015).

Between 1944 and 2013, LAM had seven fatal accidents, none of which was a security-related event, except for LAM 470. LAM is also on the list of African airlines banned from flying to the European Union countries due to EASA's concerns about LAM safety performance, the ban was imposed well before the 2013 accident and included all Mozambique air operators.

Flight 470 to Angola was operated by an Embraer 190 aircraft; the flight crashed in Namibia killing all 27 passengers and six crew members on board, when Captain Herminio Dos Santos Fernandes, age 49, locked the cockpit door after the first officer left to the lavatory and manually selected an altitude below ground level just before plunging into a fatal dive to the ground. On the cockpit voice records, repeated banging against the door by the first officer while he continuously asked the captain to open the cockpit door could be heard, according to the accident investigation report. (Namibia, 2016)

An article in Zimbabwe's 'The Herald' quoted a colleague of Fernandes, who said that he was always depressed during the two month directly preceding the accident due to long term marriage problems and that he was not talking to his wife for a long time. (The Herald, 2013)

Cited in the same article were the comments of Namibia's Director of Aircraft Accident Investigation, during an interview with the Namibian Sun newspaper

> *"Nengola further stressed that the airline has the responsibility to ensure that all crewmembers are medically and mentally fit. He added that airline management should be notified in an instance whereby one of the crew is acting "funny or depressed".*
> *"This situation should be monitored to ensure whether a pilot is able to fly".*
> (The Herald, 2013)

Mr Nengola's comments reflect a thought pattern that supports the research recommendations regarding suicidal behaviours recognition, training and processing. It also highlights the significant impact of martial issues (personal factor) on a pilot's mental health. Nengola stressed on corporate responsibility towards the employees, not only by caring for their physical health but also for the equally crucial, mental health monitoring and maintenance.

Nonetheless, LAM confirmed that both pilots satisfactorily passed their routine medical check in September 2013.

The identified triggering factor in Fernandes case is mainly 'personal'. The investigation report also focused on the following sub-factors; marital issues (divorce), loss of a loved one (son died the year before in a car accident assumed to be suicide at age 21, Fernandes did not attend the funeral) and the chronic illness of a loved one (Daughter had a heart surgery shortly before the accident). However, assuming a certain level of post-traumatic stress because of Fernandez son's tragic death and the similarities between Fernandez and Batouty's profiles in term of daughter's sickness and the relevant stress, the 'psychological' factor could not be ruled out as well. (Namibia, 2016)

It is worth mentioning that the investigation report also blamed non-adherence to company procedures, namely, the 'Minimum crew in the flight deck' procedure, as a contributing factor to the accident.

Attempts to interview some LAM pilots that personally knew Fernandes were also unsuccessful, for reasons similar to those of the Egyptian and Singaporean pilots. Despite the different cultural, social and even religious backgrounds, pilot's suicide in itself proved to be a very sensitive subject to discuss with pilots, irrespective of their origins or backgrounds.

Ethiopian Airlines flight ET 702, February 17, 2014

Founded in 1945, Ethiopian airlines started operations a year later to become one of the leading airlines in Africa and the flag carrier of Ethiopia. The airline operates a modern fleet of 72 aircraft (with 42 more already ordered) to 128 cargo and passenger destinations in Africa, America, Europe, Asia and the Middle East. The airline won the African airline of the year award consecutively from 2009 to 2013. (Ethiopian, 2015)

Between the start of operations and 2015, the airline had 63 occurrences with many fatalities involved, seven of which were hijack events, with the majority of the hijacked flights being stormed by security forces and the hijackers ending up dead.

The Eritrean freedom fighters hijacked two of the events that took place between 1969 and 1972 before Eritrea got its independence in 1993. However, security forces foiled the attempts, and most of the hijackers were killed in the process. (FSF, 2017 a)

The 30 years old first officer Hailemedhin Abera, of Ethiopian Airlines Boeing 767 flight ET 702, hijacked the aircraft when his captain left the flight deck for a visit to the lavatory.

The first officer locked the cockpit door and flew to Geneva, Switzerland instead of his original destination, Milan, Italy. Abera was un-armed and did not pose any threat to the crew or passengers. After landing, he exited the plane from the cockpit window by using an escape rope and surrendered to the police. Later, it was reported that Abera requested political asylum.

Eric Grandjean, a spokesperson for Geneva police, commenting on Abera's actions said: *"His act was motivated by the fact that he says he felt threatened in Ethiopia and wanted to ask for asylum in Switzerland"*. (Kashyap, 2014)

Although the apparent motive behind this event was seeking political asylum, the accumulated frustration due to the geopolitical environment and the resultant financial strains in Ethiopia, caused the pilot to give up his promising career and hope for a better life elsewhere as a refugee.

Moreover, instead of flying to the original destination in Italy, where the economic situation is not as favourable as it is in Switzerland (especially when it comes to asylum seekers benefits), Abera elected to fly to Switzerland in this case, a choice that points towards the financial factor based on the selected asylum country.

Other possible reasons behind the hijacker's choice could be the known neutral political nature of Switzerland and the less intimate relationship it has with Ethiopia when compared to Italy.

Malaysian Airlines MH370, March 8, 2014, and MH17, July 17, 2014

Established in 1937, Malaysian airlines grew from one aircraft to a modern fleet of 91 jets including the modern Airbus 380 with orders for 14 more A380's. The one world alliance member earned many international prestigious awards and is still considered a legacy carrier. The airline's safety record was good despite the three accidents it experienced before MH370. (MAS, 2015)

The first MAS accident was the 1977 hijack of flight 653 that caused the Boeing 737 from Penang to Kuala Lumpur to crash, killing all on board (Mohsin & Boykoff, 2014). The second accident was in 1983 when an Airbus 300 operating as flight 684 crashed during landing and fortunately had no fatalities (Kilroy, 1983). The airline's third accident was the 1995 Fokker 50 fatal runway overrun in Tawau, Malaysia. (Livesey, 2014)

MH370 mysteriously vanished in thin air while operating a flight to the Chinese capital Beijing, operated by *"Captain Zaharie Ahmad Shah; a Malaysian citizen aged 53 who joined Malaysia Airlines in 1981. His second in command was First Officer Fariq Ab. Hamid; a Malaysian citizen aged 27 who joined the airline in 2007"*. (MAS, 2014 a)

Speculations and theories about the fate of MH370 are still surfacing from time to time. However, the author's operational experience as a Captain, Instructor, Examiner and a test pilot on the Boeing 777, supported by robust technical knowledge of the aircraft systems, makes it hard to accept that such a sophisticated aircraft, which is equipped with the latest in technology, could disappear like that. A dilemma that makes it tempting to research the pilot's profiles for inclusion into this research, as all the available information are pointing towards deliberate pilot action.

Nonetheless, academic research ethics would not allow the use of assumptions and speculations without having supporting evidence. However, if confirmed and authenticated information, based on the recordings of the cockpit voice recorder and or the flight data recorder becomes available or if the wreckage or part of it is located, a research revision would be considered to include the pilot's profiles and the new supporting evidence.

Similar to their Singaporean, Egyptian and counterparts from Mozambique, ex-MAS pilots that knew MH370 crew, refused to give consent to publish the event discussed information, more or less sharing the same culture and religious values as their Egyptian and Moroccan counterparts.

The shooting down of MH17 (also a Boeing 777 belonging to the same company), a little over four months following MH370's disappearance, was an unfortunate coincidence. Reports confirmed that a missile shot down MH17, rendering it irrelevant to the research subject, a brief review of the event was necessary, as the media and public tried to link the two events.

German wings flight 9525, March 24, 2015

German wings is a regional operator based in Europe, which is a wholly-owned subsidiary of the German flag carrier 'Lufthansa', it was established in 2002 and operated a fleet of 62 aircraft. It ceased operations in October 2015, months after the loss of flight 9525.

The Airbus 320 was on a regular flight between Barcelona, Spain and Dusseldorf, Germany. The French civil aviation safety investigation authority preliminary report revealed that 27 years old first officer Lubitz waited until he was alone in the flight deck, three minutes after levelling off at 38,000 feet, as the captain left to visit the toilet, this was Lubitz awaited opportunity, he locked the flight deck door and immediately started a steep dive towards the mountains. Lubitz ignored his captain's continuous knocking on the flight deck door until the point of impact, as indicated by the cockpit voice recordings. (BEA, 2015, pp. 1-29)

All six crew members and 144 passengers perished in the event, and the investigation findings revealed that Lubitz intentionally crashed the aeroplane.

Andreas Lubitz, the first officer on the ill-fated flight, started his pilot training with Lufthansa training school on September 1, 2008. A few months later, the school suspended Lubitz training for medical reasons. It was not until the end of August 2009, when Lubitz restarted his flying training and managed to complete it by March 2011.

Lubitz started working as a cabin crew for Lufthansa while studying for his theoretical 'airline transport pilot license' exams and continued to work as a cabin crew for two and a half years. Lubitz joined German wings in September 2013 and completed his training as an A320 first officer by June 2014. (BEA, 2015, pp. 1-29)

The following extracts from the preliminary accident investigation report, explains Lubitz mental health problems timeline

> *"On 9 April 2009, his class 1 medical certificate was not revalidated by the Lufthansa aero medical centre due to depression and the taking of medication to treat it.*
> *On 14 July 2009, his request for renewal of his class 1 medical certificate was refused by the Lufthansa aero medical centre".* (BEA, 2015, pp. 1-29)

However, on 28 July 2009, Lubitz managed to renew his medical which contained a restriction requiring the aero medical examiner (AME) to contact the licensing authority before renewing the medical certificate. Lubitz renewed his medical certificate annually, which contained the same limitation every time, taking his last medical exam in July 2014 that was valid until August 2015. (BEA, 2015, pp. 1-29)

In an interview with ABC News, Klaus Radke the head of the flying club where Lubitz first learned how to fly, described him and said

> *"He was a completely normal guy [...] I got to know him, or I should say reacquainted with him, as a very nice, fun and polite young man".* (AFP, 2015 a)

Commenting on the event, the German interior minister said that Lubitz *"had no known association with terrorist groups"*, eliminating the possibility of a political factor. (Reuters/AFP, 2015)

Some personal, work and financial related comments, as well as attention-seeking comments (pointing towards triggering factors such as 'financial', 'job security' in addition to the prominent 'psychological' factor), were made by Lubitz while talking to his ex-girlfriend. The comments were made public and included the following

> *"The 26-year-old woman, identified only as Maria W, recalled in an interview with the mass-circulation Bild daily how Andreas Lubitz told her: "One day I'm going to do something that will change the whole system, and everyone will know my name and remember".* (AFP, 2015 a)

Later during the same interview, Maria also said that Lubitz used to wake up at night screaming *"We're going down"*, Maria then concluded that if Lubitz crashed the plane, he did it because he lost hope to achieve his lifetime dream of becoming a Lufthansa pilot and flying big jets around the world due to his health problems. (AFP, 2015 a)

Lubitz had all the necessary ingredients for a PSUA scenario, and it is confirmed that he had a mental disorder. Nonetheless, that does not change the fact that so many people are living a relatively normal life with similar psychological disorders such as stress, depression and anxiety.

Apparently what aggravated Lubitz actions (apart from his mental illness), was the combination of financial, job security and relationship factors. It all added up, causing him to lose hope and that must have triggered his desire to end his life in such a dramatic way to fulfil his statement to his ex-girlfriend that 'everybody will remember him'.

5.0 Data analysis and findings

> *"We need to continue to be vigilant, and think about tomorrow's threat instead of trying to prevent yesterday's attack. If there's anything that keeps me awake at night, it's when I see complacency amongst people who should know better".*
>
> *Capt Craig Hall, Chairman of IFALPA's Security Committee.* (Du Bedat, 2014, p. 18)

Aviation would have never got to where it is today without building on the solid foundation of the experiences gained through the trials and errors of the pioneers in this industry, both positive and negative, as feedback from the end-users of any product (including procedures) is crucial for the continuous development of the product to reach the ultimate goal of what is expected from it.

Security procedures that are designed to combat PSUA are not an exception, and in the following pages, a detailed analysis of the pilot's survey feedback scrutinises a currently used procedure that is meant to mitigate hijack/PSUA risk. The feedback is also meant to identify gaps in the presently utilised tools and measures such as psychometric screening and identify the triggering factors and appropriate mitigation of PSUA. Additionally, the survey data analysis is used to assess the possible effects of religion, culture and ethnic origins on the perception and implementation of security procedures.

In this section, the research discusses data from the pilot's survey which reflects that pilots feel the most significant threat in terms of PSUA is not from a terrorist radicalisation of a pilot, instead of the political factor, pilots are far more concerned about the effects of psychological issues, perceiving the psychological factor as the most influential trigger in a PSUA situation. The survey data also confirmed the third possible factor behind a PSUA to be the personal factor.

The findings show that PSUA events in airline working environment were not affected by the political factor. The data also indicates that for a PSUA event to occur the presence of two factors, one of which must be psychological is required, meaning that in a PSUA, the other possible factor is mostly personal. Therefore, and as the psychological factor is not easy to identify and mitigate using the existing measures in its current format, this research is focusing on reducing the total risk by 50% through the mitigation of the personal factor, and addressing the survey confirmed personal sub-factors as explained in this chapter. However, the possibility of a pilot getting radicalised or recruited by a terrorist organisation must not be discarded, and vigilant efforts to develop and enhance the political factor must continue to address and mitigate this risk.

Pilot's survey data analysis

The following question explored the case study airline pilot's impression as end-users of the procedure after more than two years of implementation, in an attempt to measure the procedure's efficiency and validate some of the SME comments that were collected during the interviews.

Question 2; Minimum two people in the flight deck (cabin crew replacing a pilot on the flight deck) policy is

The majority of 63% of the participants thought the procedure could protect against a pilot using an aircraft to commit suicide; nonetheless, the same group of pilots also thought it was not 100% robust in combating PSUA, reflecting the group doubts about the reliability of the procedure, for different reasons as explained by pilot's comments on this question, and mainly due to cabin crew insider threat and their lack of knowledge regarding the objective of their presence in the flight deck, which is attributed to the content of cabin crew current training programs.

Only 10% of the surveyed pilots thought the procedure could effectively guard against PSUA. In comparison, 27% considered it not effective in addressing the discussed risk.

Question 3: Minimum two people in the flight deck policy is

Differently asking the same question, this technique was used to validate the previous question responses. The answers still reflected a majority of 49% of the participants believed the policy could sometimes be practical and efficient; confirming that almost half of the surveyed pilots still had their doubts about the procedure's efficiency despite the 14% drop from the 63% similar response to the previous question.

However, 33% of the responses perceived the policy as practical and efficient, while the remaining 18% thought the policy was neither practical nor efficient.

Question 4: In your opinion, a cabin crew replacing a pilot in the flight deck could prevent a pilot from using an aircraft to commit suicide.

The same question was asked one more time in a different format, to measure both efficiency and practicality at the same time, while triggering gap identification comments, to clearly understand the pilot's perspective of the procedure by giving a more specific choice of either 'YES' or 'NO'.

To confirm the answers are accurate and eliminate any doubts, a third choice of 'Did Not Answer' was offered as an option, to guard against pilots who are trying to be politically correct in answering this direct question. This time 62% responded by 'NO', while 38% answered 'YES', and none of the pilots selected the third option.

The combined outcome of questions 2, 3 and 4 confirmed the end user's dissatisfaction with the procedure as an effective PSUA risk mitigation, mainly because of cabin crew insider threat concerns and their inability to stop a determined suicidal pilot from committing suicide using the aircraft. The cabin crew deficiency in this regard was blamed on the inadequate training they receive regarding how to handle such a situation. Many of the received pilot's comments called for

improving cabin crew training and exploring alternative measures to mitigate PSUA risk, which is covered later in the chapter.

This gap analysis question aimed at generating as many comments as possible to help identify gaps in the used procedure, the question brainstormed the participants to identify the un-tackled vulnerabilities, possible threats and potential risks including the insider threat as represented by the presence of cabin crew in the flight deck that was highlighted by many of the pilot's comments.

Question 5: The cabin crewmember replacing a pilot on the flight deck

While 53% of the pilots said that at times the procedure could represent a potential security/safety threat, confirming the previously identified finding that more than half of the surveyed pilot's had their doubts about the procedure's effectiveness, 39% of the pilots did not see a threat in cabin crew presence in the flight deck, and only 8% of the participants believed it could be a potential threat.

Post survey closing date, discussions with some of the pilots that responded to this question revealed why 39% of the pilots did not see a threat in cabin crew presence in the flight deck. It is merely because cabin crewmembers always had flight deck access, either to serve meals and beverages to the flight deck or for operational reasons. That regular presence seemed to obscure the higher risk involved with granting the extra and unnecessary access to the flight deck.

Question 6: During the course of your career, did you ever take a psychometric pilot screening test such as PILPAT, PAT, and PSA.

This question is another gap analysis attempt that is aimed at measuring the efficiency, practicality and simplicity of the pilot's psychometric screening, which is used by the airline to mitigate pilot's mental disorders risk.
Responses reflected that 87% of the pilots answered YES, confirming they did attend this kind of test at least once, while 13% responded by 'NO'.

Pilot's responses to this question identified a serious gap, as 13% of the surveyed pilots were not screened and are currently flying. The actual numbers could be higher among the entire pilot's workforce. This issue must be corrected by screening the remaining pilots as soon as possible, using the enhanced screening (see page 117) until an alternative PSUA mitigation is in place.

Question 7: The psychometric test result was a pass or fail. Please mark "Not applicable" if you did not take such a test.

Identical answers matching those from the previous question validate the results. Pilots that passed the test represented 86% of the group while 1% failed it, and 13% responded with not applicable, meaning they did not take the test.

Question 8: Psychometric pilot screening tools such as PILPAT, PAT and PSA is: Accurate and efficient, sometimes could be accurate but not very efficient or neither accurate nor efficient

This question is meant to measure the pilot's confidence in the screening tools used by the company and to generate more gap identification and bridging comments.

The results show that only 17% of the pilots considered the test as accurate and efficient, 59% thought it could sometimes be accurate but not very efficient while the remaining 24% believed it is neither accurate nor efficient.

Almost a quarter of the surveyed pilots discarded the screening process as a mental health or PSUA risk mitigation, and nearly 60 per cent displayed their doubts about the tool's effectiveness. The airline utilised measures (two in the flight deck policy and psychometric screening) are considered by most of the end-users (pilots) as obsolete and several survey comments highlighted the importance of gap bridging and alternative measures introduction to address PSUA risk properly. However, the enhanced tool should continue to be used until replaced by a suitable alternative.

For the research to introduce alternative and effective measures, the survey consulted the pilots to validate the factors that could trigger a PSUA through the following questions.

Question 9: In your opinion, what factor(s) from the list below could lead (if ever) a crewmember to commit suicide? (You can select more than one answer if applicable). Please write any other unmentioned factors in the comments section below.

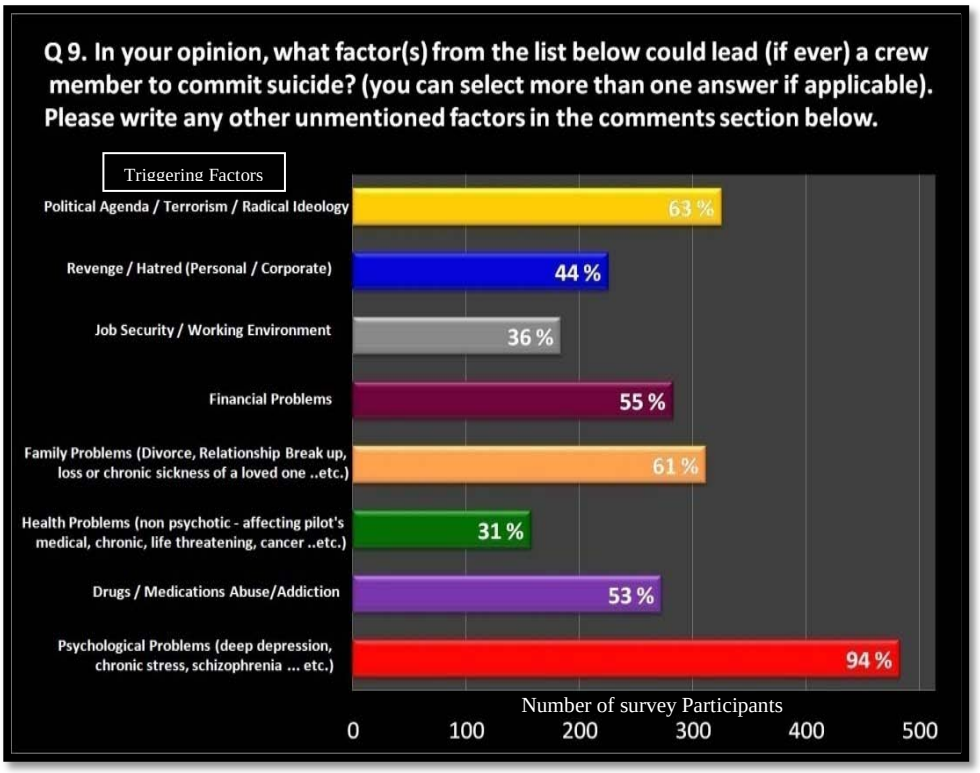
Collectively grading the factors identified from chapter 4 events analysis, the survey participants rated the factors, with 94% of the pilots selecting psychological problems like deep depression, chronic stress and schizophrenia, as the leading factor that could cause PSUA, an interesting finding as the psychological factor is the most subtle and hardest to detect among the identified factors, the psychological factor also existed in every confirmed PSUA event that was reviewed in this research and is found in 90% of suicidal people according to Kulbarsh (2014).

The second most popular response was the political agenda, terrorism and radical ideology with 63%, while third place with 61% was for family problems such as divorce, relationship break up and loss or chronic sickness of a loved one, placing the personal factor in the top three factors, which is in agreement with actual PSUA events analysis and validate the earlier discussed findings.

In contrast, financial problems scored 55%, followed by 53% for drugs, medications abuse and addiction, while 44% selected revenge and hatred as possible motives. Job security and the working environment collected 36% and at the last place with 31% were the non-psychotic, chronic or life-threatening health problems, like cancer or illnesses that could affect a pilot's medical fitness.

This data also highlights the significance of the un-tackled personal factor and sub-factors in contributing to PSUA from the end-users perspective and the gap in current security measures that do not cater for this important factor, which is explored further along with the possible mitigation later in the chapter.

Figure 5-1 Survey Question number 9 results



**Chapter 3 Survey analysis, p15*

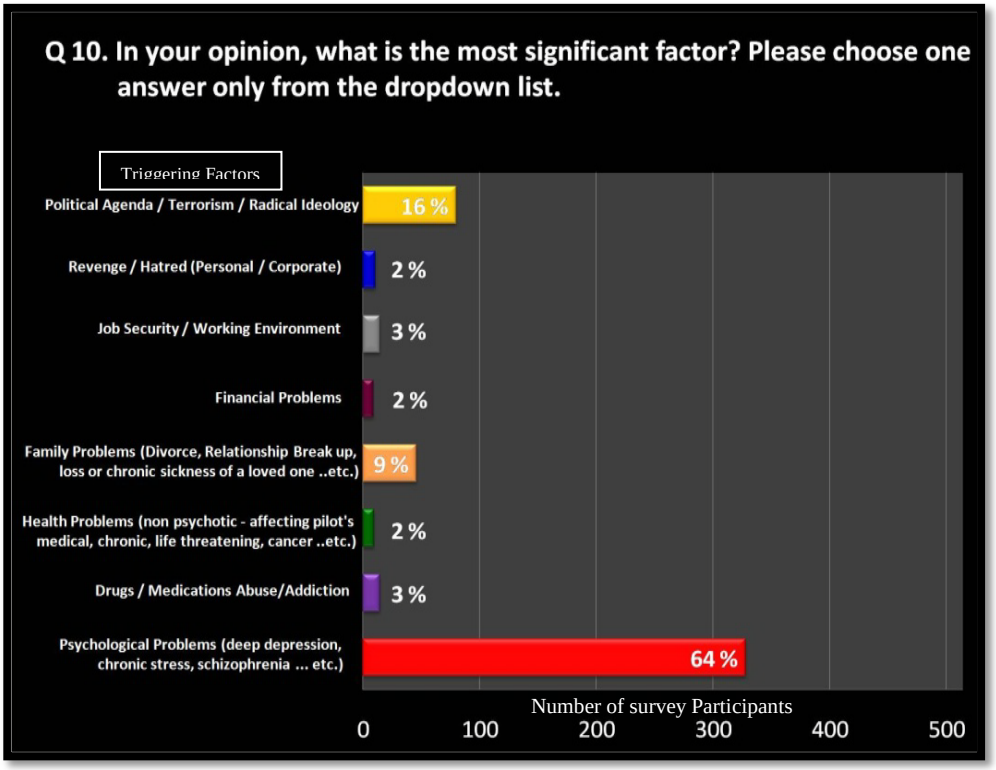
Question 10: In your opinion, what is the most significant factor? Please choose one answer only from the dropdown list.

To further filter the factors, pilots were asked to select the one factor they considered most significant to PSUA. The results indicated that the majority of 64% still selected psychological problems, while 16% opted for political agenda, terrorism and radical ideology and 9% chose family problems. This data validates and confirms the three significant factors identified through the analysis of chapter 4 events, namely, psychological and political in addition to the personal factor, which still ranked amongst the top 3 factors that could trigger a PSUA. The remaining factors scores ranged between 2 and 3% each, as reflected below in figure 5-2.

The confirmed top ranking of the psychological factor as PSUA contributor by pilots as clearly highlighted in figure 5-2 can be attributed to the pilots feeling of vulnerability to some mental disorders that are job-related such as stress, anxiety, sleep disorders, depression and mode swings, which could develop into a more aggressive illness if left unattended and when aggravated by the presence of other factors, the simple and generally harmless disorders could lead into suicidal ideation and perhaps a PSUA.

For pilots, mental disorders is still a mystery that is veiled in stigma and viewed as a taboo that could threaten the pilot's career, family and social status. However, the surveyed pilots seemed eager to learn about suicidal behaviours and wanted to gain some psychological knowledge and awareness to bridge the gaps identified in other PSUA mitigations, as explained by the responses received to the following questions.

Figure 5-2 Survey Question number 10 results



**Chapter 3 Survey analysis, p16*

Question 11: The best line of defence against a pilot using an aircraft to commit suicide is (You can select more than one answer if applicable).

Addressing pro-active risk mitigation proposals, 54% of the pilots selected suicidal behaviours recognition training for pilots and cabin crew as the best possible defence, 50% supported classic security background checks and in the third place with 44% was the two in the flight deck policy. Nonetheless, the un-popular among pilots, psychometric screening still managed to score 38%. Additionally, 15% of the participants selected "others" totalling 79 responses, with some of the relevant comments suggesting revolutionary changes such as having an access door from the flight deck into a crew only dedicated toilet.

Knowing that most of the reviewed crew related events happened while one of the pilots was away from the flight deck to visit the toilet, the dedicated flight deck toilet suggestion could be enhanced by having the toilet door locking from the inside only, with the door opening inwards into the toilet and no handles installed on the cockpit side doorframe, to guard against the suicidal/hijacker pilot locking it from the cockpit side. This suggestion could be the perfect replacement for the discussed

procedure and excellent mitigation against PSUA, especially when coupled with a real-time camera display of the flight deck that could be monitored from inside the toilet.

However, the reason this brilliant idea might not find its way into current aircraft production lines is the high cost involved (re-design, modification and certification of current aeroplanes). Nevertheless, it is a good idea for implementation in current and future aircraft types that are not built or manufactured yet.

When weighing the modification costs against the probability of having a PSUA event and the availability of alternative mitigation at no additional cost, such as the 'two in the flight deck procedure', the financial manager's decision becomes obvious, most probably 'No modification'.

It is a matter of cost-effectiveness; if 9/11 had involved one aircraft only, and if it crashed in a remote location with loses and fatalities limited to the aircraft and its occupants, perhaps the heavy and costly armoured flight deck door, would not have become a standard feature on most of the commercial jets flying around today. Sometimes the severity of the event along with the dense media coverage and the resultant public pressure, are the required ingredients to obtain the required approval for a safety-critical measure that is considered expensive in (direct) costs term.

Pre-employment psychological screening by an independent psychiatrist, improving working conditions and environment, having emotional support teams and asking psychiatrists to share the privileged medical information of pilots diagnosed with mental health problems with the concerned authorities, were among the useful proposed mitigations that were collected through the pilot's survey comments.

Question 12: Would you be interested in receiving Suicidal Behaviours Recognition training, and why?

While 61% of the answers to this question were 'YES', the remaining 39% selected 'NO'. Most of the comments from those who responded with 'YES' were praising the tool as a reliable defence mechanism against the recurrence of PSUA events, as they would learn how to identify a suicidal pilot, what behaviours to look for and the process to follow after identifying a suspect. Pilots that responded with 'NO' were mainly concerned that the training might not enable them to make the correct assessment, with the possibly dire consequences for the pilot involved and his family based on their evaluation, which could be wrong.

Policy and procedure design must consider this assumption by planning for an independent psychiatrist to act as the recipient of such reports and handle the data filtering to establish genuine potential risk cases and process it accordingly.

Highlighted in appendix 2 at the end of this research (in bold font) are the suicidal behaviour indicators as identified from the analysis of previous events which are discussed in chapter 4 and are categorised and listed in appendix 2 following chronological order by flight. The highlighted indicators, both verbal and behavioural, supplemented by inputs from company psychiatrist, safety and security management, could be the foundation for a suicidal behaviours recognition course for employees, peers and family members.

A good and recent example of effective suicidal behaviour indicators recognition and application that managed to foil a possible PSUA event is covered in more details later in the chapter while discussing Jet Blue flight 191.

Question 13: In your opinion, what would represent a good job security campaign?

The presence of the personal sub-factor (financial pressures) is evident in 50% of the confirmed PSUA events (namely, Silk air, Egypt air and German wings). Additionally, the role played by financial pressures in triggering many of chapter 4 researched events, implies that easing financial pressures off airline employees could help prevent or at least reduce the possibility of PSUA.

The survey data supports the assumptions above, a pilot's first choice with 36% of the votes was Job placement in another function within the company for pilots who lost their medical/license, as this would secure an alternative source of income, job security and the ability to maintain lifestyle and image, while 22% selected company psychologist/flight safety or welfare manager counselling (in confidence) if in trouble. Another 22% selected just culture implementation (the punishment for an intentional violation is relevant to the outcome of the violation and subject to a written and published, transparent policy that applies to every employee).

The remaining 20% was equally divided, with 10% selecting pension scheme and the other 10% selecting others, with comments from 48 pilots focusing on work environment improvement and different views of just culture implementation.

Question 14: In your opinion, is armoured flight deck door considered efficient security risk mitigation?

The pilot's majority choice of 81% was 'YES', while the remaining 19% selected 'NO'.

This research compared the un-affected, 'YES' or 'NO' answers of a straight forward, no-frills armoured door question to an ethnic and religion sensitive topic, to measure ethnic and religion effects on the collected data, such as alcohol-related answer which is covered in the next question.

Pilot's comments about the armoured door question supported the figures, as those who answered 'NO' were concerned about PSUA implications of having a suicidal pilot locking his colleague

outside the cockpit and pursuing a PSUA, making use of the door created vulnerability. While the majority that answered 'YES' were considering the large numbers of unauthorised flight deck access attempts that were foiled or deterred by the strong armoured door, as evidenced by the decline in the number of hijack events.

However, for an accurate gap analysis, it is essential to consider the pilot's role in increasing the vulnerabilities of the flight deck door. A review of the following real-time complacency scenario would explain the possible threats and risk involved with lack of adherence to procedures.

During a flight to Jakarta onboard a Boeing 787, a flight-deck door check mishap was encountered while training a new captain that just joined the company. The trainee captain did not conduct the flight deck door check as per the published supplementary procedures. Instead, he performed the check from memory.

The published procedure systematically describes how to check the armoured door for correct operation to ensure the mechanism functionality to lock and unlock the door. This check is required at least on the first flight of the day by one of the pilots while cabin crew procedures also require an independent door check by them.

Both the trainee captain and the cabin crew assigned to liaise with the cockpit did not perform the check correctly as per the written procedures, and when questioned by the instructor pilot, they both replied, 'It is how everybody is doing it'.

The trainee captain and the concerned cabin crew were asked to review the supplementary procedures in the aircraft manual, which explained the correct way to do the check. They were both surprised and explained that the written procedure is hard to do by memory and that for most of the time; it is not practical to take out the manual to read and do the procedure.

Fortunately, when the door check was performed as per the published procedures, the door unlocking mechanism was discovered to be unserviceable. When the engineers checked the system, they found that during a routine update of the aircraft navigation system, the door unlocking code was erased due to a system anomaly.

The event was reported to both safety and security departments through an air safety report, as this was perceived as a high-risk situation. Suggestions to mitigate the flight deck access door identified risks included;

- Contacting the manufacturer (Boeing Aircraft Company) to identify a fix to the software glitch that caused the unlocking code to be erased, and also to issue a bulletin to make all operators including end-users (pilots and cabin crew) aware about the problem.

- Cabin crew and pilot's manuals must be aligned to reflect the same procedures.

- Emphasis on the responsibility of the pilots to check the door mechanism on every flight instead of the first flight of the day, as pilots have easier access to the written procedures and the door checking mechanism is located in the flight deck.

- Although it is not required to check the door mechanism more than once, emphasis on cabin crew cross-check of the mechanism (not the full procedure), by requiring a cabin crew to observe while a pilot is performing the door check, which could also serve as a gross error check and a refresher to cabin crew that usually fly more than one type of aircraft.

- To inform the training department to emphasis during initial and recurrent training on the correct procedure to check the door mechanism, which is a 'read and do' procedure, and not to be performed from memory.

- To request the engineering department to include in their procedures (as a checklist), that after the navigation system is updated, the engineers are to confirm flight-deck door system functionality by performing a door mechanism check and if found faulty, to fix it, and then perform a functionality check before releasing the aircraft for service.

  Perhaps the steps mentioned above are explicitly applicable to the flight deck door. Nevertheless, generic procedure design risk-mitigation lessons were learned from this scenario and are concluded in the following points;

- Always eliminate the confusion due to procedure complexity by making it read and do if it is not a time-critical task.

- To solve a problem, always target the root cause (the interaction glitch between the door mechanism and the navigation system update in the discussed scenario).

- The importance of information dissemination to all end-users, pilots and cabin crew in the discussed scenario, to mitigate similar risks.

  Question 15: Unruly Passengers (Air Rage) is considered one of the most serious security threats in aviation. Statistically, one of the major drives behind air rage is alcohol consumption. In your opinion, should airlines ban alcohol in a similar fashion to smoking?

The majority of 75% answered 'NO', while 25% selected 'YES'.

This question was specifically designed to signify the effect of religion on policy perception. Muslims account for 85 of the 514 received responses, and as their faith considers suicide a sin, they were not so concerned about PSUA probability. Hence, 85% of Muslim pilots answered question 14 by selecting 'YES' versus 15% that answered 'NO', almost identical to the collective response to the question. However, as the carriage of alcohol in an aircraft is discouraged by most Muslim clerks when answering the Alcohol related question, the Muslim's answer to question 15 was 64% 'YES' versus a relatively unexpected 36% who selected 'NO', this time an apparent contradiction to the collective response.

When comparing the Muslim to the non-religion group responses, accounting for 109 participants, question 14 collected 83% 'YES' against 17% 'NO', again, almost identical to the collective response to the question and the Muslim pilot's response to it as well. However, the response to question 15 regarding alcohol, which is not an issue for the non-religion group, data indicated that 16% only responded with 'YES' versus a strong 84% with 'NO'.

Although the non-religion group responses were in line with the collective response, the result was contradicting question 15 Muslim pilots results, despite being almost identical in response to question 14 when religion was not a factor, a finding that prove the effect of religion on policy interpretation and perhaps implementation as well.

To explain the ethnic effect on the choice of answers; it was noticed that Muslim responses were dominated by 49% Arabs with the second-largest Muslim group of 25% made up of Asians while American and European Muslims accounted for 2% each.

The none-religion group was dominated by 62% Europeans followed by 10% South Americans, 6% Asians and only 4% Arabs, indicating a certain level of influence of ethnic origin on the choice of answers especially when paired with the religion and cultural influence effects.

Objectives of the pilot's survey questions were to generate a reasonable amount of end-users feedback to help assess the over two year's implementation of the 'Minimum crew in the flight deck' procedure. Additionally, it is meant to collect comments that could be used in gap analysis and data collection to support the findings based on the study of the events discussed in chapter 4, and explore the following five bold and bullet-pointed objectives that are listed in this chapter.

- **Measure the efficiency of 'Minimum crew in the flight deck' procedure**
  Only 38% of the pilot's survey responses were in support of the policy based on answers of question number 4, very much in line with professional and academic opinions such as the case-

study airline Flight operations manager (A), the interviewed SME and the respected psychologists, Bor and Teichmuller respectively, whom all are in support of the procedure.

The support for the procedure persisted for some time despite professional opinions such as IFALPA's opposition and the procedure's ranking as third behind suicidal behaviour training and the classic security-background checks when evaluating the proposed mitigations to guard against crew related hijack/PSUA events in response to question number 11.

Regarding the efficiency of the procedure, the majority of pilot's survey responses of 62% selected 'NO', when asked whether the presence of a cabin crewmember could prevent a PSUA event or not, while most of the pilot's comments focused on the lack of cabin crew appropriate training to handle the situation or their ability to take the necessary actions to prevent the situation from developing into a PSUA event. Moreover, some of the responses questioned the physical abilities of (the mostly females) cabin crew, assuming it would make them more vulnerable to physical aggression.

The majority (58%) of female pilots that responded to the survey considered the policy as inefficient, and the remaining 42% thought the policy could protect against a PSUA situation while none of the female pilots considered it a perfect policy to guard against PSUA.
Found below are the survey comments of one of the female pilots;

> *"What about a cabin crew, that only take a few months to become a crew member, that with a few notions of how to bring an aircraft down, is seated behind the pilot, and is so easy to kill him, take the control, select V/S 5000*[19] *and control the access door. What are the requirements to become a cabin crew?"* [20]

The pilot comment highlights a valid risk that is addressed later by the research recommendations. Nonetheless, two of the female pilots (one of which was quoted above), commented that the policy could be of great use in case of pilot incapacitation[21].

On the other hand, while only 8% of all pilot's responses identified a potential security threat in the presence of a cabin crewmember in the flight deck, the majority of 53% had their doubts and thought it could be a potential threat. However, when interviewing samples of the 39% of pilots who thought no potential threat was involved, shadows of complacency because of the relatively long policy application with no reports of security events, started to clutter the picture.

Supporting the survey data in perceiving the procedure as inefficient, while highlighting the potential threat linked to the unnecessary additional access by cabin crew, the International Federation of Airline Pilots Association (IFALPA) notes that

> *"The tragedy of German wings flight 4U9525 triggered a number of initiatives and interim measures within the aviation industry. These measures were not the result of a structured*

[19] *Very high rate of descent dive (Vertical Speed)*
[20] *Q2 response received on 14/01/2017 11:21 PM*
[21] *Q3 response received on 12/01/2017 12:00 PM and 14/01/2017 11:21 PM*

> *approach to flight safety and security, which must have a thorough threat and risk analysis as its foundation. Considering the vast number of flights taking place safely every single day, this accident was clearly an extremely rare event.*
>
> *IFALPA believes that the "minimum occupancy" concept will not prove effective against the reoccurrence of the German wings situation, and therefore will not support its worldwide implementation.*
>
> *Conclusion*
> *The "minimum occupancy" concept is NOT an effective security tool. IFALPA is extremely concerned that such a measure has the potential of introducing a risk higher than the one it is trying to prevent. IFALPA remains committed to contribute to the discussions taking place within the industry and to consider any future recommendations designed to improve aircraft security".* (IFALPA, 2015)

IFALPA's opinion seems to be gathering momentum as reflected by the federal association of German air transport comments on the latent threat of cabin crew presence in the flight deck; the association notes that

> *"However, more and more airlines are dropping in; for fear that constant changeover of crew in and out of the cockpit actually puts safety at more risk than that of a rogue pilot - such as Lubitz - crashing the aircraft. The evaluation has shown that the two-person regulation does not bring any safety gain, the Federal Association of German Air Transport (BDL) said in Berlin, April 28".* (Sputnik, 2017)

The German Association views the frequent opening of the flight deck door as an unnecessary vulnerability that could increase the risk of unauthorised access to the flight deck and a reason that more airlines are opposing the procedure.

Nonetheless, the report praised EASA for introducing the pilot's mental health screening regulations after German wings event. However, the author disagrees with IFALPA's statement that EASA has introduced significant regulations for testing a pilot's mental fitness as no such regulations are implemented yet. (Sputnik, 2017)

In conclusion, the majority of pilots that responded to the survey deemed the policy as inefficient, as 62% of the surveyed pilots thought that the presence of a cabin crewmember could not prevent a pilot from committing suicide and voiced concerns that cabin crews must be trained for the role and a more specific tasks related to their presence in the flight deck must be defined, mandating an urgently required revision to cabin crew manuals and training to bridge the identified gaps in the current procedure.

The relevance of specific survey data to the remaining research objectives are discussed later in this chapter, but only after reviewing the lessons learned during this research regarding the development of terrorism and why terrorists target airlines, this review would facilitate a better understanding of the threats and risks discussed in this research and help formulate robust and practical findings and recommendations.

Lessons learned

Development of terrorism

Throughout the history of aviation, terrorist's objectives and techniques saw significant development. The first serious incidents were perpetrated to release prisoners, force a government reaction and make a statement or gain publicity for a particular cause. As time progressed, so did the level of violence, some radical and terrorist organisations objectives evolved into causing mass destruction while inflicting the maximum number of casualties, to spread fear, chaos and thus, gain respect and power.

Major terrorist attacks always resulted in the introduction of new countermeasures by the international regulatory bodies, with the directly affected countries, tightening legislation against negotiating with or harbouring hijackers.

In response to the shrinking value of hostages during negotiations, terrorists changed their techniques, tactics and therefore, suicide attackers evolved. This new breed of fanatics were not concerned about finding a way out of a hijack situation anymore, they believed that killing people would better serve their objectives and for them, it did not matter if they died in the process.

Terrorists are convinced that the more they kill, the better the publicity and the light shed on their cause. They also assume that, by using the inflected fear and the resultant public pressure, they could compensate for the hostage's lost advantage and would be able to enforce their demands.

Airlines as an attractive target

It is the number of people involved in any single aircraft event in addition to the different nationalities of passengers that guarantees instant publicity and generates the required level of pressure on a government or an airline to start negotiating under the hijacker's terms. Moreover, the limited and confined space on an aeroplane makes it easier to control the relatively big number of passengers and allow their use as human shields, then bargain for extortion, ransom or any other demands.

If the hijacker's objective is to cause either reputation or economic damage to the country or the airline, the perfect tool to achieve that is hijacking an airliner, as airlines are generally perceived as the flag carriers of their nations, and the resultant operational disruption could cause massive financial losses.

Airlines remain vulnerable to terrorist attacks, due to the continuously increasing traffic volumes while operating to different parts of the world, which might not be adhering to the same safety, security or moral standards, and that makes it harder to screen and intercept possible threats.

Azani et al. highlights some of the motives behind targeting the civil aviation sector by terrorist organisations, their comments focused on the psychological and media effects of terror attacks on aviation targets, Azani et al. said the attacks would create fear and anxiety in addition to disrupting the transportation system both locally and internationally. (2016, p. 2)

> *"The famous statement made by George Habash following the successful hijacking of an El-Al flight to Algeria at the end of the 1960s that "when we hijack a plane it has a more significant effect than if we killed a hundred Israelis in battle", emphasizes the importance that terrorist organizations ascribed, even then, to the psychological and media effect of terror attacks in the aviation arena"*. (Azani, Lvovsky, & Haberfeld, 2016, p. 2)

Harrison, in turn, lists four reasons that made civil aviation so important to states (as well as terrorist organisations), he explains

> *"States are concerned with civil aviation for four main reasons: (1) national security; (2) economic issues; (3) safety reasons and (4) prestige. First, civil aviation is a key variable in national security planning"*. (Harrison, 2004, p. 83)

In the same context, Harrison explained the negative economic effect of 9/11 attacks on passenger's numbers and the resultant job losses across the aviation sector, he said

> *"Hundreds of thousands of jobs in airlines, aircraft manufacturers, airports and industries such as travel and tourism were all deeply impacted by this downturn. Much of the "just on time" management strategy that has developed over the last 20 years depends on the rapid global delivery of supplies by air, which makes the system acutely vulnerable to disruption"*. (Harrison, 2004, p. 84)

Describing terrorist attacks financial impact on governments, Harrison then added

> *"Governments also felt the impact of September 11 through the decreased tax revenue from the declines in hotel room taxes. Many governments use aviation as a development tool"*. (Harrison, 2004, p. 84)

Harrison's safety concerns are self-explanatory when interpreted in terms of the resultant loss of life and damages to both humans and property after a terror attack. However, he seems to approve the increased cost of implementing safety measures, as he found it justified by an increase in safety margins as he explained in the following example

> *"In the early 1990s, the American government banned its employees and contractors from using any of the Soviet successful airlines due to their unfortunate habit of inadequately fuelling their aircraft. This ban increased costs for those facing the ban, but it did increase their safety"*. (Harrison, 2004, p. 84)

Discussing the prestige factor, Harrison explained the reason why airlines are directly linked to the state in general public perception, talking about airlines in that context he said

> *"[...] all carry the name of their nations and more importantly the national flag, somewhere on the aircraft. This sends a message to the world that this nation is important enough to have an airline representing it"*. (Harrison, 2004, p. 84)

A statement that is both, true and applicable to most of the Gulf States legacy carriers, as they contributed to their nation's introduction to the world. For example, nobody knew anything about

most of the small Gulf States, unlike the current situation with some of the Gulf airlines flying to the six continents and ranked as the best in the world.

Harrison's identified factors behind targeting the aviation sector are accurate. An evidence-based example is the almost bankrupt Malaysian airline's situation in the aftermath of MH370 or the collapse of PAN AM shortly after Lockerbie accident.

Harrison's answer to the question, "*Why target International Civil Aviation",* was short and concise, as he said

> *"The primary reason international civil aviation has become a lasting target is that terrorists are looking for ways to inflict damage on their opponents far beyond the cost of the actual attack".* (Harrison, 2004, p. 85)

While in his explanation of why *"aviation provides a powerful symbolic target",* Harrison did emphasise the airline's symbolic role as he explained

> *"[...] for the terrorist, they serve as a nation's proxy. Some of their names illustrate this point: Japan Airlines, British Air, American Airlines and even Trans World Airlines (TWA) are all targets not because of any particular business decision they have made, but because they carry the name and flag of the nation they serve".* (Harrison, 2004, p. 85)

Harrison also used the 1985 Hezbollah hijack of TWA Flight 847 to highlight how *"Aviation provides a unique multinational stage".* He described how Hezbollah wanted to use the American and Israeli passengers as a bargaining tool to pressure Israel to release more than 700 of its captured members. He also described how the presence of other nationalities, namely Greek and German passengers, represented an added advantage by increasing the global involvement in the hijack, which secured more extensive media coverage and a stronger public pressure. (2004, p. 85)

Highlighting the media interest in aviation-related events in general and in security events in particular, Harrison used the TWA 847 and Lockerbie examples to make his point, he said

> *"During the TWA Flight 847 hijacking, the National Broadcasting Company (NBC), one of the three major US television networks, dedicated two-thirds of its half-hour nightly news broadcast to it. [...] The Lockerbie disaster in December 1988 was accorded saturation coverage. [...] Another aircraft had been destroyed to achieve a political purpose and it elevated various Middle Eastern conflicts to become major news stories".*
> (Harrison, 2004, p. 86)

Using the same examples, Harrison continued to explain why "*The operations against aviation targets are relatively simple",* at least (as perceived by terrorists) when compared to the relatively significant results including the intense media coverage, he said that a hijack operation could be planned and executed with a small group of people (mostly 2 to 4) without the need for a specific training, using small guns and accessible explosives that are easy to conceal and smuggle into an aircraft. (2004, p. 86) Harrison then added

> *"Such a small cell can control a multi-million dollar aircraft, several hundred lives and the agendas of governments and the media for as long as the cell is in command of the aircraft,*

> *as illustrated by the two young men who hijacked TWA Flight 847. Sabotaging an aircraft requires, perhaps, a like number to fashion the device, but does not require the perpetrators to be on board before takeoff".* (Harrison, 2004, p. 86)

Harrison used TWA 847 and the 1986 bombing of TWA 840 examples to highlight the economic targeting of a nation (Israel in this example) by the Popular Front for the Liberation of Palestine (PFLP). The organisation's objective was to deliver an economic strike, Harrison also explained the unintended (but considered as a bonus) negative impact on the Greek economy, it was the price that Greece had to pay for its involvement in the security events. (2004, p. 87)

The negative impact on Greece prestige is also evident in Harrison's words

> *"[...] the Greek economy suffered a major down turn when the Reagan administration announced that the Greek government was failing to meet its international security obligations and advised travellers to avoid travelling to Greece. The "naming and shaming" cost the Greek economy more than US$30 million".*
> (Harrison, 2004, p. 87)

"*Aviation can create political embarrassment for the intended targets",* Harrison said, describing the armed forces of the Colombian Revolution (FARC) and the Sri Lankan Tigers of Tamil terrorist group's reversion to aviation targeting, that was used to pressure their governments to negotiate. Harrison concluded the discussion by highlighting the terrorist's paramount objective,"[...] *the message here was the same: an ineffective government".* (2004, p. 87)

In the same context, Harrison described another factor behind civil aviation targeting, he added

> *"Terrorists also use attacks to embarrass other factions in the struggle to gain predominance within the larger movement. A classic illustration of this is the Abu Nidal Organization's (ABO, named after its leader) attacks against the Rome and Vienna airports in December 1985".* (Harrison, 2004, p. 87)

Harrison also used the "*September 1989 bombing of the French Airline UTA flight 772",* as an example to highlight revenge as another factor. The security event was perceived as an act of revenge by the Libyans for *"French interference in Libyan interests in Chad during the early 1980s",* in cooperation with the Syrians, who also wanted revenge for the *"French involvement with anti-Syrian forces in Lebanon".* (2004, p. 88)

Nevertheless, the author agrees with Harrison's conclusion that

> *"The strategic use of international civil aviation attacks has to this point failed, while the tactical use of aviation as a weapon has achieved notable success".*
> (Harrison, 2004, p. 88)

After all, the US economy managed to recover from 9/11 implications. However, the media exposure secured by Al Qaeda managed to promote its cause among radical young Muslims while it attracted support and resources. Perhaps it even triggered the evolution of new and more fanatic factions such as ISIS and inspired other terrorist groups or individuals.

Supporting this argument, Azani et al (2016) said that the foiled terrorist attacks still indicated the organisation's knowledge of the aviation industry vulnerabilities and its well to continue exploring these vulnerabilities by directly targeting aeroplanes or using it as means of transport and weapons of mass destruction. Azani et al. also said

> *"In addition, recent successful attacks against aviation targets strengthen the motivation of terrorist organizations to carry out attacks in this arena, which - as demonstrated above - are not limited to attacks on planes but include attacks within airports as well".*
> (Azani, Lvovsky, & Haberfeld, 2016, p. 4)

The comments of Azani et al. were beneficial in highlighting the growing concerns surrounding the insider-threat, which is the subject of this research. Azani et al. also stressed on the emerging risks involved with terrorist organisations gaining access to restricted areas and privileged technology through the recruitment of individuals working in the aviation industry, such individuals could be used in either directly executing an attack or smuggling weapons and explosives across security screening points using their privileged access. (2016)

Azani et al. also mentioned that a 2015 research by the International Institute for Counter-Terrorism (ICT) revealed the existence of airport employees across Europe who can access secure areas and locations, who wrote radical Islamic/Jihadist comments on Face book. Confirming Azani et al. concerns, Abu Al Ayna Al Ansari, a Salafi/Jihadist from Gaza Strip connected to the Islamic State, said in an interview that his organisation had recruited employees at sensitive facilities across the globe, which are ready and awaiting orders. (2016, pp. 4-8)

> *"Another trend emerging in light of events taking place in conflict zones and from the jihadist discourse has to do with the tactical and technological knowledge and experience that terrorist organizations and their fighters accumulate. This knowledge is likely to be applied to the implementation of terror attacks in the local and international aviation industry, in the foreseeable future".* (Azani, Lvovsky, & Haberfeld, 2016, p. 8)

Highlighting some operationally significant threats from an aircraft control perspective that could directly be linked to PSUA and airline employee's hijack/suicide attempts, while discussing the simulators threat, Azani et al. (2016, p. 12) explained that terrorist organisations widely use simulators as a training tool, highlighting the accuracy and efficiency of this tool that is easily accessible and affordable. Azani et al. added

> *"The Islamic State is one such terrorist organization that uses this type of simulator. For instance, the organization trains its fighters in Libya using civilian and combat simulators. The simulators, which are posted in the city of Sirte, simulate various aspects of flight, including air-to-ground communications. It should be noted that the use of simulators has become a widespread phenomenon in various arenas of jihad".*
> (Azani, Lvovsky, & Haberfeld, 2016, p. 12)

Addressing the emerging cyber terrorism threat and its possible impact on civil aviation, Kaspersen, reviewed some potential vulnerabilities and the way terrorists could exploit it, she said that new technologies are changing the types of threats and players in this new war, making it easier to launch massive attacks that could cause severe damages by a small group of people or

even an individual, which mandates a faster adaptation by the industry to mitigate the possible risks and prepare for the expected boom in the passenger numbers over the next two decades. (2016)

Discussing the new vulnerabilities that could be explored by the new cyber terrorists, Kaspersen focused on remote attacks that could create chaos by hacking air traffic control, tickets reservation and other aviation-related systems that could jeopardise safety and security of air travel and cripple the transportation system. Kaspersen went on to name many of the vulnerable systems that could be targeted by cyber terrorists and discussed the possibility of hacking the aircraft navigation and control systems, highlighting one of the main reasons this research did not explore the remote control aircraft option any further as explained in chapter 1. (2016) Kaspersen then added

> *"As civilian aviation is so critical to the smooth functioning of economies - and as aviation-related incidents have such an impact on the media, especially with new technologies enabling the rapid spread of information and misinformation - it is likely to remain an enticing target for attackers who want to cause maximum disruption"*. (Kaspersen, 2016)

Kaspersen concluded her review with some vital recommendations stressing on the importance of communication and cooperation between all stakeholders in civil aviation to share intelligence and information as a successful attack on one of them could bring the entire industry into a halt, she also stressed on the importance of creating this cooperation mechanism as soon as possible. Perhaps Kaspersen most significant recommendation is to avoid *"Too much compliance"*, as focusing on compliance could cause overlooking new threats and impair preparedness. (2016)

One of Kaspersen suggestions to anticipate the new threats is to think like a terrorist and not limit risk management to the classic reactive methods, as that could only shift the vulnerability. She used the example of creating a long queue by adding an extra security checkpoint which could expose the queue to an attack similar to that of Istanbul or Brussels. (2016)

Similar to TSA vision discussed in chapter 2, Kaspersen (2016) proposed the use of *"global trusted traveller programme"*, to guarantee a smoother flow of passengers while managing the risk involved by having a regulated exchange of passenger's data analysis and border control, she added

> *"The travel industry overall, and the aviation industry in particular, is at a crossroad. With security concerns intensifying, the security of flying increasingly depends on cross-industry and multi stakeholder dialogues and collaboration to tackle new and shared vulnerabilities"*. (Kaspersen, 2016)

Implementing Kaspersen's recommendations should not wait for another aviation disaster to happen; the industry needs to act pro-actively and use these recommendations to produce measures and procedures that are capable of efficiently combating the emerging threats including the insider threat.

Motives

From a security perspective, identification of PSUA triggering factors (motives) and finding a way to mitigate these factors could at least reduce the risk of encountering another PSUA event.

The most common triggering factors as identified from the analysis of the examples discussed in chapter 4 and the review of crew specific hijack events (15 out of the reported 1073 airline hijack events), spanning the period between 1942 and 2016 are summed up to the following non-exhaustive motives. (FSF, 2012 b)

Financial motives, for example 'extortion by threat, blackmailing or insurance fraud', personal or relationship motives such as 'marital problems, breakup and divorce' and political motives, like 'obtaining political asylum'. However, political asylum could at times be misleading as in some instances; it could include an impeded financial motive.

Revenge or hate motives were also identified in individual events, while terrorism motives such as, 'deterrence of public and disruption of normal life aimed at forcing a government policy change or undermining and discrediting a government to achieve publicity for an ideology or a faction', were not present in most of the reviewed events, except for 9/11 attacks.

Non-psychotic health problems such as pilot's loss of license or medical, chronic illness or death of a loved one and self chronic-illness, were also evident while studying some of the PSUA cases.

Perhaps the psychological motive was the dominating and most concerning of all factors, due to the difficulty in detecting it.

Apart from the mentally ill, tracking most of the criminally motivated potential hijackers is possible through specialised databases. Specialised agencies such as the INTERPOL, EUROPOL, FBI, CIA and other national law enforcement and security agencies, are most efficient at the identification and tracking of a criminal person or group, including a suspected pilot or cabin crew.

Once a criminally motivated suspect is identified, the specialised agency will process the information accordingly, to decide on how to handle the threat and apply the required mitigation.

Unfortunately, intercepting potential hijackers with mental illness is not as easy. Mental illness is the most concealed of threats and one that could easily be missed, as no database of pilots who have a mental illness is available, yet.

Hijacker groups

In conclusion, the following five categories describe the most common profiles of people or organisations that represent a hijack threat to airlines

Terrorists: (Fanatic and ideologically driven extremists) they are desperate, could be aggressive and willing to die or kill for their cause or to achieve a goal.

Their objective is to shock the public and spread fear and terror. The more shocking and brutal the event, the better the media attention and public interest in following the news, attracting more attention and globally shedding light on the terrorists cause.

Criminals: Usually are somehow rational thinkers, they hijack an aircraft for gain or other specific objectives such as the release of fellow criminals. They are not usually in favour of unnecessary violence and are unlikely to kill the people involved.

Unlike terrorists, once criminals lose the initiative, motive or hope, they are likely to surrender. However, if cornered or left with no room to manoeuvre, their actions could become unpredictable.

Political: (Refugees and asylum seekers) are usually desperate people, who believe that hijacking is the only way to escape from an oppressive regime. This category of hijackers would often value their own lives and respect those of others, so they are unlikely to resort to violence. They are mainly using the aircraft as a means of transportation and passengers as hostages to guarantee their arrival to their destination.
Despite falling under the personal motives category, financial and social dissatisfaction co-existed (to a certain level) in some of the politically motivated hijack events.

Fanatic and ideologically driven extremists belong to the terrorist group; they could also fall under this group. However, the terrorists who were not previous or active crewmembers were excluded from this category for research relevance purpose.

Personal: (discontent employee, job security concerns, financial security, partner relationship problems, health "non-psychotic", drugs/medications/alcohol addiction)
In the above-mentioned personal sub-factors, motivation might vary from making a point by an unsatisfied employee to objection on a perceived as an unfair action or treatment.

In extreme cases, personal motives could lead to the killing of everyone on board, similar to what happened in US airways example, when accompanied by corporate or personal revenge or hatred.

Psychological: (mental illness) are becoming the centre of attention of security experts as it involves people who have personality disorders, making them irrational, very unpredictable and even suicidal/homicidal.

Therefore, this category is tough to detect. It is common for mentally unstable people to use hoax or improvised weapons, as demonstrated during some of the research reviewed hijack events.

The research will focus on the last three groups, as current rules, procedures and security measures are already catering for the first two, as witnessed by the declining numbers of terrorism and criminally driven hijack events.

Nevertheless, continuous monitoring and development of measures to tackle emerging threats and bridge any newly identified gaps are mandatory to maintain and enhance the achieved standards.

Therefore, and based on the following theories, and the analysis of the researched events, three main PSUA triggering factors were identified, namely (Personal, Political and Psychological).

The psychological factor is somehow considered a constant in every studied event, and this hypothesis is based on the assumption that a minimum level of psychological vulnerability must exist in a pilot before the other factors could aggravate the mental instability to the level required to trigger a hijack/PSUA situation. This hypothesis is very much in line with Shneidman *'Psychache' [sic]* theory explained below, as cited in Olson about suicide theories. (2014, p. 2)

In his review of some respected suicide theories., Olson focused on psychological and sociological perspectives, including Durkheim's sociological approach, Baumeister's escape theory, Leenaars's multidimensional model, Joiner's interpersonal theory, Beck's hopelessness theory, Linehan's emotion '*dysregulation' [sic]* and Shneidman's *'Psychache' [sic]*. (2014, pp. 1-5)

One of the common motives among the reviewed theories was found to be the personal sub-factor (relationships), as highlighted by Durkheim's fatalistic example of a young woman forced into an arranged marriage or Leenaars's frustrated relationships listed under interpersonal factors or Joiner's thwarted belongingness example of the strain of a loss of previously strong relationship. However, Shneidman claimed that *'Psychache' [sic]* is the main factor behind all suicides. He defines it as,

> *"[...] hurt, anguish, soreness, and aching psychological pain in the mind". It is "the pain of shame or guilt, or humiliation, or loneliness, or fear, or angst, or dread of growing old"* (Olson, 2014, p. 2)

Shneidman's theory identified four factors that could trigger *'Psychache' [sic]*, namely,

> ***Thwarted love, acceptance or belonging;***
> ***Excessive helplessness*** *or the feeling that one has no control;*
> ***Damaged self-image*** *invokes feelings of avoidance, shame, defeat, and humiliation; and*
> ***Damaged relationships,*** *accompanied by subsequent feelings of grief.*
> (Olson, 2014, p. 3)

At least one of Shneidman four factors was present in every researched potential and actual PSUA event, while some events such as Air Botswana PSUA witnessed the presence of all four factors.

On the other hand, Hudson (1999) also previewed some of the opinions that support the research hypothesis mentioned above. Cited in Hudson's report was Ferracuti who thought that

> *"[...] there is "no such thing as an isolated terrorist - that's a mental case." Mentally unbalanced individuals have been especially attracted to airplane hijacking".*
> (Hudson, 1999, p. 27)

Hudson also quoted Hubbard (1971), who conducted a psychiatric study of airplane hijackers in 1971 and concluded *that "[...] skyjacking was used by psychiatrically ill patients as an expression of illness "*, a conclusion that equally applies to most of the crew hijackers. (1999, p. 27)

Other academic theories reviewed by Hudson that was found to apply to Lubitz's profile in particular, and other PSUA pilot's profiles as well, was Knutson (1981), in her view, *"terrorists engage in terrorism as a result of feelings of rage and helplessness over the lack of alternatives".* (1999, p. 20)

Hudson also referred to psychologists Post, Crayton and Pearlstein; as they considered the terrorist a mentally ill person. Their narcissism-aggression hypothesis describes what Lubitz and some of the other PSUA perpetrators did,

> *"[...] if the psychological form of the "idealized parental ego" is not neutralized by reality testing, it can produce a condition of helpless defeatism and narcissistic defeat can lead to reactions of rage and a wish to destroy the source of narcissistic injury", writes Crayton (1983:37-8).* (Hudson, 1999, p. 20)

Another theory that applies to almost all PSUA events, while it supports the "psychological factor as a constant" hypothesis, that was cited in Hudson as well, is Kellen (1990), who said

> *"[...] most of the West German terrorists "suffer from a deep psychological trauma" that "makes them see the world, including their own actions and the expected effects of those actions, in a grossly unrealistic light".* (Hudson, 1999, p. 29)

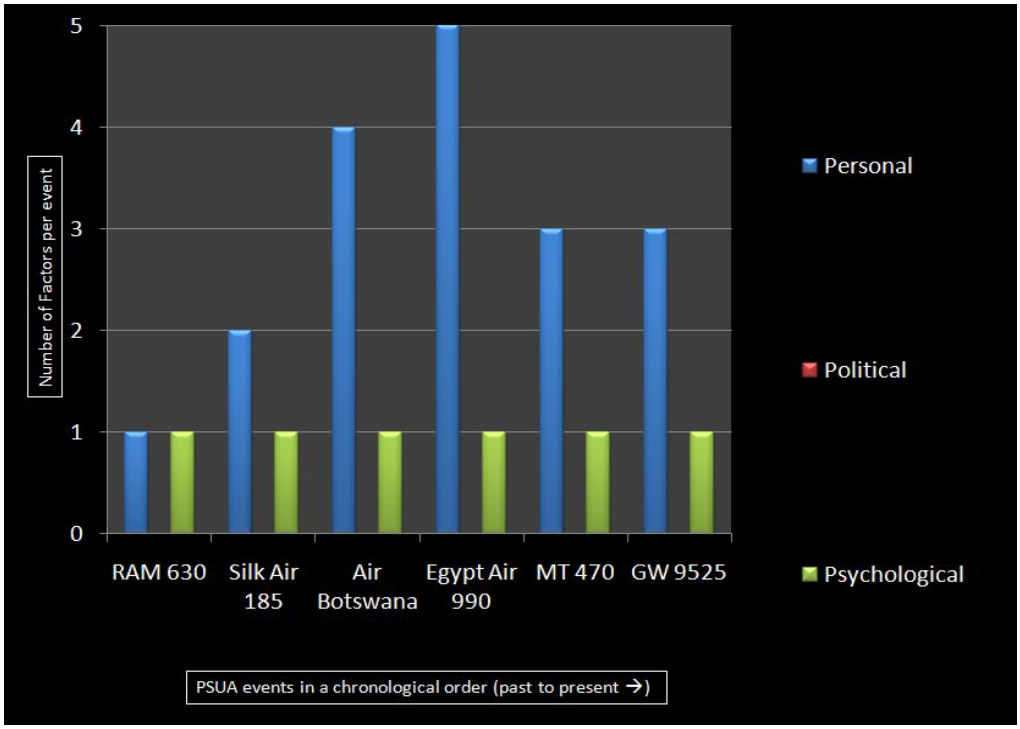
Some examples of the psychological disorders (in different levels), were identified while studying the researched events, the non-exhaustive list included, stress, anxiety and the extreme case of 'paranoid schizophrenia' that were identified as the main factor behind JAL 350 attempted pilot suicide by Captain Katagiri as explained earlier in chapter 4.

Although it is agreed that psychometric screening and other related measures (in an enhanced format) are necessary to minimise the psychological factors risk (which is addressed later in this chapter and chapter six), perhaps it is more efficient and cost-effective for airlines to reduce the overall risk by addressing the easier to identify, personal triggering factors and sub-factors.

The confirmed PSUA events data analysis depicted in figure 5-3 confirms that the political factor was not present in these specific events, and therefore the following hypothesis was formulated; 'Except for the psychological factor that could trigger an event on its own in severe cases (Paranoid

Schizophrenia in JAL350 event, and despite the shadow of job security effect), for a PSUA event to occur, a minimum of two triggering factors must be present, one of which must be psychological'.

Figure 5-3 'All confirmed PSUA events with crew involved and the personal Factor.'



**Chapter '4' events analysis, p8*

Supporting this hypothesis, Kulbarsh quoting statistics by the 'WHO' and the American Foundation for Suicide Prevention, said that *"90% of people who commit suicide have one or more diagnosable mental illnesses"*, although it might sound generic as it is not explicitly addressing pilot's suicide. Kulbarsh also listed the majority of the triggering factors previously identified by this research under what she called *"Experience Risks"*, except for her so-called *"Legal problems"* factor, which is included under job security in this research. (2014)

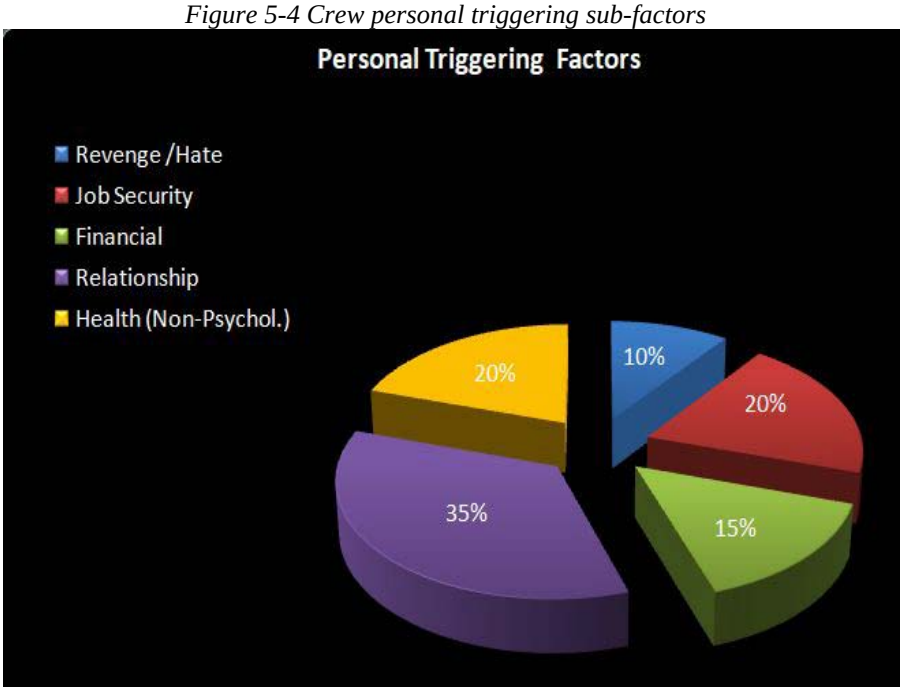
Consequently, if the personal factor is one of the two factors identified in a potential PSUA situation, eliminating the personal factor through proper mitigation could reduce the resultant overall risk by 50 per cent or at least 33 per cent when considering the political factor possibility.

Understanding the significance of personal factors, made it necessary to divide it further into six sub-factors, namely; Revenge/Hate, Job security, financial, relationship, health (non-psychotic) and drugs/medications/alcohol addiction, with the last being removed from the following graph, as addiction did not contribute to any of the studied PSUA events.

Further analysis of the personal triggering sub-factors from the six actual PSUA events, is depicted in the following graph. It places relationship problems (marital issues, divorce, and breakup), on top of the triggering factors with 35% of the events, followed by 20% each for job security and

Health (non-psychotic), then 15% for the financial factor, while the Revenge/hate factor appeared in only 10% of the events.

Figure 5-4 Crew personal triggering sub-factors



**Chapter 4 events analysis, p8*

The research used personal interviews and the data extracted from the pilot's survey analysis, as explained in the methodology chapter to measure and validate the factors identified above.

In addition to identifying gaps in the psychometric screening process and suggesting how to bridge the identified gaps, chapter 6 will also suggest some practical solutions to address the triggering factors identified in this chapter that is based on the outcome of actual PSUA events analysis.

Pilots versus cabin crew risk analysis

Reviewing the recruitment process of cabin crew and pilots within the case study airline revealed similarities in the process, which is used by most of the legacy carriers in the region and worldwide. However, the higher turnover rate among cabin crew members when compared to other union-affiliated and similarly sized airlines in other parts of the world was the main difference.
Of course, the recruitment processes witnessed several improvements after 9/11, including the introduction of psychometric testing (for pilots only and not for cabin crew), while the classic but slightly enhanced security background checks are applied to both.

Security background checks for pilots are still more stringent than cabin crew checks, perhaps because pilots perpetrated 9/11 events. Another possible reason is the statistically proven fact that only pilots committed all the insider jobs that are related to suicide using aircraft events.

Conversely, the number of hijack events carried out by cabin crew (only one) suggests that cabin crew members represent a less significant hijack threat than their flight deck counterparts. This assumption is supported by data extracted from the examples reviewed in chapter 4.

Another possible factor behind the less strict cabin crew screening is the cost involved versus the length of service. In a cost-saving obsessed industry, cost became an essential factor, viewed by some airlines as the difference between sustainable existence and extinction.

The lower training cost and shorter employment term of cabin crews, when compared to pilots, is a fact. It justifies a more thorough and consequently more expensive checks for the job applicant that is expected to last longer and produce a better return on the higher cost invested in the screening. Nonetheless, this finance-based theory ignores the fact that both groups will eventually have the same access to the vulnerable flight deck as perceived by terrorist organisations fishing for recruits.

It is also a fact that pilots tend to remain employed on average, four to five times longer than a cabin crew does over 15 years of employment with the case study airline. However, when considering other factors such as experience and its effect on the level of risk, while balancing the outcome against the airline current recruitment criteria, the results could dramatically change the perception of the risk level and gaps identified in the procedure's example as explained below.

Security profiling studies covering terrorist age groups by Hudson (1999), suggests that the average terrorist retirement age from operational deployment (meaning hijack and suicide missions in this context) is 40, in table 5 that listed Italian female terrorists between 1970 and 1984, only 3% were aged 40 and above (1999, p. 157). Additionally, age statistics of the number of ISIS recruits having been arrested and entered into the legal system of the United States reflects that only 12% of the detained were above age 40, as of 12 November 2015. (Statista, 2015)

Similarly, Otterbacher assumed that the average age of terrorist organisations recruits ranges from 18 years to the mid-thirties. (2016, p. 3)

Hudson also quoted Taylor (1988) who said that *"[...] international terrorists of the 1980s were in their early twenties and unmarried"*, He also cited Russell and Miller findings based on arrest statistics, indicating that 75 to 80% of terrorists in the late 1970s were single, and they attributed that to the terrorist requirements of mobility, flexibility, initiative, security (being covert) and total dedication which mostly contradicts family responsibilities and married lifestyle (1999, pp. 48-51). Discussing the operational terrorist profile, Hudson later said

> *"Terrorists tend to be in their twenties and to be healthy and strong; there are relatively few older terrorists, in part because terrorism is a physically demanding occupation. Training alone requires considerable physical fitness. Terrorist leaders are older, ranging from being in their thirties to their sixties"*. (Hudson, 1999, p. 61)

According to the United Nations, the numbers of unmarried people in general and in the countries represented in the pilot's survey, in particular, are significantly lower above age 40, making the possibility of finding a suitable unmarried recruit above age 40 a difficult task for terrorist recruiters. (2004)

Moreover, 58% of the employee-related hijack/PSUA events were perpetrated by a person younger than 40 years old, while 42% were above 40. However, the mentioned numbers exclude China airlines 334 due to the unavailability of data to establish the age of the perpetrator, Malaysian Airlines MH370 was excluded as well due to lack of evidence regarding the fate of the aircraft or a solid proof to confirm a PSUA, and 9/11 as the hijackers were not airline employees.

Ethnic/geographical origin and religion did not prove to affect the age variation in the events researched in chapter 4, and the topic was not explored outside the researched events.

Based on the above and as the minimum airline pilots or cabin crew entry age is 18, an operational-high risk range of 22 years is expected. However, despite the less probability of an insider job by a crewmember above age 40, this hypothesis would not totally discard the possibility, as over 40 crewmembers still perpetrated some insider jobs. Therefore, for this research, age band 18 to 40 would represent 100% Insider risk, and then the risk is reduced by a fraction thereof of every year above 40 till the retirement age of 65. Other factors need to be added to the equation to calculate the overall risk. The first factor is the minimum qualification required to join the subject airline.

For cabin crew, as per the airline operations manual part D[22], the minimum hiring age for cabin crew is 18 years old, and even though the manual does not stipulate a maximum age, it is rare to identify a cabin crew that was hired over the age of 40 since the airline started. This finding alone

[22] *Chapter 2.2, Page 73 (revision 00),*

is enough to place the case-study airline cabin crews in the higher insider risk category. However, cabin crewmembers over age 40 are found in service as training/checking personnel who still fly few times a year and in most other (unionised) airlines, including many Middle Eastern carriers. It seems that over 40 cabin crewmembers are only rare in the Middle Eastern legacy airlines.

The second factor is the medical fitness requirements, as cabin crews are required to pass a class three medical examinations, which is a straightforward physical check when compared to the detailed class one medical exam that a pilot must pass before being hired.

The third factor is passing the induction training, as cabin crews are required to complete the initial training successfully and hold a safety training attestation, which is an internal qualification issued by the company. The entire process takes approximately three to four months for a walk-in candidate to become an operational cabin crew.

Conversely, the pilot's induction process is much more complicated, even though it might take the same time like cabin crew, depending on the position the pilot is applying for as explained later.

In conclusion, an 18 years old person with a high school certificate who is medically fit from a general public perspective could join an airline and four months later, board an airliner as an operating crewmember with an ID card and the unrestricted access to all security-sensitive company material and the sterile airside of an airport. Most important of all, the new-recruit can now gain access to the flight deck of an aircraft while the busy undoubting pilot is unable to see the threat coming from behind.

This research revealed that a large number of the case-study airline cabin crew members are citizens of high-risk countries such as; Egypt, Indonesia, Iran, Iraq, Pakistan, Palestine (with Jordanian passports at times), Philippines, Sudan, Syria, Tunisia and Yemen.

Some of these countries are witnessing armed conflicts and are known to host some extremist and radical factions, known to have used terrorism as means of fighting for their cause in the past, with a country like Sudan being listed as a terrorism-sponsoring country since it offered refuge to Bin Laden during the mid-1990s.

This fact opened a window of unlimited scenarios in the absence of a robust background screening to establish if an applicant represents a threat or not. Unfortunately, such a system is not easily accessible as it is only available to highly resourced security and intelligence agencies such as the CIA, FBI, Scotland Yard, Europol and some very high-level law enforcement agencies.

The use of this level of resources and cooperation was explained earlier while discussing the US national research and development plan for aviation safety, security, efficiency and environmental

compatibility, and academics such as Kaspersen and Azani et al. highlighted the significance of cooperation in sharing resources and the impact it could have on counter-terrorism efforts.

Unless cabin crew candidates (and in-service) are screened using similarly, reliable resources and airlines are willing to invest in applying such measures and level of cooperation; the airlines should at least reduce the possible risk by keeping flight deck access by cabin crew to a minimum.

When a robust background check of cabin crewmembers is implemented, only then, the procedure could achieve the required level of efficiency, but also depending on other essential factors, such as training as confirmed by the reviewed comments during the pilot's survey data analysis.

Similarly, a review of the pilots minimum qualifications to join the same airline, as stipulated in the airline operations manual part A[23], revealed the airline's five categories or levels of experience of the pilots hired by the airline. The main difference between the categories is the flight experience and age requirements that varies if the candidate is applying as a captain (commander of the aircraft), first officer (second in command) or second officer (cadet pilot).

For simplicity, the following is a brief flight deck crew qualification versus risk summary. For second officers, the requirement to be between 18 and 40 places them in the same high-risk group as cabin crew. However, effective risk mitigation for pilots falling under this category is achieved by the much longer training period due to the lower flying experience of second officers when joining the airline and the smaller number of pilots hired in this category.

Additionally, for most of their training, the presence of a more senior, third pilot in the flight deck (minimum a first officer) is required to act as a safety pilot (until the second officer gains a certain level of experience), and that should minimise the possibility of having this category of pilots alone in the flight deck.

For first officers, the entry-level is between 18 and 55 years old, and given the fact that the position requires a minimum of 1,000 flying hours on twin-engine airline jets, this requirement narrows the age group band by approximately 2 to 3 years, which is needed to obtain the minimum hours. However, a source in the airline recruitment management confirmed that the majority of first officer applicants are joining with higher than the minimum required flying experience, and a large number of pilots apply as first officers because they do not possess the required experience to apply for a direct entry commander position.

Therefore, the first officer's age group is further narrowed into the 25 to 55 years band, by using the rate of one year to accumulate an average of 700 flying hours; this, in turn, reduces the risk of this category by 31% when compared to the cabin crew.

[23] *General/basic, chapter 5.2.4, Revision 12*

For commanders hiring requirements, the age group is between 26 (mainly for internally promoted pilots after acquiring the minimum flying experience) and 60. However, as the position requires a minimum of 6,000 flying hours, therefore, the age group is further narrowed into the 30 to 60 years old band (after factoring the number of years required to accumulate the required hours, for a first officer who joins the airline with 1,000 hours).

The result is a reduction in risk of this category by 54% following the same methodology.

Moreover, all the joining pilots will have to pass two strict security background checks, one with the airline before getting an offer of employment and the second, with the government immigration authorities when applying for a residence permit in the country of the subject airline.
Even though both pilots and cabin crew members are required to undergo the same process, pilots screening is usually more thorough and tends to take longer due to the fact they are expected to stay longer in the country, which increases the risk level as assessed by the immigration authorities, hence, a more thorough investigation is required.

All pilots are also required to pass an annual, very detailed, class one medical examination, which is the most strict when compared to class three medical required for leisure pilots and cabin crew.

Pilot's income, combined with the social status, family and social lifestyles, would all make pilots less prone to fall under the influence of radical terrorist ideologies.
Pilots mostly come from liberal and wealthy families due to the high costs involved with the initial pilot training, besides the fact that the lifestyle of most pilots is far from radical and extreme ideologies. The majority of airline pilots (if not all) are usually out of the classic, financially in-need profile that fits the terrorist recruitment pool.

Even for the growing number of self-sponsored pilots that had to work and pay for their pilot training, the personal history of such pilots is easy to track by the concerned authorities when conducting pilot candidates background checks on behalf of flight schools, a practice that was introduced after 9/11 and is mandated globally not only in the United States. This kind of background checks are mostly conducted by the immigration authorities of the concerned states, before granting an entry visa for flight training.

Currently, flight schools are required to report all foreign applicants seeking flight training who are not holding a student visa in the United States, a practice that should be extended to all countries that provide flight-training facilities.

Most of the self-sponsored pilots would also have the intellectual level, integrity, passion, dedication and love of life, which would make them a hard target for radical factions looking to recruit terrorists.

For the few that could be an exception, a thorough and more detailed background checks, including their extended family, friends and social circles are expected to reveal the level of risk such a pilot could represent. In addition to any other measures deemed necessary by the airline, which might include but are not limited to 'psychometric screening'.

Pilots, who joined the case study airline within the last 15 years, could have already gone through double security and psychometric screening. The first time, when joining the basic flight training school to become a pilot while the second time is when joining the case study airline. Perhaps it was even the third, fourth or fifth time, depending on the number and location of previous employment, making it harder for pilots to slip through the screening processes.

The ratio of cabin crews to pilots hired could also be factored to calculate the risk, the subject airline last count of cabin crew numbers versus pilots was over 10,000 cabin crewmembers compared to over 3,500 pilots (Ferreira, 2017, p. 3).

For a terrorist organisation planning to recruit an airline flight crewmember and after assessing the stringent hiring requirements for pilots versus cabin crewmembers, the organisation would realise by mathematical calculation that the probability of achieving flight deck access by recruiting a potential terrorist is 285% higher in cabin crew group when compared to pilots based on the numbers mentioned above and without factoring the hiring criteria difficulty[24].

Therefore, the following research objective was set to close the loop and eliminate any possible crew related vulnerabilities that are related to current mitigations with specific attention to psychometric testing efficiency.

- **Analyse current risk mitigation, specifically, psychometric testing and measure its efficiency**

  A little over a decade after 9/11 attacks and as the travelling public was starting to regain the lost confidence in the (statistically proven) robust and safest form of transportation, concerns regarding

[24] To factor the resultant risk by comparing the hiring criteria difficulty on a scale of one to five (where one is representative of the least stringent and five is the most stringent), this scale is used to compensate for the inability and impracticality of comparing the subject airline requirements to other airlines due to the complex variations in numbers, size and available information.

To start with, if cabin crew hiring criteria is set as one and pilot's criteria is set as three on the hypothetical scale mentioned above, by hypothetically linking the given ratings to the medical examination difficulty (class 1 for pilots and class 3 for cabin crew). The resultant 855 % risk probability is calculated by multiplying the based on numbers probability (285 %) by the process difficulty, as mentioned above (3).

Based on the above, the presence of improperly screened cabin crew in the flight deck could represent 8.55 times higher risk than that of leaving a pilot on his own in the flight deck of an aeroplane.

For critics whom would argue that the recruitment difficulty scale is not an approved or reliable method, the counter-argument is based on numbers as the calculated risk probability for cabin crews are 2.85 times higher than pilots as potential terrorist recruits, deeming it urgent to stop the unscreened properly cabin crewmembers from gaining unnecessary access to flight decks.

pilot's mental health, along with demands for their psychological screening, re-surfaced again in 2012, one year and eight months before LAM 470 and three years before GW 9525 PSUA events.

The 2012 concerns were in reaction to the widely publicised and rapidly shared on social media, videos and photos of the March 27, 2012, erratic behaviours of Captain Clayton Osbon, the pilot in command of Jet Blue flight 191 to Las Vegas. Osbon's first officer felt alarmed by the comments made by his captain about *"taking a leap of faith"*, "*not going to Vegas"* and *"sins in Las Vegas"*, he decided to use the protection provided by the armoured flight deck door by locking the hallucinating captain outside and diverting the aircraft for a safe landing. Meanwhile, the concerned passengers subdued the captain who started talking about "*Al-Qaeda"*, "*bomb"* and "*that they should start praying"*. (Avila, Hosford, & NG, 2012)

An excellent job by the first officer, who correctly interpreted his captain's behaviours, realised the threat and neutralised the situation while he brought the plane and its occupants to safety.
Therefore, this research highly recommends 'Suicidal Behaviours Interpretation and Awareness' training, a recommendation that received strong support from the pilots as reflected in the following survey comment received in response to question number 11

> *"[...] such behaviours don't happen overnight. These people must have somehow shown some kind of agitated actions in verbal discussions to indicate some signs of suicidal tendencies on earlier flights or encounters with colleagues."*[25]

Pilots, as well as aviation professionals, are calling for awareness training regarding suicidal behaviours recognition. Such training should not be limited to pilots, cabin crews and employees that directly interact with them. It should also extend to include the direct family (i.e. wife, spouse, or partner) of any crewmember who is diagnosed or suspected to have any form of mental illness. Preferably, a pro-active approach would see the training provided initially to pilots and cabin crews as part of their induction training and then gradually extending in phased stages to include pilot's direct family members.

The training should be voluntarily attended by the family of a pilot that is exposed to any life-changing crises such as chronic illness, death of a close relative, divorce, loss of medical or pilot license, demotion and any serious financial situation problems as recognised by the company (for example, if the employee requests a big loan), with mandatory attendance by the families of pilots that display signs of mental disorders. These are only examples as the list is not exhaustive and subject to modification after consulting the company psychiatrist, safety and security management.

Similar awareness programs are already existing for quite some time in other domains, a good example from the health sector is the UK's Blackpool joint strategic needs assessment, called the

[25] *Q11 response received on 12/01/2017 03:05 PM*

"*Applied Suicide Intervention Skills Training (ASIST) on suicide prevention"*. (JSNA, 2017) Perhaps it is about time to implement similar programs in the aviation sector as well.

Two years after the JetBlue event, the disappearance of MH370, followed shortly by German wings accident, caused a mounting pressure that forced airlines to introduce psychometric testing, in an attempt to mitigate the risk of suicidal pilots and re-assure the concerned public.

Airlines introduced some commercially available screening tools such as PILPAT, PSA and PAT; these tools were rushed into service and caused many operational disruptions. Despite being psychomotor skills measuring tools, airline officials saw the tests as a solution to the psychological screening dilemma. Nevertheless, most of the psychometric assessment tools that are currently used for the pilot's mental fitness assessment are not efficient.

The best evidence to support this argument is first officer Lubitz who successfully passed a similar test during his induction process into Lufthansa's subsidiary German wings, and shortly after his release as a first officer he crashed the A320 he was flying in a confirmed PSUA.

Two high profile scholars, Professor Robert Bor and Dr Hans-Werner Teichmuller testimonies were published days after the German wings accident in support of the 'minimum crew in the flight deck' procedure. The two experts seemed to challenge psychometric testing effectiveness in combating PSUA as cited in Henley, commenting on German wings accident, Bor who also advised the FAA on Jet Blue flight 191 event, said *"We concluded that nothing could have prevented that incident from happening"*, he also confirmed that the best available screening tools are not capable of predicting a pilot's behaviour or stopping a PSUA. (Henley, 2015)

In the same context, Teichmuller said he could not comprehend how Lubitz operated that flight even though he was declared unfit by a sick note on the day of the flight. Teichmuller also agreed with Bor that suicidal pilots could evade psychometric or psychiatric screening if they are smart enough as none of the existing tests are considered 100% foolproof. (Henley, 2015)

Therefore, Henley sided with the 'minimum crew in the flight deck' procedure and wrote

> "*Ultimately, the best guarantee of in-flight safety, many experts concur, maybe the "rule of two" - common in the US but introduced by many other airlines only on Thursday, and on Friday by Lufthansa and its subsidiaries - which requires at least two qualified crew members to be in the cockpit at all times"*. (Henley, 2015)

In conclusion, most of the psychometric tests that are currently in use by airlines are just another tick in the compliance box and a tool to address the growing concerns of frightened passengers. It is more of a process that measures the psychomotor and cognitive skills of pilots, which is some of the qualities that are required for pilots to perform their duties to the minimum required standard. Moreover, the tests that are available in the market are not robust enough in terms of producing

consistent and transparent results, given the dire consequences such tests could have on a pilot's career and personal life.

During a conversation between a senior manager of a psychometric screening service provider and a major Middle Eastern airline flight operations manager (B)[26] and while discussing the termination of the service contract (based on findings by the airline regarding the inconsistency and lack of sensitivity to cultural differences of the test provided), the screening company manager became emotional. She mentioned that her company is prepared to do whatever necessary to keep the contract, including tweaking the test to fit the airline's operational requirements. This manager was not ready to lose the hefty contract that could cause her company to go out of business in this lucrative sector. The firm manager approach confirmed the airline concerns, and the contract was terminated with an immediate effect.

The airline hired a new company (after extensive research) and re-screened a large number of pilots to validate their previous test results. The airline also introduced supporting, and parallel measures, such as pilot's technical and personal record review, enhancements to the recruitment simulator/line pilot's screening process and real-time pilot's assessment flights, all are conducted by a select group of senior examiners.

All the enhanced measures were used while focusing on the non-technical/cognitive skills and finally comparing the data produced by the improved process to the data generated by the newly introduced psychometric screening tool.
After using the revised process, the test produced pilot's profiles matched reality as evidenced by the pilot's technical/personal records and as a result, several pilots that did not pass the initial test while they had an excellent record, passed the new screening process that catered this time for the psychological, cultural and non-technical skills as well as technical aspects of pilots performance.

Consequently, does the revised psychometric screening process represent the solution for the industry pilot's mental health concerns or should the (cost-saving) airline industry adopt Professor Bor and Teichmuller recommendations and abandon psychometric testing?

It is beneficial to review what Feijo et al. (2012), as cited in Atherton, had to say to avoid a premature answer to this crucial question. Feijo et al. reported that 23.7% of common mental disorders were found in a sample of heavily worked 807 Brazilian pilots, which closely aligns with the UK's 25% general population lifetime mental health risk. (2016, p. 30). Atherton then added

> *"Recent MIND figures show that in the UK population at any one time 2.6/100 will be suffering from depression, 4.7/100 will have anxiety disorders and 9.7/100 will exhibit mixed anxiety and depression. With approximately 15,000 commercial pilots in the UK unless it can be shown that the pilot population differs significantly from the general*

[26] *VPFO 2013*

> *population then there could be 1500 individuals flying with some form of mental health issue*.
>
> *Additionally with global suicide rates for males at approximately 30/100k (this figure has been on the rise over the last 30 years from the 20/100k typical of the UK currently), while that for females has been steady at 5/100k (Dr. A. Evans, ICAO, 2007), there is a valid question as to the level of risk posed by these base rates".* (Atherton, 2016, p. 30)

Atherton discussed the current opposition to mandatory aircrew mental health screening and expected some regulatory actions to implement it soon. Highlighting the dilemma of aircrew mental health screening and the problems facing it, Atherton explained

> *"The first is that of the availability of qualified personnel and diagnostic tools to manage the number of individuals to be assessed (globally 130,000 pilots which becomes much more challenging if cabin crew are included). The second is the legal and political challenge of agreeing and implementing a separate and specific 'mental health assessment'.".* (Atherton, 2016, p. 30)

Atherton correctly focused on some of the aviation-industry main concerns regarding pilot's mental health and provided some beneficial figures that signify the seriousness of the problem, while he stressed on the ineffectiveness of the current mitigation tools. (2016, p. 30)

Atherton also highlighted the importance of *"research to provide an evidence base to develop policy"* and regulations, not introducing cosmetic 'tick-in-the box' procedures without adequately researching the risks, the evidence and the consequences. He also made a comparison of general public suicide rates data from Brazil to those of the UK, in the process he revealed some useful findings such as the lower female suicide rates when compared to those of males. (2016, p. 30)
This finding is so important to support the suggested mitigation of hiring more female pilots and cabin crews, as this measure alone (based on Atherton's statistics), could reduce the risk by 15%.

Another interesting statement by Feijo et al. (2012), as cited in Atherton (2016), links mental disorders in pilots to heavy workload, an assumption that is repeatedly addressed by pilots and confirmed by many survey comments as well. In the same context, the author witnessed a relevant case in April 2002, when two fellow instructor pilots developed depression symptoms after three consecutive months of working to the maximum legal limit of 100 hours per month due to heavy training workload, one of the mentioned instructors was removed from duty and assigned long vacation while he continued to follow up with a psychiatrist based on an aero medical examiner recommendation after he voluntarily informed the AME about his psychological symptoms and returned shortly afterwards to flying, while the other instructor was permanently grounded after being diagnosed with a mental disorder.

Seventeen years later, a similar case is witnessed by the author, indicating that heavy workload and the work environment pressures continue to exist while highlighting the significant effect of these elements on pilot's mental health if left unresolved, including the risk of becoming suicidal.

Going back to the pilot's survey, 13% of the pilots that responded to the survey did not take a psychometric test, and out of the remaining 87%, only 1% did not pass the test required for promotion to a commander position.

Nonetheless, the failed pilots are still flying safely as second in command to date and did not crash an aircraft. Actually, some of the pilots re-attempted the test, six months after failing the first attempt and without undergoing any psychological rehabilitation or training; they managed to pass the assessment and are now flying as captains.
Perhaps this is the reason 24% of the responses deemed the test as neither accurate nor efficient.

Another valid argument as voiced by most of the pilots is the following; 'if a pilot failed to become a commander, based on failing a psychometric test (consequently raising doubts about the pilot's mental health), should the same pilot be allowed to fly an aeroplane as a first officer? After all, a pilot could crash an aeroplane irrespective of which seat he is occupying'.

The only acceptable exception to the above is when a pilot is not meeting a specific technical standard that is required to become a commander, and in this case, it is easy to establish such a finding without the costly (and stressful) psychometric screening.
However, a supportive 17% of the pilots still agreed that the test was accurate and efficient.

Additionally, according to Grey, researchers revealed that a noticeable number of airline pilots displayed mental disorders and suicidal ideation, the study reflects the following figures

> *"After surveying almost 1,850 anonymously reporting airline pilots on their mental health, it found that 12.6% of them met the depression threshold, while a further 4.1% reported having suicidal thoughts".* (Grey, 2017)

Grey elaborated further about the public perception of mental illness, he said

> *"The delicate issue of pilots' mental health continues to be veiled in stigma. Despite recent efforts from the authorities, barriers to the full disclosure of mental health problems remain entrenched in the industry, while a robust support network is still absent".* (Grey, 2017)

Grey's statement regarding the stigma surrounding pilots mental health problems is very much applicable and is more pronounced in the Middle East than it is in the European, American or western communities.

In most of the Arab world, a person that consults a psychiatrist is perceived in local cultures as an insane or crazy person, a perception that is not confined to illiterate people, it actually extends to include a big chunk of the educated and intellectual society.

Families that include a mentally ill person considers the situation a taboo and would always try to avoid discussing the subject or deny its existence as such an illness is perceived as a stigma that could affect the entire family's reputation, as it is rare to identify a person that would consider

marrying a person from a family known to have mental illness history, simply because of the fear of having the illness genetically transferred to their children.

Almost all airlines in the world and the Middle East in particular (including the case study airline), would not employ a pilot known to have had a history of the slightest mental illness especially, after German wings accident. This fact makes it obvious why pilots are reluctant to approach their company psychologists seeking support in dealing with minor issues such as stress, even though simple stress (if left untreated) could develop into a more serious problem.

The following pilot's survey comment supports this argument and Grey's impression regarding the absence of a robust crew support network

> *"I think pilots should be encouraged to seek psychological therapy when required. I think that they are discouraged by a perceived notion that they may lose their medical should they seek this. That is not the case, or at least it shouldn't."*[27]

Saad (2015) addressed the subject by quoting Naushad Anjum, a Pakistani psychologist and *"an airline pilot himself, who is also a member of the European Association of Aviation Psychology"*; Anjum admitted that *"Job loss is a pilot's greatest fear"*. Another professional/academic opinion, which supports the factor identified in several PSUA events, including German wings accident.

Pilot's mental health figures mentioned above; combined with the tragic history of PSUA events are considered alarming and deems the development of psychological screening tools a necessity.

Perhaps not in the current format, but in an enhanced and more practical format, that is supplemented by other parallel mitigation methods, including but not limited to 'crew support networks', to guard against unnecessarily damaging any pilot's career and also to produce a tool that is capable of minimising the risk of having pilots with mental illnesses taking to the skies with all the possible consequences.

- **Gap analysis of the procedure and identifying bridging solutions**

Most of the survey produced suggestions regarding gap bridging and risk mitigation, focused on cabin crew training for the recognition of an undesired aircraft attitude and on defining cabin crew specific tasks when a situation escalates to a PSUA level on a flight deck.

The training must emphasis opening the flight deck door (to enable the other pilot's return to the FD) and then helping the other crew members restrain the hijacker/suicidal pilot, these simple but vital tasks must be clearly defined as the objectives of cabin crew presence in the cockpit.

One of the other identified gaps in the current policy is the presence of loadmasters and supernumerary passengers onboard the case-study airline cargo aircraft (representing 10% of the

[27] *Q11 response received on 02/01/2017 05:58 PM*

airline fleet size), which are not equipped with an armoured flight deck door and carry two pilots on most of the cargo flight's network, according to the interviewed manager (A).

Risks involved are not limited to the un-controlled access to the flight deck, but it also extends to include the crew meals and drinks stored in the galley area outside the flight deck, with the un-monitored catering being easily accessible by loadmasters or supernumerary area occupants.
Such access makes it possible to contaminate the supplied catering to knock the crew unconscious or in extreme cases, kill them.

Pilots who opposed the minimum crew in the flight deck procedure argued that 'if the policy is not required on a cargo aircraft, it should not be required on passengers fleet as well, unless an extra pilot or cabin crew is carried to prevent a single pilot in the flight deck situation', and 'nobody is allowed on cargo planes except the operating crew', which is not the case.

In contending this argument, the senior manager (A) of the case study airline, insisted that the risk involved on cargo aircraft is mitigated by the thorough security screening of all non-flight deck crew members that are allowed to travel onboard cargo aircraft for operational reasons only.

The senior manager's counter-argument is acceptable as a mitigation to address access by potential terrorists or employees who might have a concealed criminal record. However, it is not as reliable in addressing the risk of mentally ill potential hijackers or discontent employees similar to the earlier discussed FedEx scenario.

Security screening was not even capable of guarding against a less complicated situation, such as the August 18, 2014 event, reported by Kitching (2014), when an intense argument between a Saudi airlines captain and a male cabin crew, suddenly escalated into a fistfight just minutes before takeoff from Cairo, causing mutual injuries and a significant delay in addition to the airline embarrassment and image distortion, this example highlighted the possibilities of more dire consequences that could have included the captain's incapacitation if the physical confrontation took place in mid-flight.

To summarise, the aviation community is retreating its support to the minimum flight deck occupancy policy after realising the higher risk of having a terrorist (posing as cabin crew) access the flight deck and take advantage of the forward-facing, busy flying and undoubting pilot.

- **Measuring the accuracy of suicidal behaviours triggering factors identified through the analysis of actual and potential PSUA events as discussed in chapter 4**

Review of the FAA general aviation (so-called) aircraft assisted pilot suicide reports covering the period from 1993 to 2012, along with the 1993 to 2002 report by Johnson et al. (2006, pp. 1-16) in

addition to the 2003 to 2012 report by Lewis et al. (2014, pp. 1-14), revealed a total of 24 PSUA events.

The 24 events represented 0.37% of the 6406 fatal general aviation accidents over the same period. The reports also reflected a 50% drop in the number of PSUA events, for the period from 2003 to 2012, eight events were reported versus the sixteen events from 1993 to 2002.

Although this research is focusing on airline PSUA events and not general aviation, the reports mentioned above were consulted for comparison purpose and the identification of common factors that could be useful to the research subject.

The comparison revealed some interesting findings including the following, 'all general aviation pilots involved in PSUA events included in the reports (apart from one), were the sole occupants of the aeroplanes used to commit suicide, they were all males, and the average pilot age across the two reports was 43 years old'.
A statement that concluded both the reports indicated that PSUA events were not that common and that event numbers were declining.

The studied reports also revealed other significant findings, including the precise specification of three factors, namely, (clinical depression) Psychological, (marital) relationship and financial, as the leading triggers of PSUA in general aviation. This specific finding confirms the factors identified by this research through the study of past events and validates the survey analysis results.
The NTSB reaffirmed these findings and noted that between 2003 and 2012, eight pilot suicide cases were reported, including only one case with a passenger on board. (Zupp, 2015)

> *"Four of the eight pilots had been drinking at the time, while two had been taking antidepressants. The report noted that "factors involved in aircraft assisted suicides may be depression, social relationships, and financial difficulties, just to name a few problems." The good news. The frequency of these suicides has declined sharply in recent decades".* (Zupp, 2015)

Even though PSUA events are becoming rare, the statistical figures about pilots with suicide ideation or mental disorders are considered alarming. However, evidence-based analysis of actual PSUA events suggests that for a suicidal pilot to become homicidal and kill others in a PSUA event, the pilot's actions are rarely triggered by the psychological factor alone.

Out of the 16 analysed events in chapter 4, only two events (German wings and Japan Airlines) confirm pilot's mental illness as the leading causal factor (depression in German wings accident and paranoid schizophrenia in JAL event). However, in other actual and potential PSUA events, it was noted that a combination of two or more factors (one of which is psychological), were usually required to turn a pilot from a suicidal to a homicidal person who would kill others in the process, as explained earlier in chapter 2.

The research also concluded that suicidal pilot's objectives could vary. They might want to make a statement at times, similar to what Lubitz did and the 47 years old, ex-British Airways B747 pilot, Robert Brown was planning to do, after he killed his wife in 2010 by hitting her 14 times with a hammer following a lengthy and expensive divorce. (Zupp, 2015)

> *"He had been due to fly a 747 from London to Lagos, Nigeria the next day but rang in sick at the last minute. Brown told his trial: "I didn't want to be another husband who kills his wife and then himself and nobody cares. I thought if I got to work I could crash an aircraft, or fly to Lagos and crash it there. I wanted to make a statement".* (Zupp, 2015)

Brown words and objectives are almost identical to those of Lubitz and most of the reviewed perpetrators, and it indicates a desire for attention as explained earlier in literature review based on Lankford as cited in Goode (2015).

The survey data suggest that the psychological factor is the most significant in triggering PSUA events, with a majority of 64%, which is very much in line with the reviewed SME opinions and the data extracted from the studied events, especially in the absence of the political factor in actual airline environment and general aviation PSUA events. However, the one factor most linked to depression that was identified as the leading factor in previous PSUA events and ranked third according to survey question number 10, was the personal factor (divorce, relationship break up, loss or chronic sickness of a loved one).

Supporting this hypothesis is the example reported by FOX 8 News which highlighted the personal factor (divorce this time) and the degrading effects it could have on a pilot's mental state. The event took place when a United Airlines female pilot scheduled to operate flight UA 455 from Austin to San Francisco was removed from the flight after she showed up in civilian cloth and used the aircraft public address system to talk to the passengers about her divorce. She also addressed some political topics, such as elections and the presidential candidates. (FOX8, 2017),

The personal factor and other (less voted) factors such as; financial, job security, non-psychotic health problems and alcohol/drugs/medications abuse or addiction, are easier to identify and mitigate. Such factors are also easier to manage, only if handled in close coordination with the employer and under the umbrella of corporate responsibility towards the employees.

Turkish airlines general manager, Temel Kotil, being aware of the consequences of unstable relationships, urged his pilots to get married, Kotil did that shortly after the German wings tragedy, as news surfaced that first officer Lubitz who intentionally crashed the plane, was suffering from severe depression after breaking up with his girlfriend. Mr Kotil said

> *"The tragedy last month "taught us new things and piloting is a very critical task, The lifestyle of pilots - be they men or women - is very important, he added The accident happened after the pilot's girlfriend left him. So my dear friends take into account that we advise our single pilots to get married".* (AFP, 2015 b)

In support of Kotil's theory, Kulbarsh wrote that the National Institute of Health Care Research (NIHCR) in the United States had said that

> *"Marriage is associated with lower overall suicide rates" [...] "divorced people are three times as likely to commit suicide as people who are married"* [and that] *"divorce now ranks as the number one factor linked with suicide rates in major U.S. cities, ranking above all other physical, financial, and psychological factors".* (Kulbarsh, 2014)

NIHCR comments also highlighted the same factors, identified earlier by this research and are in agreement with the research personal (relationships) ranking as the most significant factor.

Other factors related suggestions that were submitted as comments in response to the pilot's survey, almost collectively emphasis on the importance of improving the working environment and implementing just culture. Moreover, the French Investigation Authority (BEA) last recommendation in the German wings accident investigation report, similarly recommends that

> *"EASA ensure that European operators promote the implementation of peer support groups to provide a process for pilots, their families and peers to report and discuss personal and mental health issues, with the assurance that information will be kept in-confidence in a just culture work environment, and that pilots will be supported as well as guided with the aim of providing them with help, ensuring flight safety and allowing them to return to flying duties, where applicable".* (BEA, 2016, p. 103)

As discussed earlier in the literature review chapter, the following FAA statement confirms that the percentage of mentally ill pilots is small, the agency said that

> *"[...] for every 1,000 pilots tested, only eight are denied certification for medical reasons, and only two of those for psychoneurotic disorders"* (Time, 1982)

While the research findings agree that for the mitigation of the political factors, current security procedures such as background checks and similar approaches, are managing to minimise the risk to an acceptable level, it is understandable that similarly lowering the psychological factor risk is hard due to the lack of reliable and efficient screening tools that are capable of identifying pilots with psychological problems, keeping in mind the cultural and job security barriers, and that might be the reason behind the FAA's perception that pilot's mental disorders are not that serious.

However, Atherton (2016) and Grey (2017) earlier discussed statistics prove that pilots/crew mental illness is a significant threat, while Hudson (1999) and Goode (2015) similarly identified the other than psychological factors in PSUA, which also validate the research findings.

In conclusion, and based on the analysis of actual PSUA events and the academic opinions mentioned above, the following research hypothesis materialised

"Except for the psychological factor that could trigger an event on its own in severe cases, for a PSUA event to occur, a minimum of two triggering factors must be present, one of which is psychological".

Consequently, if the personal factor is one of the two factors in a potential PSUA event, then by eliminating the personal factor through proper mitigation and effective measures, it is possible to reduce the risk by 50 per cent. Even if the political factor is introduced to the equation through a crewmember radicalisation for whatever reason or recruitment by a terrorist organisation, addressing the personal factor would still reduce the risk by 33 per cent.

Predictive procedures design

Despite the statistically proven decline in the number of hijack events over the years; the aviation industry (adopting risk-based decision-making) decided to keep the heavy flight deck door on the majority of commercial jets flying today, even though, this decision meant a marginal increase in the fuel consumption per hour that could amount to millions of dollars per year in direct fuel costs and carbon emissions taxes.

The reduction in risk as interpreted from the decline in hijack probability did not justify the removal of the heavy door, as the industry is gradually progressing (in terms of risk management) from the reactive to a pro-active level.

Decisions are becoming more evidence-based and are made after thorough investigation and research of the industry trends and all available data that are gathered through the continuously developing safety and security management systems (SMS) and by utilising valuable gap analysis tools, such as end-users feedback regarding the flight deck door procedure in this case.

The industry is progressing towards the use of academically as well as professionally qualified analysts, to improve the quality and reliability of data analysis. Hazards identification by the end-users is also an essential element of a fully functioning SMS that is paramount for an effective and pro-active risk management and applications to procedures design.

Question 14 responses reflected the pilots and general public perception of the armoured flight deck door as an effective hijack deterring tool with 81% of the surveyed pilots supporting this assumption.

The pilot's and public support for the armoured door was motivated by the (few but still happening) foiled unauthorised flight deck access attempts, especially, when live videos and photos (of such events) are virally spread on social media.
Events such as Malaysian Airlines flight MH128 on 31 May 2017, *"from Melbourne to Kuala Lumpur, that was forced to return to Melbourne"* after a 25 years old passenger attempted to hijack the A330. The hijacker threatened to blow (what he claimed to be) a bomb, if not allowed into the flight deck. (Hanrahan, 2017)

The armoured flight deck door again granted the pilots the time required for un-interrupted diversion back to Melbourne for a safe landing. However, a relatively new but very significant mitigation element came into light after MH128.

The passengers of MH128 realised the developing situation, subdued the hijacker and restrained him until he was handed over to the authorities after landing, reflecting passenger's awareness of the dire consequences of allowing a hijacker to gain access to the flight deck and a clear

demonstration of the majority of passenger's commitment to safety and security; this represents a new element that could become an efficient tool in future risks management and procedures design.

Researching the subject should also consider that passengers awareness and involvement, despite being an effective tool in MH128 and perhaps in restraining the majority of the mentally ill or (hoax explosive devices equipped) hijackers, might not work favourably every time.

Similar to the scenario of the (mentally stressed by marital issues) Egyptian citizen who pretended to wear an explosive belt (turned out to be a hoax), and hijacked Egypt air flight 181 from Cairo to Medina in Saudi Arabia. The event managed to clutter the armoured flight deck door image as a hijack proof tool. After all, the armoured door efficiency will always depend on the crew who operates the door and the level of discipline in applying the procedures in place.

Fortunately, the hijacker in this event released all on board upon arrival into Cyprus and later on applied for political asylum, shifting from his original demand of handing a letter to his ex-wife who lived in Cyprus. (Hackman, 2016).

This event also represented another evidence of personal factor (marital issues) significant effects.

Moreover, passengers might not always be as efficient when dealing with real terrorists. Similar to what happened on 9/11 United flight 93, when the heroic actions of passengers who tried to regain aircraft control and restrain the hijackers, failed to save the aircraft or its occupants.
Another situation when passengers cannot be as efficient is when a disparate or mentally ill person has a real explosive device, a firearm or even a small but sharp blade.

From a pilot's perspective, the best option under such circumstances is to use the protection granted by the armoured door to communicate the situation to air traffic controllers and land the aircraft as soon as possible.

Finally, writing procedures in general and security procedures, in particular, will always be a challenging process. Balancing the stringent security requirements such as pre-departure screening against brand requirements that focus on customer satisfaction, such as minimum check-in time and less exposure to lengthy procedures, from the time the customer walks into the terminal until comfortably seated on board, is not an easy task.

Satisfying the passenger's requirements could be the fine line between the customers coming back to fly the same airline or deciding to use another carrier, meaning that the economic influence on procedures design cannot be ignored in this financially driven world.

As established earlier, passengers want to fly safe and secure airlines. Nonetheless, boards of directors would like to do the same while making a profit.

An equation that is not as easy as it might sound, as evidenced by the once mega carrier (turned almost bankrupt), Malaysian airlines situation post MH370.

In conclusion, for a procedure to be efficient, it must be simple, practical and cost-effective, if it is not meeting these three requirements, the end-users will not follow it. Either because they cannot understand it (it is too complicated), it is hard to implement (tiring, requires more employees to perform or not delivering the expected results) or expensive (for boards of directors or passengers equally, as it always goes back to them as surcharges on tickets).

Eventually, a procedure that is not simple, practical and cost-effective is defeating its purpose, as it promotes the users to deviate from it or ignore it, damaging the safety/security culture and the working environment which could result in increased risk exposure, more vulnerabilities and dire consequences.

6.0 Conclusion and Recommendations

> *"Just culture. Unintentional errors committed should not have the same rigor of punishment as intentional violations. The detection of the error, in itself, is a learning opportunity and a chance for improvement".*[28]

Conclusion

Risk cannot be eliminated. It is the bi-product of all the vulnerabilities in our procedures, measures and human factors, which could affect the entire security system. Reducing the flying calculated risk to zero could only be achieved by not flying at all.

Failure to spot threats and errors in our system or human performance and then introduce the appropriate mitigation, after the careful consideration of latent threats that might be concealed in the proposed mitigation itself, could result in a higher risk, contrary to the objective of any newly developed procedure.

Studying the history of PSUA events and comparing different opinions and perspectives reaffirmed the rarity and declining numbers of such events while strong evidence that the risk is low was established by comparing the number of mentally ill pilots who got involved in PSUA events, to the number of pilots safely transporting millions of passengers all around the globe.

From a risk management perspective and taking into consideration the probability of another PSUA to happen versus the severity of the consequences of such an event if it happens, the resultant calculated risk is as low as reasonably possible (ALARP), which is an internationally acceptable risk level for conducting commercial flight operations.

Although restricting fight deck access proved to be valuable in preventing terrorist attacks, it may also help a pilot (when left alone in the cockpit) commit suicide using an aircraft. Measures introduced after 9/11 such as the armoured flight deck door, are believed to have foiled many unauthorised flight deck access attempts, failing the objectives, and different agendas behind these hijack attempts. The industry stands grateful to the Kevlar coated flight deck door for preventing these incursions.

The flight deck door somehow also worked in favour of suicidal pilots in German wings and Mozambique airlines accidents. Nevertheless, when considering events such as JAL 350, Royal Air Maroc 630, Silk Air 185 and Egypt Air 990 that took place before 9/11, none of the involved aeroplanes in these events had an armoured door. Similar to the 10% freighter fleet of the case study airline, which is not equipped with a flight deck door and carries two pilots on most of the cargo flights, and similar to many other freight carriers as well.

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[28] *Q13 response received on 18/01/2017 06:07 PM (survey comment on effective PSUA countermeasures)*

Moreover, the presence of another pilot in the flight deck of the events mentioned above did not prevent the accidents from happening, except for JAL 350, when the presence of another pilot and a flight engineer (not a cabin crew), helped reduce the number of causalities.
Even when statistically considering the risk involved with keeping the armoured door, versus the risk of removing it (that could serve cost reduction efforts), the lower risk achieved by keeping the armoured door still justified keeping it, despite the higher direct operational costs involved.
Now that the armoured door is staying, risk management called for 'minimum crew in the flight deck' procedure, as an acceptable mitigation to the risk of having another suicidal pilot flying alone in the flight deck who might crash another aeroplane.

Based on the thorough review of conflicting academic and professional opinions regarding the 'Minimum crew in the flight deck' procedure and after comparing end-users feedback based on two years of practical application, the outcome was in agreement with the industry's major airlines and international organisations to withdraw the support for the procedure (including the majority of the surveyed pilots as 63% of the pilots had their doubts about the procedure's reliability and 27% declared it not effective in addressing PSUA risk in response to question number 2 and 62% answering question number 4 by 'NO' when asked if the procedure could prevent a pilot from committing suicide). These bodies justified this shift in position by addressing the latent threat of having a rouge cabin crew gaining access to the flight deck or in other words 'The insider threat'.

Airlines also introduced Psychometric screening for pilots as an additional risk management tool.
Meanwhile, Psychometric-screening review revealed that it is not 100% PSUA proof, even some well-respected psychiatrists admitted that it is not possible to predict mentally ill pilots behaviours, validating the opinions of the 27% of the pilots that responded to question number 8 and saw the tests as neither accurate nor efficient, raising doubts about the ability of a psychomotor skills measuring tool (in its current format) to assess pilot's behaviours, primarily when assessed outside their real working environment.

Research revealed that mental health issues exist in pilots as it does in the general public and that some pilots have suicidal ideation. Nevertheless, in-depth study of past PSUA events, including the review of the involved pilot's profiles and validating the findings through comparison with findings from the pilot's survey analysis, revealed the following results;

Mental illness on its own might trigger suicidal thoughts, and if aggravated by other factors (at least one), it might lead a person into committing suicide. However, a suicidal person would usually commit suicide in privacy and away from people.
For a suicidal pilot to become homicidal and decide to take the lives of his colleagues and passengers by crashing an aircraft and if the motive is other than political (terrorism) reasons, the

combination of at least two factors is required to trigger such an action, one of which is usually psychological. The other two major factors behind PSUA are either personal or political.
Consequently, if airlines are unable to identify all pilots with mental health problems, due to logistic and legislative issues and until these issues are resolved, airlines should focus on factors that are easier to identify and work on addressing their root causes as this could result in 50% PSUA risk reduction.

Political factor motivated hijack risk is already mitigated by the current security measures, as the already in place procedures should intercept a pilot or a cabin crew who turned into a terrorist at a very early stage using current security profiling, background checks and available intelligence.
Airlines with the suitable resources could reduce the risk further, by using enhanced security background checks that dig further by randomly screening selected pilots and cabin crew's extended family, friends and social circles. Crewmembers can be chosen for this enhanced check based on fitting a specific risk profile.

Psychological factor mitigation could be achieved through enhancing psychiatric screening of pilots and cabin crews by using independent psychiatrists during the induction process.
A closer coordination between the psychiatrist and the flight crew welfare manager is required for a continuous monitoring and routine review of pilots and cabin crews, especially after a life-changing event such as the loss of a close family member, diagnosis with a life-threatening illness of the crewmember or a close family member, financial crisis and similar stressful situations.

The welfare manager must be granted the level of authority to handle situations that contribute to psychological stress, fatigue, and depression, such as heavy workload and job security. This level of authority should enable the mitigation of such conditions without the fear of punitive actions.

Crewmember's support by colleagues, family and the company is paramount in PSUA prevention. Awareness training should be provided to pilots and cabin crews to enable the recognition of suicidal behaviours and motivate them to immediately report any observed suspicious behaviours by their colleagues, to the welfare manager for confidential and appropriate action coordination with the psychiatrist and the aero medical examiner.

An independent psychiatrist to support the airline crewmembers community is an essential tool. While equally important is a cultural awareness program to improve the mental illness/disorders understanding by the crews and their families, in addition to other airline employees, and the importance of counselling by the welfare managers or psychiatrists (when required), in a corporate-sponsored campaign to change the negative impression about psychiatric disorders and counselling.
Psychological factor mitigation will not be complete, unless rules are changed to enable psychiatrists who are treating diagnosed pilots from a certain level of mental disorders, disclose the

appropriate information about the patient's condition, at least, to the aero medical examiner, to decide together on the fitness of the concerned pilot for flying duties and the next course of action.

Relationship-based personal sub-factors like (divorce, separation or break up) and other factors such as financial, job security, health or substance abuse are mostly covered by the introduction of enhanced welfare management and independent psychiatrist availability for counselling. Nevertheless, the financial and job security factors requires a higher level of corporate responsibility, as stress caused by fear of losing a job is present in all crew jobs, but in different levels depending on the experience and qualification of the employee, as these are the necessary tools to land another job if required.

Job security campaigns to transfer a crewmember who is diagnosed with a mental disorder preventing him or her from flying (temporarily or permanently), to a suitable ground job, would not only cater for the financial obligations of the employee and guarantee employee's loyalty, it will also, significantly improve the working environment reflecting positively on the employees overall productivity.

Finally, just culture implementation is the main pillar of a healthy working environment, and it would not leave any room for hatred, grudges or dissatisfaction.

Recommendations

Bridging the gap (risk management)

The first step in any procedure design is to establish a clear and well-defined objective. For the procedure in hand, the objective is to stop the only pilot in a flight deck of an aircraft, from committing suicide using the aircraft he or she is piloting. With the objective established, the data collected from the survey analysis and pilot's comments were used to validate the outcome of personal interviews. The data is also compared to the data extracted from past PSUA events analysis to measure the accuracy of the research findings and recommendations.

The reviewed literature and articles, supplemented the following risk management proposals, which materialised after researching the 'Minimum crew in the flight deck' security procedure, the detailed study of previous PSUA events, trends and the case study airline end-users hands-on application for more than two years and valuable feedback.

Recommendations made by this research are focused on bridging the gaps of the researched 'minimum crew in the flight deck' procedure and proposing effective risk mitigation for the identified PSUA triggering factors while presenting a process to produce a pro-active approach to eliminate the personal factor and enhance the psychological factor mitigation.
The proposed mitigation is divided into short and long-term mitigation.

Short-term mitigation

The following recommendations need to be incorporated as soon as possible to address the insider threat and the risk involved with the presence of a rouge crewmember on the flight deck, also to eliminate the identified vulnerabilities in the current procedure that deemed the presence of a cabin crew in the flight deck as inefficient in preventing a PSUA event. Therefore it is recommended

- To maintain the use of the 'minimum crew in the flight deck' procedure until an acceptable alternative measure is made available to mitigate the possibility of having another PSUA event.

- To integrate the following procedures into the current crew training programs, and revise the relevant NOP/SOP accordingly.

- The introduction of cabin crew training to enable the recognition of a sudden change of aircraft attitude, speed, altitude or a pilot induced increase in cabin altitude, intended to knock the cabin crew unconscious before pursuing a PSUA, or any other related alarming actions.
  For example, observing a pilot unnecessarily wearing the oxygen mask, without informing the cabin crew to do the same, this could be an alarming action.

- To change the Normal/Standard operating procedures (NOP/SOP), to mandate the selection of radio speakers instead of headsets, by the pilot remaining in the flight deck, to enable the cabin crew listening to ATC instructions to the remaining pilot. (This proposed change does not prevent the pilot flying from keeping the headset on), for example, air traffic controllers instructions to change the altitude, enabling the recognition of unjustified or pilot induced deviations, such as an abrupt change in aircraft altitude or speed.

- If possible, and according to the flight deck seating configuration, the cabin crewmember replacing a pilot in the flight deck is to occupy a seat beyond the direct reach of the pilot, to avoid possible physical assault intended to disable the cabin crew.

- The pilot flying and cabin crew must both be seated with the seat belts and shoulder harnesses fastened, before the other pilot leaves and until he or she returns.

  This measure intends to keep the cabin crew far enough from items that could be used to attack the pilot, items such as the crash axe or fire extinguisher that are stowed behind the captain seat. The measure will also give the pilot flying some time to defend himself, call for help through the public address system or open the FD door, if the cabin crew unfasten the seat belt or try to leave the seat (before the other pilot's return) without a valid reason.

- Cabin crew training to emphasise on the objective of their presence in the flight deck. The objective is primarily to open the FD door to allow the other pilot into the flight deck as soon as an abnormal situation is developing, including; if the pilot tries to get out of his seat without a valid reason while he or she is the only pilot flying the aircraft. Also, the cabin crew must help other crewmembers restrain the suicidal pilot while the other pilot lands the aircraft.

- Restricting flight deck access to the CSD and CS only and introducing Psychiatric screening, as a pre-requisite for promotion to these positions. The screening must be conducted by professional psychiatrists to guarantee the privacy of those interviewed, and address job security concerns through reassignment to a non-flying job if found unsuccessful.
  This restriction could reduce the risk by 33% through limiting flight deck access from its current three positions (including the right door service crew) to the two mentioned above.

- Preferable hiring of female cabin crews, as female CSD and CS relatively pose 15% lower risk, when compared to their male counterparts (based on gender vulnerability to suicide), as established earlier in page 118 of this research.

- Use the same security standards that are applied to pilot candidates, to screen cabin crew applicants and conduct background checks. However, it is equally essential to provide cabin crew members with the same level of support that is offered to pilots, in terms of job security/placement, working environment and counselling.

- Although not directly related to PSUA, long aircraft security checklists that are currently conducted by pilots (except for US flights as TSA requires the search to be carried out by qualified security officers before every USA bound flight), are not precisely followed as it requires a relatively long time to complete correctly.

  Therefore, a security officer should conduct the security checks on freighter aircraft cabin to mitigate the widely observed complacency (due to time constraints and difficulty in reaching all areas in the cabin) and the possible vulnerabilities that could lead into security breaches such as the concealment of an explosive device onboard or smuggling.

Long-term mitigation

- The airline should employ the services of an independent psychiatrist, preferably specialised in aviation medicine and should schedule the screening of the entire pilots and cabin crew workforce for both routine and follow up checks.

- Screening should start with pilots and higher risk positions that can access the flight deck like CSD/CS, starting by screening candidates who are due for promotion to these positions and progressively screening the remaining cabin crew workforce.

- Whenever a pilot or a cabin crew encounters a major life-changing event such as the death of a spouse or being diagnosed with a life-threatening illness, the pilot, family, friends or colleagues must report the situation to the company as soon as possible.

  An immediate consultation should be scheduled, and if deemed necessary by the psychiatrist, the crewmember in question could be temporarily removed from flying duties until re-assessed as fit to fly by the psychiatrist.
  The criteria used by psychiatrists to remove or re-instate a pilot to flying duties must be clearly defined, and the processes to do so should preferably be documented and approved by the regulatory body to avoid bias judgement and unnecessary delays that could subject the pilot to a higher level of stress which could aggravate the condition and possibly cause a reflux of more severe symptoms.

  A three-step process would for-example require a clearance from the psychiatrist followed by a specially qualified for the purpose examiner pilot assessment during a simulator session on the aircraft type last flown by the pilot to ensure the pilot's ability to perform routine and abnormal duties in a realistic and practical working environment, such a session should avoid introducing overcomplicated or unrealistic scenarios and should allow the required time for the pilot to practice before being assessed, mainly after a prolonged grounding time to avoid wrecking the pilot's confidence due to poor performance as a result of lack of practice. Passing the simulator assessment should be followed without delay by a fit to fly clearance by the aero medical examiner and reinstatement to flying duties subject to any training requirements and based on the duration of the grounding.

- Enhancements to the crew welfare manager's role, by securing more direct interaction with pilots and their families, but only after receiving the required basic counselling training by a competent psychiatrist.

This measure would enable the welfare manager to act as the focal point of contact with pilots, their social circle (family and friends), aero medical examiner and the psychiatrist.

- Granting the welfare manager control over the sick pilot's rosters to enable the necessary modifications of assigned duties is paramount for gaining employee's trust and confidence. The welfare manager should be able to assign days off, short or long term, paid or unpaid leave based on the psychiatrist recommendations, without fear of punitive actions.

  The following survey comment reflects a pilot's view of how the process should function;

  > *"Department similar to "anti-skid" in Lufthansa which has proven to be very effective, the department functions independent and with no reporting duty to the company. Explanation: A pilot realises that another pilot might have a problem (drinking, depression, radical views). He will not put the other pilot's employment at a risk by reporting to the company. Especially in a hire and fire department and also if he is not 100% sure, If an independent department exists, they will collect reports and offer anonymous assistance without reporting to the company. Only if potential threats exist, measures or help will be arranged accordingly. This independence ensures that reporting will not put anyone's employment at risk".* [29]

- The Installation of a flight deck door on all freighter aircraft, this proposal would enable the prevention of events similar to FedEx flight 705.

  Freighter crews should use the same flight deck access procedures that are already in place on passenger aircraft whenever carrying loadmasters or supernumerary passengers. Alternatively, loadmasters or supernumerary passengers must be screened thoroughly and obtain the approval of the security department before boarding, without exceptions.

- The introduction of a numerical padlock similar to the one in a hotel room safe, when programmed by the individual pilot before departure, it could secure meals and beverages catering containers and guard against the contamination of supplies for whatever reasons. Ultimately, having a separate container per pilot would guard against the possibility that one pilot could contaminate the other pilot's catering.

- To form an action group to include, an independent psychiatrist, welfare, flight safety, security, training and flight operations managers, to discuss the possible use of the suicidal triggering factors and behaviour indicators identified by this research, in awareness training for employees and families.

[29] *Q11 response received on 03/01/2017 12:06 AM*

- Establish a direct coordination channel between AME/welfare/flight safety managers, so that, whenever a pilot is prescribed or identified to be using anti-stress/depression drugs, this team will decide on the best course of action (ground job, reduced flying duties or 'temporary/long term' grounding), depending on the seriousness of the condition as determined by the AME in coordination with the psychiatrist, while maintaining confidentiality and privacy.

- The regulatory bodies are to establish a powerful action against pilots who would intentionally hide their medical conditions or operate an aircraft while consuming psychotic drugs, which is not administered or prescribed by the AME or approved doctors.

- Airlines senior management should develop a scheme to place and utilise grounded crewmembers in ground-jobs as an alternative source of income and job security.

- Non-cosmetic Just culture implementation and balanced work versus time off for a healthy personal lifestyle, while motivating employees engagement in social and leisure activities.

- Although not directly related to the 'minimum crew in the flight deck' procedure, it is strongly recommended to introduce security events training, such as hijack and bomb threat scenarios during pilot's recurrent simulator training, and for pilots and cabin crew during joint CRM refresher training.

  With the consent of the participants of such training, recorded training sessions analysis by security, safety and training experts, and the collected data could play a significant role in procedural gap analysis and development. This process could contribute effectively to achieving predictive procedures design.

The outcome of 32 years of interaction with procedures at different levels in the aviation industry is the following;
“To successfully design an effective procedure, it must have a well-defined objective; the outcome must be simple to understand, practical to apply from an end user’s perspective and cost-effective to sustain its use. The outcome must always be updated to cater for emerging conditions while considering the relevant human factors, the environment and culture where it is implemented”.

This concept should guard new procedures against becoming another tick in the compliance box.

Just culture, Job security and job placement campaigns are tools that are meant to help crew members have a purpose in life and maintain hope, which is an essential element in combating PSUA.

One last resort countermeasure that could have saved German wings crew and passengers was identified during this research preparation. Nevertheless, it is of the utmost importance for both security and flight safety, to keep the procedure highly confidential, to prevent the information from falling into the wrong hands or being misused.

The author can only make the information available for verbal discussion with the examiners, which he is willing to do and will come so prepared at the viva examination.

Finally, for the research closing line, nothing is more suitable to conclude the research outcome than the case study airline slogan... **'Security is everyone's responsibility'.**

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[END]

Appendices

Appendix 1

Research Planning Document

ProfD - Policing, Security and Community Safety

By: Captain Hani A. NORI

1. Decide the Research Area. **15 February 2014**

"A review of hijack events by airline employees; with a particular reference to Pilot Suicide Using an Aircraft (PSUA) - An analysis of the triggering factors and current mitigation." [1]

2. Prepare the Planning Document. **16 July 2014**

3. Start draft Write UP. **19 October 2014**

4. Ethics Committee Approval (email Attached). **22 July 2016**

4.1. Interview Questions Ready. **20 August 2016**

4.2. Set up interview appointments with: (Send Relevant Q's Ahead)

4.2.1.1.	**Captain Yousif Musa, ex-Sudan Airways**	**18 January 2017**
4.2.1.2.	**Aviation Safety Expert**	**11 March 2017**
4.2.1.3.	**Chief Executive Officer (CEO)**	**Did not respond to the invitation**
4.2.1.4.	**##### Airways COO (A)**	**03 April 2017**
4.2.1.5.	**Senior Airline Psychologist**	**Rejected the invitation**
4.2.1.6.	**##### Civil Aviation Director of Air Safety**	**Deferred**
4.2.1.7.	**##### Civil Aviation Senior Medical Examiner**	**Deferred**
4.2.1.8.	**Ex-Colleagues of PSUA events pilots**	**Deferred/Rejected**

4.3. Survey Questions Ready. **20 August 2016**

4.4. Send out Survey Questions. **01 January 2017**

4.5. Closing Date for Survey. **31 January 2017**

4.6. Survey Analyses Completed. **30 April 2017**

5. Draft Thesis Editing. **31 May 2017**

6. Draft 1 Sent to Research Supervisors. **30 June 2017**

7. Draft 1 Modified to Supervisors Comments and Re-sent. **15 July 2017**

8. Draft 2 Modified to Supervisors Comments and Re-sent. **07 September 2017**

9. Thesis Final Version Sent. **31 December 2017**

10. Thesis Final Version (Rev 4.0) Sent. **18 March 2018**

11. Supervisor's Approval. (email Attached) **20 April 2018**

12. Thesis Final Version (Rev 5.2) Mailed (3 Copies). **28 May 2018**

13. Viva. **01 April 2019**

[1] *Revised 10 MAY 2019*

Appendix 2

Suicidal behaviour indicators

Financial

Pacific 773

*Deeply **in debt**, most of income to pay **loans**, sudden financial habits such as **gambling**.*

FedEx 705

*His family eligible for a $2.5 million **life insurance***

Silk Air 185

Lost more than $1.2 million** in high-risk securities trading and bought **$600,000** [sic] **life insurance** policy that **took effect the day of the crash

Egypt Air 990

One year away from retirement**, married and **father of five kids**, his youngest is a **daughter chronically ill.

GW 9525

*But got **agitated** talking about **work conditions**, such as **pay.***

- ## Personal

Pacific 773

***Talking about dying** to family, friends and colleagues, **specific** [sic] **date for dying**, **desperate statements to total strangers**; told a casino employee, "**it won't make any difference after tomorrow**".*

JAL 350

*He once summoned police to his two-story house near Tokyo because he was convinced it was **bugged**, but a thorough search turned up no devices. On three occasions, his employers had urged him to **see a psychiatrist**. Ever since he was granted one month's leave in November 1980 for a "**psychosomatic disorder**," Katagiri's **wife has worried** about his **neurotic behavior** [sic].*

PSA 1771

Discontent former employee, ***"recently terminated** by USAir for [...] **theft"***

FedEx 705

*Allegations of **false flying hours** on his job application, **hearing would put an end to his career** and wanted to **secure his family's future** and at the same time take **revenge** from the company.*

RAM 630

*Suicide due to **love life problems***

Kish 707

***Disgruntled** Iranian cabin crew*

Appendix 2

Suicidal behaviour indicators

Silk Air 185

*A devoted family man He was **quiet**, **sometimes distant**, colleagues said, but spoke his mind. He gained a reputation for **doing things his own way and not always following** [sic] **procedure**. **Taking away his newly won promotion, His income was not enough to cover his monthly household expenses.***

Botswana ATR42

Grounded for medical reasons, repeatedly** warned airport authorities that he would **kill himself.** Suffering from **AIDS,** wanted to **speak to his girlfriend** in addition to the **president.

Egypt Air 990

*He would be **taken off the United States route** because of accusations of **sexual misconduct. Revenge on a company executive** who had just **demoted him** and was riding as a passenger.*

MT 470

*"He was **very depressed** due to **marital problems** and that he was **not in talking terms with his wife**".*

GW 9525

Medical certificate was not revalidated** by the Lufthansa aero medical centre due to **depression** and the taking of **medication to treat it.

- ## Suicide resources

Pacific 773

Buying a gun**, **showing the gun

PSA 1771

Using his un-surrendered ID, "*armed with a loaded"* **gun "*that he had borrowed from a co-worker"***, some former girlfriends, neighbours and law enforcement officials described him as a **violent** man.

FedEx 705

*Calloway also had other weapons, a **spear gun, a hunting knife** and **two** other **hammers** on the aircraft.*

[END]

LONDON METROPOLITAN UNIVERSITY
SOCIAL SCIENCES & HUMANITIES

Aviation Security Management
Airline Security Procedures Design

Doctoral Thesis Survey

Combating Pilot Suicide Using an Aircraft (PSUA)

Captain Hani NORI *MSc FRAeS (UK)*

This form is used to collect feed back data from pilots regarding the research areas mentioned below for pure academic purpose, the questions are generic and does not apply to a specific airline. Collected data would only be used for the production of a Doctoral degree thesis.

Survey participants information will remain strictly confidential as per London Metropolitan University ethics committee approval and shall not be disclosed by the author under any circumstances without a written consent of the concerned person.

No name, staff number, email or personal information are required on this form for the protection of participants identity as per survey engine settings.

1. Please submit the completed form before 31 January 2017.
2. Please invite your fellow pilots to participate in the survey.
3. For inquiries regarding filling out the form please contact +974 5010 4950
4. On iPads and iPhones, if you are unable to complete the survey and you are getting a red "*This question requires an answer*" on top of the first question. Please slide the first question to the left to finish the remaining two dropdown lists.
5. Once you have answered all questions, please press done.

Thank you very much for your time and continuous support.

Captain Hani NORI ***MSc FRAeS (UK)***

Rev. 1.7 (JAN 2016)

1. I am (Please select one option from each of the six dropdown lists).
On iPads, please slide to the left to finish the remaining two dropdown lists.

	Rank	Training Qualification	Management Pilot	Gender	Ethnic Origin	Religion
.						

2. Minimum Two People in the flight deck policy (cabin crew replacing a pilot on the flight deck) is .....

- ◯ Perfect policy to protect against a pilot using an aircraft to commit suicide
- ◯ Could protect against a pilot using an aircraft to commit suicide but not 100 % fool proof
- ◯ Not an effective tool to protect against a pilot using an aircraft to commit suicide

Comments:

3. Minimum Two People in the flight deck policy is .....

- ◯ Practical and Efficient
- ◯ Some times could be Practical and Efficient
- ◯ Neither Practical nor Efficient

Comments:

4. In your opinion, a cabin crew replacing a pilot in the flight deck could prevent a pilot from using an aircraft to commit suicide ?

- ◯ Yes
- ◯ No

Comments:

5. The cabin crew member replacing a pilot on the flight deck .....

- ◯ Is a potential Security/Safety threat
- ◯ At times could be a potential Security/Safety threat
- ◯ Is not a potential Security/Safety threat at all

Comments:

6. During the course of your career, did you ever take a Psychometric Pilot Screening test such as .. PILAPT, PAT, PSA ...etc.

- ◯ Yes
- ◯ No

7. The psychometric test result was pass or fail ?
Please mark *"Not Applicable"* if you did not take such a test.

- ◯ Pass
- ◯ Fail
- ◯ Not Applicable

8. Psychometric Pilot Screening Tools such as .. PILAPT, PAT, PSA ...etc. is....

- ◯ Accurate and efficient
- ◯ Some times could be accurate but not very efficient
- ◯ Neither accurate nor efficient

Comments:

9. In your opinion, what factor(s) from the list below could lead (if ever) a crew member to commit suicide? (you can select more than one answer if applicable).
Please write any other unmentioned factors in the comments section below.

- ☐ Psychological Problems (deep depression, chronic stress, schizophrenia ... etc.)
- ☐ Drugs / Medications Abuse/Addiction
- ☐ Health Problems (non psychotic - affecting pilot's medical, chronic, life threatening, cancer ..etc.)
- ☐ Family Problems (Divorce, Relationship Break up, loss or chronic sickness of a loved one ..etc.)
- ☐ Financial Problems
- ☐ Job Security / Working Environment
- ☐ Revenge / Hatred (Personal / Corporate)
- ☐ Political Agenda / Terrorism / Radical Ideology

Comments:

10. In your opinion, what is the most significant factor? Please choose one answer only from the dropdown list.

Comments:

11. The best line of defence against a pilot using an aircraft to commit suicide is ..... (you can select more than one answer if applicable).

- [ ] Security background checks
- [ ] Psychometric screening (PILAPT, PAT, PSA.....etc.)
- [ ] Two In the Flight deck policy
- [ ] Suicidal Behaviours Recognition training to pilots and cabin crew
- [ ] Others ... Please explain in the comments box found below

Comments:

12. Would you be interested in receiving Suicidal Behaviours Recognition training? and why?

- ( ) Yes
- ( ) No

Comments:

13. In your opinion, what would represent a good job security campaign?

- ( ) Job placement in an other functions within the company for pilots whom lost their medical/license
- ( ) Company Psychologist / Flight Safety or Welfare manager counselling in confidence if in trouble
- ( ) Just Culture (punishment for an intentional violation is relevant to the outcome of the violation and as per a written and published policy that is applicable to every employee).
- ( ) Pension Scheme
- ( ) Others ..... Please explain in the comments box found below

Comments:

14. In your opinion, is armoured flight deck door considered an efficient security risk mitigation ?

- ( ) Yes
- ( ) No

Comments:

15. Unruly Passengers (Air Rage) is considered one of the most serious security threats in aviation. Statistically, one of the major drives behind air rage is alcohol consumption.
In your opinion, should airlines ban alcohol in a similar fashion to smoking ban? and why?

- ◯ Yes
- ◯ No

Comments:

LONDON METROPOLITAN UNIVERSITY
SOCIAL SCIENCES & HUMANITIES

[redacted]CEO

1. [redacted] Growing airline in the world, [redacted] Airline and [redacted] Best Airline in the World. Must have been hard to get there... In the world we live in today with ISIS, Radical movements, Instability in the middle East ... Your very busy schedule as [redacted]CEO of [redacted] and all its divisions ... How involved are you when it comes to daily security management of the airline? How do you insure the adherence to laid down procedures and policies?

2. How is [redacted] handling security issues to provide customers safe and secure air travel? (Iraq, Syria Yemen....etc)

3. MH370 fate is still unknown... as a major B777 operator... What is [redacted] doing to prevent any of its B777's from disappearing into thin air?

4. With the huge demand for pilots and cabin crew, the diverse nationalities and backgrounds both cultural and ideological... how is [redacted] managing to keep the wrong person from gaining access to an aircraft flight deck?

5. German wings 9525 ... Mozambique Airlines MT 470 and several other Pilot Suicide Using an Aircraft (PSUA)... What is [redacted] doing to prevent it from happening?

6. In your opinion... is working environment and job security considered factors that could lead a pilot into a PSUA situation (similar to known Pacific Southwest Airlines Flight 1771, Federal Express Flight 705 & Air Botswana ATR 42)?

7. What are you doing as [redacted]CEO to insure a just culture and fair working environment?

COO

1. [redacted] The fastest Growing airline in the world, [redacted] Airline and [redacted] Best Airline in the World. Must have been hard to get there... In the world we live in today with ISIS, Radical movements, Instability in the middle East ... as COO of [redacted] ... How involved are you when it comes to daily security management of the airline? How do you insure the adherence to laid down procedures and policies?

2. How is [redacted] handling security issues to provide customers safe and secure air travel? (Iraq, Syria Yemen....etc)

3. MH370 fate is still unknown... as a major B777 operator... What is [redacted] doing to prevent any of its B777's from disappearing into thin air?

4. With the huge demand for pilots and cabin crew, the diverse nationalities and backgrounds both cultural and ideological... how is [redacted] managing to keep the wrong person from gaining access to an aircraft flight deck?

5. German wings 9525 ... Mozambique Airlines MT 470 and several other Pilot Suicide Using an Aircraft (PSUA)... What is [redacted] doing to prevent it from happening?

6. In your opinion... is working environment and job security considered factors that could lead a pilot into a PSUA situation (similar to known Pacific Southwest Airlines Flight 1771, Federal Express Flight 705 & Air Botswana ATR 42)?

7. On Cargo Aircraft, are load masters being carried? If yes, are they subjected to Security background checks before employment?

8. Are cargo aircraft equipped with a flight deck door? If not, how are the risks involved with carrying loadmasters and supernumerary passengers are mitigated?

9. What are you doing as [redacted] COO to insure a just culture and fair working environment?

10. Is Psychometric screening for pilots a regulatory requirement in the [redacted]?

11. If not, are you expecting it to be and why?

12. Is [redacted] using a Psychometric screening tool? Which one? Why?

13. How would [redacted] guarantee the quality of selected Psychometric screening system? Given the dire consequences such a system could have on a pilot career and the impact on daily airline operations both short and long term?

Senior Airline Psychologist

Quote

..... "All of the pilots who killed themselves were male and middle-aged."

..... "Depression appears to be the leading cause of aircraft-assisted suicides, and in 2010, the FAA did away with a generations-old ban on pilots taking anti-depressants. The aviation agency, which has mental health restrictions for pilots, now can issue certificates permitting pilots to take Prozac, Zoloft, Celexa, and Lexapro, CNN reports." (McCoy, 2014)[1]

End of Quote

1. Fast growing airlines in the world ... How involved are you as an airline Psychologist when it comes to pilot's selection, monitoring flight crew (pilots & cabin crew) mental health and psychological status?

2. Do your airline regulations allow pilots to fly while consuming any of the above mentioned medications?

3. For a Psychiatrist, if a pilot is a patient under treatment for depression and is prescribed any of the above mentioned medications, would the psychiatrist be required to report the situation to the aviation authority, AME, Employer, Flight Safety Manager, Welfare Manager or company psychologist?

4. In the airline, is there a mechanism by which a troubled pilot (personal, technical or psychological issues) could approach the company for help without fearing for his/her job security? How would you monitor such an employee to guarantee that his/her problems will not affect the delivery of his duties?

5. With the huge demand for pilots and cabin crew, the diverse nationalities and backgrounds both cultural and ideological... how is the airline managing to keep the wrong person from gaining access to an aircraft flight deck?

6. Is Psychometric screening for pilots a regulatory requirement in the state where you are practicing?

[1] *https://www.washingtonpost.com/news/morning-mix/wp/2014/03/11/just-how-common-are-pilot-suicides/*

7. If not, are you expecting it to be and why?

8. Is the airline using a Psychometric screening tool? Which one? Why?

9. How would the airline guarantee the quality of the selected Psychometric screening system? Given the dire consequences such a system could have on a pilot career and the impact on daily airline operation both short and long term?

10. German wings 9525 ... Mozambique Airlines MT 470 and several other Pilot Suicide Using an Aircraft (PSUA)... What is the airline doing to prevent it from happening?

11. In your opinion... is working environment and job security considered factors that could lead a pilot into a PSUA situation (similar to known Pacific Southwest Airlines Flight 1771, Federal Express Flight 705 & Air Botswana ATR 42)?

12. What are you doing to ensure a just culture and fair working environment (If Applicable)?

[redacted] Director of Air Safety

1. [redacted] [redacted] Growing airline in the world, [redacted] Airline and [redacted] Best Airline in the World. Must have been hard to get there... In the world we live in today with ISIS, Radical movements, Instability in the middle East ... as [redacted] Director of Air Safety ... How involved are you when it comes to daily security management of the airline? How do you insure the adherence to laid down procedures and policies?

2. How is [redacted] handling security issues to provide customers safe and secure air travel? (Iraq, Syria Yemen....etc). How is [redacted]CAA facilitating that?

3. MH370 fate is still unknown... as a major B777 operator... What is [redacted] doing to prevent any of its B777's from disappearing into thin air? What is [redacted]CAA role?

4. With the huge demand for pilots and cabin crew, the diverse nationalities and backgrounds both cultural and ideological... how is [redacted] managing to keep the wrong person from gaining access to an aircraft flight deck? What is [redacted]CAA role?

5. German wings 9525 ... Mozambique Airlines MT 470 and several other Pilot Suicide Using an Aircraft (PSUA)... What is [redacted]CAA -in coordination with- [redacted] doing to prevent it from happening?

6. In your opinion... is working environment and job security considered factors that could lead a pilot into a PSUA situation (similar to known Pacific Southwest Airlines Flight 1771, Federal Express Flight 705 & Air Botswana ATR 42)?

7. What is [redacted]CAA doing to insure a just culture and fair working environment in [redacted]?

8. Is Psychometric screening for pilots a regulatory requirement in the [redacted]?

9. If not, are you expecting it to be and why?

10. Is [redacted] using a Psychometric screening tool? Which one? Why?

11. How would [redacted]CAA guarantee the quality of selected Psychometric screening system? Given the dire consequences such a system could have on a pilot career and the impact on daily airline operation both short and long term?

Aero Medical Examiner (AME)

Quote.

..... *"All of the pilots who killed themselves were male and middle-aged."*

..... *"Depression appears to be the leading cause of aircraft-assisted suicides, and in 2010, the FAA did away with a generations-old ban on pilots taking anti-depressants. The aviation agency, which has mental health restrictions for pilots, now can issue certificates permitting pilots to take Prozac, Zoloft, Celexa, and Lexapro, CNN reports." (McCoy, 2014)*[1]

End of Quote

1. Fast growing airlines in the world. How involved are you when it comes to airline pilot's selection, monitoring flight crew (pilots & cabin crew) mental health and psychological status?

2. Do the regulations allow pilots to fly while consuming any of the above mentioned medications?

3. For a Psychiatrist, if a pilot is a patient under treatment for depression and is prescribed any of the above mentioned medications, would the psychiatrist be required to report the situation to the authority, AME, Employer, Flight Safety Manager, Welfare Manager or company psychologist?

4. In the airline, is there a mechanism by which a troubled pilot (personal or psychological issues) could approach the company psychologist or AME for help without fearing for his/her job security? How would you monitor such an employee to guarantee that his/her problems will not affect the delivery of his duties?

5. With the huge demand for pilots and cabin crew, the diverse nationalities and backgrounds both cultural and ideological... How are the AME's managing to keep the wrong person from gaining access to an aircraft flight deck?

6. Is Psychometric screening for pilots a regulatory requirement in the state where you are practicing?

[1] *https://www.washingtonpost.com/news/morning-mix/wp/2014/03/11/just-how-common-are-pilot-suicides/*

7. If not, are you expecting it to be and why?

8. German wings 9525 ... Mozambique Airlines MT 470 and several other Pilot Suicide Using an Aircraft (PSUA)... What is the authority doing to prevent it from happening to your airline?

9. In your opinion... is working environment and job security considered factors that could lead a pilot into a PSUA situation (similar to known Pacific Southwest Airlines Flight 1771, Federal Express Flight 705 & Air Botswana ATR 42)?

10. What are your recommendations as an AME to prevent the repetition of German wings accident?

Aviation Safety Manager

1. Fast growing airlines in the world ... In the world we live in today with ISIS, Radical movements, Instability in the middle East ... as a senior safety manager ... How involved are you when it comes to daily security management of the airline? How do you insure the adherence to laid down procedures and policies?

2. How are airlines handling security issues to provide customers a safe and secure air travel? (Iraq, Syria Yemen....etc)

3. MH370 fate is still unknown... as a major operator... What is your airline doing to prevent any of its aircrafts from disappearing into thin air?

4. With the huge demand for pilots and cabin crew, the diverse nationalities and backgrounds both cultural and ideological... how are airlines managing to keep the wrong person from gaining access to an aircraft flight deck?

5. German wings 9525 ... Mozambique Airlines MT 470 and several other Pilot Suicide Using an Aircraft (PSUA)... What are airlines doing to prevent it from happening?

6. In your opinion... is working environment and job security considered factors that could lead a pilot into a PSUA situation (similar to known Pacific Southwest Airlines Flight 1771, Federal Express Flight 705 & Air Botswana ATR 42)?

7. On Cargo Aircraft, are load masters being carried? If yes, are they subjected to Security background checks before employment? (If APP).

8. Are cargo aircraft equipped with a flight deck door? If not, how are the risks involved with carrying loadmasters and supernumerary passengers mitigated? (If APP).

9. What are you doing as senior airline safety manager to insure a just culture and fair working environment?