

**Curtin Graduate School of Business**

**An Exploratory Study Investigating the Management of Flight  
Operational Risk with Selected Airlines in the Asia Pacific  
Region**

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**This thesis is presented for the Degree of  
Doctor of Philosophy  
of  
Curtin University**

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**DECLARATION**

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007), updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262). The approval numbers are GSB-02-09 and GSB 17-14.

Signature: .....**David George Prior**.....

Date: .....**September 2nd 2017**.....

## ABSTRACT

The airline industry within the Asia Pacific Region is in the process of becoming the largest airline market in the world. Market forces will cause competitive pressure to increase between airlines resulting in substantial changes to existing airlines culture and cost base. As a requirement of survivability, all of these airlines have to efficiently manage their risks, with flight operational risk being a principal risk. The title of this thesis is 'An exploratory study investigating the management of flight operational risk by selected Airlines within the Asia Pacific Region'. The research question is 'What is the perceived importance and approach to the management of flight operational risk by selected airlines within the Asia Pacific Region?' There are four sub-questions that were answered relating to; defining flight operational risk, the importance placed on the management of flight operational risk by these airlines, the key drivers to establish a formal RMS and what are the factors inherent in such a system? Four airlines were involved in this study; except for a Low Cost Carrier (LCC) these airlines represent a cross section of the airline market from the region. A review of the literature was conducted and is presented in seven areas; risk, risk management, operational risk management, flight operational risk management, risk drift, management systems and business risk with these areas containing applicable elements. A qualitative methodology was utilised with data being obtained through semi-structured interviews and was analysed using a two stage process of data fracturing and data connecting with phenomenology and cognitive mapping being the analytical methods. The study produced nine findings which involve; flight-crew compliance to SOPs, establishment of a just culture, the role of a quality function with regard to an airline's SMS, balance between production and protection, the role and relationship of the regulator to each airline, change management processes, and three findings relating to the establishment of a formal RMS. This study's theoretical contribution to the topic's body of knowledge is the theory of 'Flight Operational Risk Float'

Keywords: risk, operational risk, flight operational, risk management, safety management, quality, culture, regulator, risk drift, flight crew.

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<sup>1</sup>Field of specialisation was finance

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## DEFINITIONS

### Accident

An occurrence associated with the operation of an aircraft, which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked. Alternatively, in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until it comes to rest at the end of the flight and the primary propulsion system is shut down, in which:

a) A person is fatally or seriously injured as a result of being in the aircraft, or direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or direct exposure to jet blast. Except, when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or

b) The aircraft sustains damage or structural failure, which adversely affects the structural strength, performance or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component. Except for engine failure or damage, when the damage is limited to a single engine, (including its cowlings or accessories). As well as to propellers, wing tips, antennas, probes, vanes, tires, brakes, wheels, fairings, panels, landing gear doors, windscreens, the aircraft skin (such as small dents or puncture holes), or for minor damages to main rotor blades, tail rotor blades, landing gear, and those resulting from hail or bird strike (including holes in the radome); or

c) The aircraft is missing or is completely inaccessible.

Note 1. An aircraft is considered to be missing when the official search has been terminated and the wreckage has not been located (2013a, 1-1).

### Business risk

The variability in an organisation's EBIT. The nature of the organisation's operations causes it business risk, with this risk being affected by the firm's cost structure, product demand and competitive pressure from rivals (Petty et al. 1996, 356).

### Change management

A formal process to manage changes within an organization in a systematic manner, so that changes which may impact identified hazards and risk mitigation strategies are accounted for, before the implementation of such changes (ICAO 2013c, xii).

### Complacency

Self-satisfaction especially when accompanied by unawareness of actual dangers or deficiencies (Merriam-Webster 2015).

### Crew Resource Management

A management system which makes optimum use of all available resources, equipment, procedures and people to promote safety and enhance the efficiency of flight operations (CAA 2006, 1).

### Incident

An occurrence, other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operation (ICAO 2013a, 1-2).

### Non-Technical Skills

The mental, social, and personal-management abilities that complement the technical skills of workers and contribute to safe and effective performance in complex work systems. They include competencies such as decision-making, workload management, team communication, situation awareness, and stress management (CASA 2011, 8).

### Risk Factor

Individually or in association with other risk factors erodes the margin of safety (Abkowitz 2008, 2).

### Safety

The state, in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level (ICAO 2013a, 1-2).

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**ACRONYMS AND ABBREVIATIONS**

AAIB	Air Accidents Investigation Branch
ACAS	Airborne Collision Avoidance System
AC	Advisory Circular
AFI	Africa (IATA Region)
ALA	Approach and Landing Accidents
ALAR	Approach and Landing Accident Reduction
ALARP	As Low As Reasonably Practicable
AMO	Aircraft Maintenance Organisation
AO	Audit Organisation
AOC	Air Operator's Certificate
AOG	Aircraft on Ground
ARMS	Airline Risk Management Solutions
ASEAN	Association of Southeast Asian Nations
AS/NZS	Joint Australian/New Zealand Standard
ASPAC	Asia/Pacific (IATA Region)
ASM	Air Safety Manager
ASR	Air Safety Report
ATS	Air Traffic Services
ATSB	Australian Transport Safety Bureau
BBS	Behaviour Based Safety
BCI	Business Continuity Institute
BIS	Bank for International Settlements

CAAG	Controlled Flight into Terrain and Approach and Landing Action Group
CAIB	Columbia Accident Investigation Board
CAIR	Checklist for Assessing Institutional Resilience
CAR	Corrective Action Required
CAS	Casualty Actuarial Society
CASA	Civil Aviation Safety Authority
CBA	Cost Benefit Analysis
CBT	Computer Based Training
CEO	Chief Executive Officer
CFIT	Controlled Flight into Terrain
CFO	Chief Financial Officer
CIS	Commonwealth of Independent States (IATA Region)
COO	Chief Operating Officer
COSO	Committee of Sponsoring Organizations of the Treadway Commission
CRM	Crew Resource Management
CROPS	Cross Runway Operations
CSF	Critical Success Factor
DFO	Director of Flight Operations
DDFO	Deputy Director of Flight Operations
EASA	European Aviation Safety Agency
EBIT	Earnings Before Interest and Taxes
EFB	Electronic Flight Bag

EGPWS	Enhanced Ground Proximity Warning System
ERM	Enterprise Risk Management
ES	End State
EUR	Europe (IATA Region)
FAA	Federal Aviation Administration
FDA	Flight Data Analysis
FDM	Flight Data Monitoring
FIR	Flight Information Region
FOI	Flight Operations Inspector
FOM	Flight Operations Manual
FOQA	Flight Operational Quality Assurance
FOR	Flight Operational Risk
FORD	Flight Operational Risk Drift
FORF	Flight Operational Risk Float
FORM	Flight Operational Risk Management
FRMS	Fatigue Risk Management System
FSF	Flight Safety Foundation
FTL	Flight Time Limitations
GFC	Global Financial Crisis
GM	General Manager
GRM	Group Risk Manager
HR	Human Resources
HRO	High Reliability Organisation

IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IIF	Institute of International Finance
IMS	Integrated Management Systems
IOSA	IATA Operational Safety Audit
ISM	IOSA Standards Manual
ISO	International Organization for Standardization
IT	Information Technology
LATAM	Latin America and the Caribbean (IATA Region)
LCC	Low Cost Carrier
LOFT	Line Oriented Flight Training
LOSA	Line Operations Safety Audit
LRC	Long Range Cruise
MALIAT	Multilateral Agreements on the Liberalisation of International Air Transport
MEL	Minimum Equipment List
MENA	Middle East and North Africa (IATA Region)
MLO	Manager Line Operations
MOR	Mandatory Occurrence Report
MSR	Manager of Safety and Risk
NAM	North America (IATA Region)
NASA	National Aeronautics and Space Administration
NASIA	North Asia (IATA Region)

NIST	National Institute of Standards and Technology
NTS	Non-Technical Skills
NTSB	National Transportation Safety Board
OH&S	Occupational Health & Safety
OR	Operations Report
ORM	Operational Risk Management
OTP	On Time Performance
PC	Proficiency Check
PD	Position Description
PDCA	Plan-Do-Check-Act
PiNC	Procedural Intentional Non-Compliance
PRC	People's Republic of China
PWS	Predictive Windshear
QA	Quality Assurance
QDAS	Qualitative Data Analysis Software
QMS	Quality Management System
Q&SM	Quality & Standards Manager
RAP	Risk Assessment Program
RAT	Ram Air Turbine
RERR	Runway Excursion Risk Reduction
RMS	Risk Management System
RNP AR	Required Navigation Performance Authorisation Required
RQ	Research Question

RSI	Runway Safety Initiative
SAG	Safety Action Group
SARPs	Standards and Recommended Practises
SCB	Safety Citizenship Behaviours
SMG	Safety Management Group
SMS	Safety Management System
SOA	Society of Actuaries
SOP	Standard Operating Procedure
SQ-1	Sub Question One
SQ-2	Sub Question Two
SQ-3	Sub Question Three
SQ-4	Sub Question Four
SRA	Society for Risk Analysis
SSP	State Safety Programme
STEADES	Safety Trend Evaluation, Analysis and Data Exchange System
TAS	True Airspeed
TCAS	Traffic Alert and Collision Avoidance System
TEM	Threat and Error Management
TC	Transport Canada
UAS	Undesired Aircraft State
USD	United States Dollar
VSS	Vulnerable System Syndrome
WTC	World Trade Centre

# 1 Chapter One Introduction

## 1.1 Significance of the Study

This study is significant as the Asia Pacific Region is predicted to become the largest airline market in the world, underpinned by the region's economic expansion. Because of this substantial growth, this region's airline industry will undergo changes through new airlines entering the market in addition to regulatory changes, such as the deregulation of air services, which will result in a paradigm shift in the dynamics of the airline market. These changes may influence airlines to change internal procedures to remain competitive, increasing the level of Flight Operational Risk (FOR), which can result in a heightened level of business risk. As these changes to the airline market are substantial, new risks will emerge which will need to be managed.

In 1990, the economic output from the Asia Pacific Region represented 22 percent of the global output; in 2010, the economic output from this region had increased to 27 percent of the total. The forecast for the year 2030 is that the economic output from the Asia Pacific Region is expected to be 35 percent of the global economic output (Airbus 2011). Airbus (2012) claims that economic growth is the primary driver of increasing demand for air travel and, consequently, the number of sectors flown within this region will increase substantially, requiring in excess of 9,370 new aircraft during the next 20 years.

Boeing Commercial Airplanes (2013c) believes the number of new aircraft the Asia Pacific Region will require over the next 20 years is substantially more and this expansion will result in the Asia Pacific Region becoming the largest airline market in the world, with 35 percent of the airline aircraft domiciled within this region as per Table 1-1.

**Table 1-1 Regions of the World's Airline Fleet**

Year	Region				
	Asia Pacific	North America	Europe	Balance	World
2012 Fleet	5,090	6,590	4,390	4,240	20,310
2032 Fleet	14,750	8,810	8,010	9,670	41,240

(Boeing 2013c).

The airline industry is highly competitive and is one of the least profitable industries (Porter 2008). Globally, between 2000-2010, the aviation industry cumulatively lost assessed in United States Dollars (USD) \$47 billion (Cleary 2010). One of the major reasons contributing to this loss is the low operating margin of the industry resulting in the industry failing to meet its cost of capital (Pearce 2005). The belief of the poor financial performance of the airline industry is also supported by the finance industry, with an analysis provided by DBRS (2011), a credit rating agency who have assessed the business risk rating of the airline industry as BB (low). The reasoning supporting this view is contained in Appendix 1-1. One reason why the airline industry is profit poor is the long term reduction in the price of airline tickets. An example of the downward pressure on an airline's pricing power is the industry's constant reduction in costs where new entrants such as Jetstar, according to the Chief Executive Officer (CEO), are "...reducing their controllable costs by five percent annually" (Buchanan 2010 quoted in Citrinot 2010, 6). With deregulation, customers have greater choice forcing competitor airlines to match in value terms the industry set price.

Allied with this growth, it is anticipated that the current bi-lateral air agreements between countries will be liberalised along with the introduction of Multilateral Agreements on the Liberalisation of International Air Transport (MALIAT). As well as these agreements reducing the restrictions of air travel within the Asia Pacific Region, trading blocs within this region, such as the Association of Southeast Asian Nations (ASEAN), are planning to liberalise their airline industry (Herdman 2006). This dismantling of the restrictive agreements of air travel between countries within the Asia Pacific Region is indicative of an elevated level of competition between established airlines and new entrants.

As the Asia Pacific Region is undergoing a paradigm change in air travel, established airlines have to change to compete with ever changing market forces. Airlines both established and new that do not have a high calibre of resources, successful strategies, adaptability, cost controls and management systems, including risk management, will have a heightened level of business risk, increasing the likelihood of these airlines ceasing to operate.

Business risk is prevalent in all for-profit companies and "...organisations as diverse as Barings Bank and Enron, have suffered large monetary losses resulting in their respective collapses as a consequence of inadequate or faulty internal processes, people, or systems. These factors are central to operational risk" (McCarthy and Flynn 2004, 131) which leads to the study's title and research questions which are presented in the following section.

## 1.2 Study's Title and Questions

The title of this thesis is:

*An exploratory study investigating the management of flight operational risk by selected Airlines within the Asia Pacific Region.*

The objective of the study is to answer the following Research Question (RQ):

*What is the perceived importance and approach to the management of flight operational risk by selected airlines within the Asia Pacific Region?*

In conjunction with answering the RQ, four Sub Questions (SQ) will also be addressed.

These four sub-questions are:

1. *SQ-1. What is the definition of flight operational risk?*
2. *SQ-2. Do Airlines in the Asia Pacific Region consider the management of flight operational risk important?*
3. *SQ-3. What are the key drivers for establishing a flight operational risk management program?*
4. *SQ-4. What are the key factors inherent in a flight operational risk management program?*

As the study is exploratory in nature, the RQ is phrased to capture the broad spectrum of the multitude of diverse risk factors, the strategies these airlines have adopted and the issues that emerge as a result of their management of FOR. As these airlines are situated in different parts of the Asia Pacific Region, they are subject to different cultural, management and ownership pressures which may result in a difference between each airline's perceived importance and approach to the management of FOR. Whilst this diversity may cause differences between these airline's management of FOR, they are all partners in a global community referred to as the airline industry which binds them together in a universe of standards and regulations created and enforced by the International Civil Aviation Organisation (ICAO) and International Air Transport Association (IATA). The exploratory nature of the RQ is counterbalanced by the specific nature of the four SQs. Whilst each question is answered individually, they are integrated with the specifically phrased SQs providing structure to the RQ.

SQ-1 regarding the definition of FOR is a research-scoping question and should be answered as a result of a pilot study before undertaking the research. The reason why no pilot study was conducted was the researcher believed obtaining access to the airlines would be problematic and to obtain approval to conduct a pilot study and return at a later date to conduct the main research would result in the airlines declining to be involved in the study. Subsequently, no pilot study was conducted with SQ-1 included in the main study. The rationale why defining FOR is an objective of the study is operational risk has no universal definition and it is up to each industry to define it (Hoffman 2002) and to date the aviation industry is yet to define it. The banking and finance industry has conducted research on operational risk and to provide the readers of this report an understanding of what FOR is, this industry's definition of operational risk is the "...risk of loss resulting from inadequate or failed internal processes, people and systems or from external events; this definition includes legal risk, but excludes strategic and reputational risk (BIS 2011).

Because of the diversity separating the airlines and the binding nature of the universe of standards and regulations bringing the airlines together on the study's topic, the researcher approached the methodology with an open mind without any preconceived ideas. Information regarding the methodology of the study is outlined in section 1.5.1.2 of this chapter and in Chapter Three Methodology. The findings from the study are used as a base to answer the questions.

As outlined previously, airlines have to manage two principal risks to remain viable both of which are reviewed in the following section.

### **1.3 Airline Industry's Principal Risks-Operational and Business**

Even with diligent risk and safety management systems in place, highly improbable accidents can occur. On the 17<sup>th</sup> of January 2008, a Boeing 777-236ER crashed 330 metres before the paved section of the Runway 27 Left at London Heathrow after a loss of thrust from both engines. This lack of thrust was the result of ice causing a restriction in the fuel feed system, restricting fuel flow to both engines with additional issues further exacerbating the post-accident period caused by unintended consequences from a change to procedures (AAIB 2010).

This accident highlights the two areas of risk the ICAO has identified, which are required by legislation to be managed on a formal basis utilising an airline's Safety Management System (SMS):

1. airline safety risk management, which in essence is managing hazards
2. airline safety assurance, which includes change management.

Additional information concerning this accident is contained in Appendix 1-2.

This accident by a well-established airline highlights the need for all airlines to effectively manage FOR. However, FOR is not the only risk an airline must effectively manage to be sustainable over the longer term. Because of severe competitive pressure, all airlines in the Asia Pacific Region must also manage business risk. The airline industry today is 'profit poor,' an example being that during the ten-year period from 2003-2013 the global airline industry generated \$5 trillion in revenue without producing a profit. "In 2013 the global airline industry was forecast to generate \$671 billion in revenue with a profit of \$10.6 billion. As a comparison to other industries, Nestlé's profit last year [2012] was the same with just one sixth of the revenue" (Tyler 2013, 1). The objective of this study is to investigate the management of FOR by selected airlines from the Asia Pacific Region. However, to manage these risks, an airline requires its financial resources to be allocated in an efficient manner. If an airline does not provide the necessary operational risk mitigating controls, an operational event, such as an accident, has a high probability of occurring.

Conversely, if an airline provides an excessive level of resources in managing operational risks, business risk may emerge where insufficient funds remain to meet the airline's financial obligations, thus increasing the likelihood of the airline becoming bankrupt. This requirement to manage both principal risks through the correct allocation of resources to an airline's safety and risk requirements forms part of the answer to study's RQ.

## **1.4 Motivation for the Study**

The author of this thesis has been an airline industry practitioner for many years, with a specific interest in FOR. Quite a few years ago when this author was a young airline captain, it occurred to him that all airlines are subject to the same or similar risks. Why was it that some airlines managed these risks reasonably well whereas others did not? A cursory glance would indicate that the positive or negative outcomes of these risks are dependent upon the internal processes, people and culture of each individual airline. However, what is required for a more complete answer is an in-depth study on the phenomenon of FOR. Conducting a preliminary review of the literature, it became apparent that there had been minimal research conducted on this topic, especially in the Asia Pacific Region. This discovery confirmed the author's opinion that there was a gap in the knowledge regarding the management of FOR and a potential opportunity existed to contribute to improving the management of this risk. This opinion was based on the author's personal experience as a B777 captain working for a large airline<sup>2</sup> from the Asia Pacific Region, as well as simultaneously being employed for a number of years in a dual role as a full-time flight operations Quality Assurance (QA) auditor. Because of this knowledge gap, the author of this thesis believes an exploratory study is required to investigate this phenomenon and to obtain a deeper understanding regarding the management of FOR. In addition, this newfound knowledge could be utilised as a platform in the future to conduct further research on this topic.

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<sup>2</sup> The author's employer has no involvement with this study.

## **1.5 Structure of the Thesis**

This thesis contains seven chapters, a List of References and Appendices with the objective of answering the research question and associated four sub-questions. To provide the readers of the thesis with an insight into the structure of the thesis and its contents, chapter outlines are presented in the following section.

### **1.5.1 Chapter Outlines**

#### **1.5.1.1 Chapter Two Literature Review**

To provide readers of this report an understanding of the various topics that are covered within the study, a review of the relevant literature is undertaken. The objective is to examine literature, which is focused on the central theme of the study, which is the management of FOR. The first part of the chapter reviews risk as a concept and risk management that manages aleatory and epistemic uncertainty. This leads into a discussion on Operational Risk Management (ORM) including organisational culture as well as a number of sub cultures. The next part of the chapter reviews the central core of the study which is FOR involving the risk of a loss from the failure of people, internal processes, systems or an external event. Airlines have to manage a large number of diverse risk factors associated with flight operations and they do this in part by complying with national regulations, subsequently the role of the regulator and relationship between an airline and the regulator is important; it is for these reasons the regulator is reviewed in this chapter. Whilst compliance to regulations is a must, it is possible that too much regulation can be detrimental to safety which is discussed in the section referred to as ‘the bureaucratisation of safety’. A key aspect of risk is ‘risk drift’ where an organisation ‘drifts towards failure’. Three theories concerning this drift are discussed in the chapter which are: ‘normalisation of deviance’ ‘practical drift’ and Vulnerable System Syndrome (VSS). The next section deals with strategies to manage the inordinate number of risk factors associated with flight operations mainly by adopting a systems approach. Such as the Safety Management System (SMS), Quality Management System (QMS) and the possibility of an airline having a Risk Management System (RMS) and the consideration of merging these systems into a single unit referred to as an Integrated Management System (IMS).

The final section of the chapter reviews another principal airline industry risk, which is business risk as this risk can have a direct impact on an airline's ability to manage its FOR.

#### **1.5.1.2 Chapter Three Research Design and Methodology**

This chapter commences with a description of the research framework which is specifically created for this study, including why the interpretive paradigm is selected. The ontological, epistemological and methodological assumptions that underpin the research is explained and why four case studies are used. How the data is collected is reviewed, including a discussion on how obtaining access to the airlines is problematic, how the interviews are conducted and who the interviewees are. The largest section of this chapter relates to how the data set is analysed using a two stage analytical framework. The first step of stage one is to transcribe the interviews into word documents and, through fracturing processes, data is separated into a hierarchal structure consisting of primary categories with associated subcategories. The second stage of analysis is the creation of the complex concepts with associated elements, which utilises phenomenology as the connecting strategy. In association with phenomenology, extensive exploratory comments, annotations and memos are written. From these texts, emergent themes are identified which formed the elements within the concepts. These concepts are further analysed using cognitive mapping as a second analytical method to confirm the output from the primary analytical method of phenomenology. The output from the cognitive mapping processes are the study's key terms. The objective of a qualitative study is to produce trustworthy findings, with this study utilising Denzin and Lincoln (2005) criteria for evaluating the findings. The final section of this chapter reviews the use of the study's analytical software.

#### **1.5.1.3 Chapter Four Analysis**

This chapter consists of two parts: the first contains the complex concepts with their associated elements and the second part presents the study's key terms. The first part of the analysis utilises a 'flat reporting' style where the emphasis is on ensuring the interviewee's narratives are heard. This involves placing a number of direct quotes from the interviews within the body of text of the elements.

These complex concepts and associated elements contain information regarding topics such as, flight deck culture, reporting culture, flight-crew's Non-Technical Skills (NTSs), resourcing, and management dilemma.

The method of analysis of these concepts in the first part is phenomenology and in the second part of the chapter, cognitive mapping is utilised with Decision Explorer™ as the tool to map the interviewee's cognition producing key-terms such as, complacency, costs, compliance, regulator, quality management, risk management and safety management.

#### **1.5.1.4 Chapter Five Results**

This chapter contains the study's findings and the answers to the RQ and two of the SQs. The findings relate to key aspects of the management of FOR such as SOP compliance which is the basis of practical drift, these airlines want to implement a just culture as part of the overall organisational culture. QA is still considered an important strategy in the management of FOR, as is compliance to regulatory requirements. Balancing the safety requirements of the airline with profit generation and change management issues are all important aspects with these airlines management of FOR. These airlines predominately manage their FOR through traditional methods, however, there is a tendency to manage this risk utilising a systemic approach the same as safety management. These findings are discussed in the answers to the three questions in this chapter.

#### **1.5.1.5 Chapter Six Discussion from a Theoretical Perspective**

This chapter answers SQ-1 and SQ-4 as well as presenting the study's theoretical contribution to the topic's body of knowledge. The data obtained from the interviewees was of insufficient quality and quantity to produce empirical findings that would satisfactorily answer SQ-1 and SQ-4. The reason for this limitation is only three of the 71 interviewee's job function was directly related to risk management, consequently the vast majority of the narratives lacked the information to be able to answer these questions from the data. The information is drawn from the literature and appropriately referenced, hence the theoretical discussion. The theory generated from this study is called 'The theory of flight operational risk float'.

The creation of this theory is based on the philosophy of little 't' theory and uses independent and dependent variables when answering the 'what are the variables within this theory', 'how do these variables relate to each other', and 'why should this theory be given credence' questions. This theory is comprehensively explained and is sourced from information contained within this report.

#### **1.5.1.6 Chapter Seven Conclusion**

This chapter revisits the study's RQ and the associated four SQs. with a brief discussion of the study's findings. The policy implications of the report are discussed with regard to an airline's policy settings on its approach to the management of FOR. This study's theoretical contribution to the topic's body of knowledge is a theory referred to as 'the theory of flight operational risk float'. The implications from this theory does not dispute existing theories but acknowledges the observation of three of them, namely 'normalisation of deviance', 'practical drift', and VSS from one of the airlines involved in the study. The implication from this study's theory is the determination of the likelihood or probability of the occurrence of an adverse flight operational event by these airlines is flawed. This leads onto recommending future research be conducted into researching aspects of the various concepts that were identified during the analysis part of this study. The limitations of the study are noted and in the final section of the chapter are the report's concluding remarks.

### **1.6 Ethics**

This study was conducted in accordance with the ethics requirements of Curtin University. The initial ethics approval was granted in 2009 with the approval identifier GSB-02-09. This approval was renewed annually over a four-year period. In 2013, a fresh application was lodged and approved with the approval identifier GSB 17-14, with this approval being renewed on an annual basis. All aspects of the research were conducted in compliance with the requirements stipulated on the ethics approval documentation and no adverse events occurred. The data will be held in a secure storage for a period in accordance with Curtin University's ethics requirements.

All reasonable measures were undertaken throughout the research period to protect participant's privacy and all participants were fully informed prior to the interviews being conducted of any possible risks associated with being identified within the thesis. Copies of the information sheet and a consent form, which was given to the interviewees prior to the interview, are contained in Appendix 3-3.

## 1.7 Conference Papers

The author of this thesis attended three conferences as part of this study to inform fellow students and academic staff on the progress of the study. The name of the conference was 'CGSB Research Forum: Emerging Research Initiatives and Developments in Business. Research at the Curtin Graduate School of Business.' The years attended and the titles of the papers are contained in Table 1-2.

**Table 1-2 List of Conference Papers**

<b>Year</b>	<b>Title of paper</b>
2011	Research design and data collection from the airline industry: A PhD candidate's perspective.
2012	Framework for analysing qualitative data from the airline industry.
2013	Connecting fractured data utilising Interpretive Phenomenological Analysis (IPA).

## 1.8 Chapter Summary

This study is significant because the Asia Pacific Region will become the largest airline market in the world with minimal research on the management of FOR on airlines that are domiciled within this region. The focus of the research is primarily on the management of FOR by airlines within this region, as well as reviewing a second risk these airlines must manage to be sustainable over the longer term, which is business risk. To provide the readers of the report an overview of the thesis structure, chapter outlines are included in the chapter. Ethics are an important component of any research and all ethical requirements were adhered to. During the writing of this thesis, three papers were presented at conferences and the details of these papers are included in this chapter.

A review of the topic's literature is presented in the following chapter.

## **2 Chapter Two Literature Review**

### **2.1 Introduction**

A literature review is an objective, thorough summary and critical analysis of the relevant available research and non-research literature on the topic being studied (Hart 1998). This literature review followed the advice of Hancock and Algozzine (2006) where it is required to review the content, style and form of the research with the objective of adding to the knowledge base of the researched topic.

The topic of this study is exploring operational risk centric to flight operations. This category of risk contains a large number of risk factors, which are ubiquitous and reside both internal and external to the airline, and includes human errors, failures of internal processes and systems as well as external events. As the sources of these risk factors are large in number, a broad review of the relevant topics were undertaken, investigating topics such as risk, risk management, operational risk, operational risk management, FOR, FOR management. As well as organisational culture and various sub cultures, the ‘bureaucratisation of safety’, business risk, risk drift and associated concepts of this phenomenon.

### **2.2 Risk**

Risk is an inherent part of human existence (Renn 1998) and each day around the world individuals, households, organisations and countries negotiate elements of risk as they go about their lives (Moeller 2007). Precious time and resources are spent in an attempt to meet stakeholder requirements (Hoffman 2002) and in doing so there are no guarantees that the outcomes that are realised from their endeavours equal their expected outcomes (McCarthy and Flynn 2004). These entities have to manage a number of risks; the specific risks each member of these entities has to deal with will vary over time and be dependent upon the member’s objectives. The one element that each of these entities have in common, within the context of the subject under discussion, is that they are collectively referred to as risk managers, albeit to varying degrees of success.

There are a myriad of reasons why some governments, industries and organisations manage their risk better than others (Adams 2000). One possible reason for this variation was the absence of a global risk management standard. In 2009, the International Organisation for Standardisation (ISO) published their standard on risk management, which was referred to as ISO 31000-2009. This standard has been updated and is now referred to as ISO 31000-2010, which provides principles and generic guidelines, is not industry specific, can be applied where risk has either positive or negative outcomes and is not intended for certification purposes (ISO 2009).

Risk as a concept is difficult to define (Aven and Renn 2009) resulting in a number of definitions (Adams 2000; Billington 1997; Hussain et al. 2006; Kaplan and Garrick 1981; Pidgeon 1991; Smith, McKeen and Staples 2001; NIST 2012).

The Society for Risk Analysis (SRA) defines risk focusing on consequences which are referenced to values or objectives with a negative or undesirable outcome with uncertainty being a central theme (SRA 2015). As stated, there are numerous definitions of risk and for consistency purposes this study has adopted the ISO definition of risk, which is the ‘effect of uncertainty on objectives’ (ISO 2009, 1). The central theme of both the SRA and ISO definitions of risk is uncertainty; consequently, managing uncertainty is a key aspect of managing risk.

### **2.3 Risk Management**

Risk management “...as a scientific field is young, not more than 30-40 years old” (Aven 2016, 1), subsequently the agreed understanding of some of risk management’s concepts and risk itself has changed. Previously, when determining future outcomes, risk was considered measurable and was calculated using objective probability whereas uncertainty utilised a subjective probability involving judgement and not scientific knowledge (Knight 1921, 233). The contemporary view of risk and uncertainty acknowledges that these concepts are related and are knowledge-centric. “Uncertainty points to a lack of knowledge, whereas risk implies that some, but incomplete, knowledge is available” (de Vries, Verhoeven and Boeckhout 2011, 489).

ISO agrees with the term uncertainty relating to a lack of knowledge as their definition of this term is "... the state, even partial, of deficiency of information related to, understanding or knowledge of an event, its consequences, or likelihood" (ISO 2009, 2). When analysing uncertainty in complex systems such as a large airline, the term uncertainty can be categorised into two types. These types are created as a result of the inequality of the knowledge between what is required and the knowledge that is available which would allow rational decision-making to occur (Tannert, Elvers and Jandrig 2007). The first type is "...aleatory uncertainty, which can occur due to the possibility of the system behaving in a multiple of different ways and is thus a property of the system itself" (Helton 1997, 4). The second type of uncertainty is "...epistemic uncertainty, which results from a lack of knowledge about the system and is thus a property of the analysts performing the analysis" (Helton 1997, 4). Aleatory uncertainty cannot be reduced through increasing knowledge but can be reduced via an increase in the level of safety within the system, reducing the randomness of events. If two airlines possessed the same level of epistemic uncertainty, however, one had a risk averse culture and the other a risk-seeking culture, the risk-seeking airline has a higher level of aleatory uncertainty increasing the randomness of events. In a mathematical modelling environment where randomness could be reduced to zero, there would be no requirement to consider aleatory risk (Der Kiureghian and Ditlevsen 2007), however, when people are involved, randomness exists, consequently so does aleatory uncertainty.

Probabilistic analysis can be used to lower both of these uncertainties with Bayesian subjective probability being a common method with epistemic uncertainty (Aven 2016). There is however, a problem with this method, as the person applying the probabilities requires substantial domain knowledge.

Increasing knowledge is not an automatic remedy in lowering uncertainty (Van Asselt 2005) as uncertainty may still exist in an information filled environment. Additional information may lower uncertainty but it may also increase uncertainty due to the possibility of the new information, exposing uncertainties previously unidentified. This additional knowledge may not reduce the epistemic uncertainties because research is not a panacea. "This leads to a paradoxical situation: on the one hand, it is increasingly recognised that science cannot provide decisive evidence on uncertain risks, while on the other hand policy-makers and authorities increasingly resort to science for more certainty and conclusive evidence"(Van Asselt and Vos 2006, 317).

This uncertainty paradox led to the creation of the precautionary principle which has “...become one of the central principles that guides decision-making involving the protection of the environment, health and safety” (Van Asselt and Vos 2006, 313).

The precautionary principle acts as a “...guide when deciding whether to take action to protect people from possible harm. It is essentially a ‘better safe than sorry’ approach suggesting that action should be taken to avoid harm even when it is not certain to occur” (Kheifets, Hester and Banerjee 2001, 113). However, “...national regulators, such as aviation regulators think about systems, not snapshots and once people see that risks are inevitably part of systems, the precautionary principle will become far less helpful” (Sunstein 2003, 1054). The overarching philosophy of the precautionary principle is to guide stakeholders, who are required to make decisions in an environment of scientific uncertainty. In the airline industry where safety is a principal Critical Success Factor (CSF), the precautionary principle should be considered where uncertainty exists that could lead to adverse safety outcomes with this principle guiding the airline’s risk philosophy until aleatory and epistemic uncertainties are reduced to an acceptable level (Macrae 2009). A key component of risk management is risk assessment which is discussed in the following section.

### **2.3.1 Risk Assessment**

Risk assessment involves identifying possible risks that may have an impact on an organisation’s objectives and the subsequent establishment of mitigation processes to minimise the effect of those risks in the event that they materialise within the contextual environment of the firm and on a cost-benefit basis (RMIA 2008; ISO 2009). This involves three stages, risk identification, risk analysis and risk evaluation (ISO 2009). The identification of operational risks “...requires an active process of interpretation by experts which includes ignorance” (Macrae 2009, 289) as a consequence of incomplete information. Risk analysis involves obtaining an understanding of the risk and assessing its likelihood of occurrence and if so, its consequence(s) and risk evaluation compares the outcome of the analysis phase with an organisation’s risk criteria and determining what if any treatments are required in mitigating the risk (ISO 2009).

In the identification and mitigation processes, risk can be separated into three categories:

1. known-knowns; where the risk is known and has been managed
2. known-unknowns where the risk is known, and has not been managed
3. unknown-unknowns where the risk has not been identified and subsequently has not been managed (Maluf, Gawdiak and Bell 2005).

A risk that is a known-known is standard within risk management. A known-unknown is a risk that has been identified, however, for a variety of reasons, has not been managed. An unknown-unknown is a risk that has not been identified and consequently it is not possible to manage.

Risk management covers all risks, however, organisations segregate risks into functional areas such as strategic, financial, and operational (McCarthy and Flynn 2004).

## **2.4 Operational Risk Management**

On a generic level, Operational Risk Management (ORM) is a human based process within an organisation that identifies and manages hazards as they occur and can, if required with the input of experts and technology, adjust the processes to manage the emerging risks (Beroggi and Waliace 2000). Within the civil and military sections of the aviation industry, ORM has the same underlying principles; however, the objectives are different. The goals of ORM in the military are focused on mission objectives and combat capability (USAF 2000), while the goals of ORM in the civilian sector are to "...minimize risks in order to reduce mishaps, preserve assets, and safeguard the health and welfare of personnel" (FAA 2000, 15.1). In essence, military flying is combat and mission orientated, whereas civilian flying is safety orientated. Subsequently, military ORM is outside the scope of this study.

Organisations have been managing their operational risk for hundreds of years (Bernstein 1998), although not necessarily in a formal manner such as per the guidelines contained in ISO 31000:2010. The Banking and Finance industry has conducted research into this recently emerged category of risk. Before the Basel 11 reforms were implemented, operational risk was a residual category for risks that did not fit into established categories (Power 2005).

There is currently no generally accepted definition of operational risk so it is up to organisations and industry as a whole to define this term (Hoffman 2002). As an example of this lack of a universally accepted definition of operational risk, a number of organisations and their definition of this risk are presented as follows:

OPRisk Advisory and Towers Perrin (2010, 3) definition of operational risk is:

The risk of loss from an operational failure and encompassing a wide range of events and actions as well as inactions and includes, for example, inadvertent execution errors, system failures, acts of nature, conscious violations of policy, law and regulation, and direct and indirect acts of excessive risk taking (OPRisk Advisory and Perrin. 2010, 3).

The Bank for International Settlements (BIS) through its Basel Committee on Banking Supervision (2011) defines operational risk as:

The risk of loss resulting from inadequate or failed internal processes, people and systems or from external events; this definition includes legal risk, but excludes strategic and reputational risk (BIS 2011, 3).

The Society of Actuaries (SOA) (2006) defines operational risk as:

The risk of direct or indirect loss resulting from inadequate or failed internal processes, people, and systems or from external events (SOA 2006, 53).

BCI defines operational risk as:

Risk by which deficiencies in information systems or internal controls will result in unexpected loss (BCI 2011, 35).

As outlined previously, operational risk is not formally defined and it is up to individual industries to define this risk. One possible reason for the difficulty in defining operational risk is "...there is more than a slight suspicion that the invention of operational risk is an attempt to frame the unframeable, to assuage our deepest anxieties and fears about uncontrollable 'rogue others', and to tame monsters which have been created and nurtured by the system itself" (Power 2005, 596).

It is important to note that operational risk is different to operations risk. "Operations risk and operational risk sound alike, but represent two very different types of exposures. Operations risk is a subset of operational risk and is characterized by unconscious execution errors and processing failures. As these risks are generally well known, they also tend to be well managed" (Hettinger et al. 2008, 4).

The finance industry, including regulators, realised what catastrophic outcomes could occur if operational risk was not addressed; an example being the bankruptcy of Barings Bank by the failure of systems, processes and people. Macaulay claims operational risk "...was not implemented as a junior player to the other more established risk measures of credit and market, it was intended as a full-fledged partner" (2008, 2). The move to include operational risks was the first major step to an integrated risk management approach, leading to the creation of the Enterprise Risk Management (ERM) philosophy.

#### **2.4.1 Enterprise Risk Management**

In 2004 the 'Enterprise Risk Management – Integrated Framework' was implemented with an objective to improve the corporate governance of organisations and manage the risk of organisations across the enterprise including operational risk. COSO (2004) defines ERM as:

A process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives (COSO 2004, 2).

ERM was implemented in the USA as a method to improve the corporate governance of organisations.

Operational risk definitions outlined previously claim operational risk is the risk of a loss resulting from the failure of people, internal processes, systems or external events. What is missing from this definition is culture, because the failure of people does not necessarily mean culture, it could be an error resulting in an operational failure committed by an individual or a small group of individuals within the organisation which may not reflect the overall organisational culture. However, if a safety critical organisation has an inappropriate organisational culture, it will be subject to operational losses, and therefore culture should be a major element when discussing operational risk.

### **2.4.2 Organisational Culture**

Societal culture in its simplest form consists of “...commonly experienced language, ideological belief system, ethnic heritage and history” (House and Javidan 2004, 15). Culture, in short, defines the rules of the game; it is not documented as such but organisational culture has to be absorbed for an employee to be integrated and accepted into the organisation. Instead of it being documented, it is the glue that binds the firm together so that employees understand what is expected from them with regard to their spoken words, behaviours and attitudes (Pidgeon 1991; Robbins et al. 2001).

The culture of an organisation is the “...commonly used nomenclature within an organisation, shared organisational values, and organisational history” (House and Javidan 2004, 15). Deal and Kennedy (1983) comment that organisational culture is elusive, intangible, implicit and taken for granted, although every organisation follows these principles

Every organisation develops a core set of assumptions, understandings and implicit rules that govern day-to-day behaviour in the workplace. Until newcomers learn the rules, they are not accepted as full-fledged members of the organisation. Transgression of the rules either by an executive manager or a front line employee results in universal disapproval and powerful penalties. Conformity to the rules becomes the primary basis for reward and upward mobility (Deal and Kennedy 1983, 501).

An organisational culture is an amalgam of attitudes and values from national, organisational and professional origins (Helmreich and Merritt 1998) with “...national cultures emerging from shared values whereas organisational cultures are shaped mainly by shared practises” (Reason 1997, 192). These shared practises “...are signals employees get from the corporate processes that structure their work priorities” (Gerstner 2016). Consequently, employees will be influenced to a greater extent by national culture rather than organisational culture (Adler 1997). One aspect of an organisation’s culture is its safety culture, with the term originating from the aftermath of the Chernobyl nuclear reactor accident in Ukraine in 1986 (Pidgeon 1991).

### 2.4.3 Safety Culture

The importance of safety culture within the domain of operational risk cannot be overstated as the two most important factors in the occurrence of accidents is, "...management commitment to safety and the organisation's safety culture" (Leveson 2004, 240). The Flight Safety Foundation's (FSF) Icarus Committee believes "...within the aviation industry, management defines the safety culture of an airline. The safety culture should be operationally wide extending from the maintenance shop floor, to the ramp, to the cabin and to the cockpit." (1999, 9). There is some dispute between researchers in their endeavours to define a safety culture, with some definitions being extensive and including extreme detail. The Commission Members from the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling acknowledges these definitions; however, it maintains a more popular definition is "...safety culture means doing the right thing even when no one is watching" (2010, 218).

Safety is an important component of an organisation's culture, "...which can then be referred to as the safety culture, but it is only past a certain stage of development that an organisation can be said to take safety sufficiently seriously to be labelled as a safety culture" (Hudson 2001, 30). Hudson (2007) believes that an organisation's safety culture can be categorised as one of five types, ranging from the lowest level referred to as 'pathological,' to the highest level which is referred to as a 'generative' safety culture as outlined in Table 2-1. As an organisation's safety culture matures, the level of trust between its stakeholder's increases as well, with these stakeholders becoming better informed.

**Table 2-1 Five Types of an Organisation's Safety Culture**

Type	Description
Generative	Safety is how we do business around here.
Proactive	We work on the problems that we still find.
Calculative	We have a system in place to manage all hazards.
Reactive	Safety is important; we do a lot every time we have an accident.
Pathological	Who cares as long as we are not caught.

(Hudson 2007, 704).

Whilst the terms organisational culture and safety culture have been subject to a substantial amount of research, the term risk culture has not. Consequently, this term is yet to be clearly defined.

#### 2.4.4 Risk Culture

Reviewing the Banking and Finance industry, where operational risk of recent times has been well researched, "...the conclusion is the term 'risk culture' is not well defined, often described by equally vague concepts such as 'tone at the top', and 'walk the talk'" (McConnell 2012, 23).

In 2009, the Institute of International Finance (IIF) presented elements which they believed were essential for a risk culture to be successful. These elements are contained in Table 2-2.

**Table 2-2 Elements of a Successful Risk Culture**

Element	Requirement
Governance	An effective governance structure with evidence of management objectives linked to risk management objectives.
Culture	A culture in which senior management sets the correct tone at the top, as the firm is more likely to respond to decisions or actions that reflect actual risk culture rather than admonitions about risk culture.
Risk Management System	Establishing the conditions inside the firm so that there is the correct budget and support for the risk management unit, with those working in risk management having an effective voice.
Employee Empowerment	An environment where employees can challenge and ask questions. Employees who must have the willingness and ability to ask the right questions, along with acknowledgement that a risk culture depends not only on both formal and informal channels for employees to raise these questions but also on their being accountable for those who do or do not step forward.

(IIF 2009).

In addition to the elements which the IIF believes are essential for an organisation to have a successful risk culture, the IIF also identified a number of major threats to the creation and implementation of a good risk culture with these threats presented in Table 2-3.

**Table 2-3 Threats to a Successful Risk Culture**

Threats	Behaviour or action
Excess confidence	When a sense of superiority leads to a sense of immunity to risk.
Blind spots	Resulting from a lack of challenge or excessive comfort.
Fear of bad news	Shoot-the messenger mentality can prevent people from raising issues forcefully.
Passivity	Focusing on one's own specific tasks and not sharing the warning signals of internal or external risks within the firm.
Indifference	Lack of sense of engagement in the firm's fate or prospects that leads to a reluctance to react to situations.
Denial	Refusal to accept the reality that things are not going the firm's way.
Acceptance of bad behaviour	Failure to correct behaviour that is contrary to espoused values.
SOP Non-compliance	Frequent breaches of procedure, ignoring limits, failures to complete reports, or disregard of compliance requirements, if not corrected can lead to the rapid spread of the threats identified above.

(IIF 2009).

Interpreting these threats and elements, communication is a key factor in the success of a firm's risk culture. What is required for this to occur, is for an organisation such as an airline, which is FOR critical, information must flow freely. This requires a culture of reporting as well as a just culture, in short 'do not shoot the messenger'.

### **2.4.5 Reporting Culture-Just Culture**

Organisations such as an airline are required to have a culture of reporting where operational employees willingly submit reports with no fear of punishment, as long as no wilful violation has been committed. These organisations need to know safety critical information; without this knowledge it is exceedingly difficult to manage unknown FORs as these risks are referred to as unknown unknowns (Maluf, Gawdiak and Bell 2005). To encourage flight crews to submit reports, a culture of punishment cannot exist, as nobody wants to self-incriminate (GAIN 2004). Consequently, a just culture, where there is agreement between management and flight crews delineating between what constitutes acceptable and unacceptable behaviour or actions (Reason 1997), will add to the safety culture of the airline.

The term just culture has become broadly accepted within the airline industry. However, ICAO believes "...there is no universal definition for the term because without the consideration of the applicable local culture, a universal definition of just culture could possibly be discriminatory or even judgemental" (2009, 2-30). Whilst there is no universal definition of what constitutes a just culture, ICAO (2005) believes a strong safety culture includes inter alia a just culture.

A non-punitive environment is fundamental for a good reporting culture; the workforce must know and agree on what is acceptable and what is unacceptable behaviour. Deliberate violations must not be tolerated by management or by workers. A culture that recognizes that, in certain circumstances, there may be a need for punitive action is considered a just culture. Personnel tend to be self-disciplined in a just culture (ICAO 2005, 3-17).

This lack of a definitive term for a just culture may lead to some confusion amongst line managers and line pilots as to what is acceptable and unacceptable behaviour. Research shows that organisations within the aviation industry that have moved from a punitive culture to implementing a just culture improve the safety culture within the organisation (Eurocontrol 2006). This journey requires a fundamental change in attitude from both management and flight crew as, although the objective may be aspirational, it is fraught with failure, with numerous possible setbacks along the way (Hudson 2000). Whilst the implementation of a just culture may improve an airline's safety outcomes, punitive actions can still be imposed on a person who committed an honest act and reported it, in an environment that contains a just culture as outlined in section 2.5.3.

This concludes the section on operational risk management, the following section reviews literature involving operational risk specific to flight operations.

## **2.5 Flight Operational Risk Management**

Flight Operational Risk Management (FORM) involves managing operational risk that has an association with flight operations. Using the same elements from operational risk, FOR is the risk of loss from inadequate or failed internal processes, systems, and people or from an external event(s). The objective of the management of FOR is to ensure the risk of a loss from these elements is maintained within the airline's risk criteria. Associated with these elements are a large number of risk factors; when enough of these risk factors are present, a catastrophic event has the potential to occur (Abkowitz 2008). Examples of risk factors with descriptions are contained in Tables 9-1 and 9-2 in Appendix 2-1. The accidents and disasters such as the 1986 explosion of the reactor core in a nuclear power station in Chernobyl Ukraine, the environmental disaster of the oil tanker Exxon Valdez impacting a reef in Alaska in 1989, and the Challenger and Columbia space shuttle accidents in 1986 and 2003 respectively all contained risk factors. The risk factors that were present at the time of these accidents and others are contained in Tables 9-3 and 9-4 in Appendix 2-2.

### **2.5.1 People-Internal Processes-Systems-External Events**

ICAO accepts "...the aviation system cannot be completely free of hazards and associated risks. Human activities or human-built systems cannot be guaranteed to be absolutely free from operational errors and their consequences" (2013c, 2-1). However, with correct management, the level of risk reduces and the corresponding level of safety is improved. As an example, during the 1950's FOR was exceptionally high as the worldwide airline accident rate was approximately 40 hull losses per million departures, with most of these accidents caused by technical failure(s) of the aircraft (systems). By the early 1970's this rate had been substantially reduced to a rate of about 4 hull losses per million departures (Boeing 2009). With the technological advances made during this period, the focus of safety moved from hardware to human-ware (failure of people).

### **2.5.1.1 Failure of People**

The focus on human-ware shifted the safety improving processes and products to human performance and human factors with the emergence of Crew Resource Management (CRM), Line Oriented Flight Training (LOFT), human-centred automation and other human performance interventions. A key element of CRM is the flight crew's Non-Technical Skills (NTS) which relate to the management of the flight rather than manipulation of the controls. These skills can be separated into two groups; namely, cognitive and interpersonal, whereby cognitive skills are "...the mental processes used for gaining and maintaining situational awareness, for solving problems and for taking decisions whereas interpersonal skills are regarded as communications and a range of behavioural activities associated with teamwork" (CRM Standing Group 1999, par 7). Substantial investments were required in the evolutionary processes of these products to bring under control the elusive and ubiquitous human error (ICAO 2013c).

The substantial allocation of resources by the aviation industry globally with regard to human factors has contributed to the lowering of the airline accident rate. It is now believed that allocation of resources to the threat caused by human factors has now reached a point of diminishing returns and it is believed that further allocation of resources will produce a minimal return with regard to safety benefits (FSF Icarus Committee 1999). Other methods of accident prevention emphasize looking at the total picture and taking into account accident prevention strategies in all industrial activities (FSF Icarus Committee 1999), with the intention of looking beyond just the operational staff such as pilots, dispatchers, mechanics and air traffic controllers. The FSF (1999) proposes, after reviewing accidents in both the aviation sector and other high risk organisations, the failure of decision-making processes from both the management team and operational employees should be reviewed. This view is supported by Holloway and Johnson (2005) who claim, in a study looking at probable and contributory causes of airline accidents in the USA and Canada between 1996 and 2003, the major probable cause of these accidents was human error.

However, when contributory factors were included in the analysis, in the USA regulations were considered the major contributory factor, followed by company management, whereas in Canada the major contributory factor was company management, followed by aircraft design. Some of these contributory factors are referred to as latent conditions, with all organisations possessing latent conditions (Reason, Hollnagel and Paries 2006).

#### **2.5.1.2 Failure of Internal Processes and Systems**

A latent condition itself does not cause an accident, although they are required to be present for one to occur. For example, to use fire as an analogy, three elements are required for a fire to start which include fuel, ignition and oxygen, "...whereby ignition is the cause of the fire and oxygen is the latent condition" (Reason, Hollnagel and Paries 2006, 7). Reason believes latent conditions "...are spawned in the upper echelons of the organisation" (1997, 11), whereas IATA (2009) believes latent conditions are created organisation wide. The existence of latent conditions within an airline increases FOR, as they are "...conditions present in the system before the accident, made evident by triggering factors which often relate to deficiencies in organisational processes and procedures" (IATA 2013a, 19). Taxonomy of latent conditions and specific examples of such that may exist within the sphere of an airlines flight operations are contained in Tables 9-5 and 9-6 in Appendix 2-3.

The concepts and outcomes of operational risk and safety, once the domain of the production divisions, has moved up the organisation and is now part of executive management reviews (Macaulay 2008). One of the outcomes of the management of operational risk is safety and, in the past, operational level employees managed this risk. However, the flight operations and maintenance divisions were the cause of, or contributed to, sixty five percent of aviation accidents (failure of people, processes and systems) (Rankin 2008). As a consequence of these negative outcomes with regard to safety, executive management began to take a very close view of safety and today most airline safety manager's report to the highest levels of management (Lewis 2008).

### **2.5.1.3 Loss from an External Event**

Safety risk management is the management of hazards which "...provides the foundation for a balanced allocation of resources between all assessed safety risks and those safety risks the control and mitigation of which are viable" (ICAO 2009, 5-2-5-3). These mitigation processes have to be cost effective as ICAO (2006b) believes risk is ubiquitous, however, it is not desirable to eliminate all risk. To determine what risk has to be eliminated or mitigated requires a rational process; this process is known as risk management and comprises "...three essential components; hazard identification, risk assessment and risk control" (IATA 2006, 66).

ISO defines a hazard as a "...potential source of harm"(ISO 2014, 1), whereas ICAO has a more elaborate definition by defining a hazard as a "...condition or an object with the potential to cause death or injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function" (ICAO 2013c, 2-24). ICAO (2009) categorises hazards into three groups: natural, technical and economic hazards. Reviewing the classification of hazards contained in Table 9-11 in Appendix 2-9 indicates the management of these hazards, especially natural and economic hazards is the management of a risk of a loss from an external event(s).

### **2.5.2 Airline Risk and Safety Management**

The relationship between risk and safety is inversely proportional; that is, decreasing the level of risk increases the level of safety. The relationship between risk and safety is, risk is measured as a combination of the probability of a hazardous event occurring and the severity of the consequences and safety in its basic form is an antonym of risk and is achieved by reducing the level of risk to an acceptable level (Moller, Hansson and Peterson 2006). The level of risk in the USA domestic airline operation has been reducing for a number of decades and today is exceedingly safe and low risk. A passenger who randomly chose a domestic airline jet flight in the USA between 1967 and 1976 would have a one in two million chance of dying. This death risk fell to one in seven million during the decades 1977-1986 and 1987-1996. Using data from 1990 to the present, the death risk falls to one in eight million. Stated somewhat differently, if a passenger facing a death risk of one in eight million chose one flight at random each day, that person would, on average, go for 21,000 years before perishing in a fatal crash (FAA 1997, 10).

This very high level of safety is supported by the findings of a U.S. National Safety Council study conducted between 1997-2006 which claimed it is approximately 70 times safer travelling in a commercial jet aircraft than travelling by a personal vehicle (Boeing 2013b). This safety comparison between airlines and other forms of transport within the USA is contained in Table 2-4 which compares the number of fatalities in the year 2007 from eight different modes of transportation in the USA.

**Table 2-4 Comparison of Fatalities with Different Modes of Transport**

<b>Mode of Transport</b>	<b>Fatalities</b>	<b>Mode of Transport</b>	<b>Fatalities</b>	<b>Mode of Transport</b>	<b>Fatalities</b>
Highway	35,707	Bicycles	698	General Aviation	491
Pedestrians	4,654	Recreational Boating	685	Commuter and Air Taxi	43
Railroad	845	-----	-----	US Air Carrier	1

(Boeing 2013b).

Whilst the data contained in Table 2-4 pertains to the USA, the world as a whole has also demonstrated a dedicated commitment to reducing risk, consequently increasing the level of safety within the global aviation industry. As a result of this commitment, “...in 2012, 2.9 billion people used air transport to help them realize their business and tourism requirements” (ICAO 2014, 1).

The regions of the world where airlines have a safety level of  $10^{-6}$  or better are classified as ultra-safe (Amalberti 2001). However, not all airlines operate to this level of safety and aside from compliance requirements, judgement regarding whether an airline operates to an acceptable level of safety is generally left to the stakeholders. However, the actual level of safety that an airline has achieved may be measured using a number of methodologies. One common method is the ‘hull loss rate per million sectors flown’ where a hull loss is defined as an “...accident in which the aircraft is destroyed or substantially damaged and is not subsequently repaired for whatever reason including a financial decision of the owner” (IATA 2013a, 84).

As stated previously not all regions of the world are classified as ultra-safe with regard to the aviation industry. Table 2-5 displays total accident rate per million sectors for each IATA Region for the year 2012. The accidents are attributed to the domicile of the accident airline as per its Air Operator's Certificate (AOC) and not to the geographical location of the accident.

**Table 2-5 Total Accident Rate per Million Sectors per Operator Region**

<b>AFI</b>	<b>ASPAC</b>	<b>CIS</b>	<b>EUR</b>	<b>LATAM</b>	<b>MENA</b>	<b>NAM</b>	<b>NASIA</b>	<b>WORLD</b>
12.44	2.73	3.63	1.93	1.79	1.79	1.14	0.57	2.01

(IATA 2013a, 15).

Risk and safety management within the airline industry in part, is managed through regulations. The industry regulator is charged with the responsibility of ensuring airlines comply with these regulations, subsequently the regulator plays an important role in an airline's safety and risk management functions.

### **2.5.3 Regulator**

Airlines that are domiciled in countries who are member states of ICAO "...are required to abide by the ICAO safety management SARPs which provide the high-level requirements states must implement to fulfil their safety management responsibilities related to, or in direct support of, the safe operation of aircraft" (ICAO 2013c, 3-1). These countries are responsible for the establishment of a safe and efficient environment for civil aviation. For this to occur, a legal framework comprising legislative and regulatory provisions is required, with an associated organisation charged with ensuring these laws are complied with, as per Article 12 of the Chicago Convention on International Civil Aviation.

Each contracting State undertakes to keep its own regulations in these respects uniform, to the greatest possible extent, with those established from time to time under this Convention. Over the high seas, the rules in force shall be those established under this Convention. Each contracting State undertakes to insure the prosecution of all persons violating the regulations applicable (ICAO 2006a, 7).

The prosecutor is the Regulator and its primary role is to "...provide the necessary oversight for compliance with the State's laws and regulations for air safety and for the fulfilment of the State's safety goals" (ICAO 2006b, 2-3).

Compliance to a nation's aviation laws is an absolute requirement as a base to develop solid safety practices. However, the contemporary thinking is to move beyond a pure compliance mindset, as this may inhibit the identification of emerging safety problems (ICAO 2013c). What is required is for the regulator and the airlines to cooperate and create a generative safety culture. Input by both parties into the creation of a generative safety culture signals the building of a relationship between these two parties (ICAO 2013c). This relationship requires a mindset of "...openness between both parties resulting in better safety communications through constructive dialogue rather than the concealment of safety issues (ICAO 2009, 2-26).

This cooperative approach between the airlines and the regulator must be understood, as the ultimate responsibility of the regulator is to enforce the national regulations. Douglas (2010) asserts that the concept of a just culture has been incorrectly interpreted by some stakeholders within the aviation industry who believe that an honest error will not be prosecuted after being reported. If an event were to occur, and under the civil aviation act this event was regarded as a 'public welfare regulatory offence,' the public would demand that those involved in the event be held accountable. It must be appreciated that even if the event was non-intentional, and the outcome was deemed to be a 'public welfare regulatory offence,' it is still regarded as a criminal offence (Douglas 2010).

The basic role of the regulator is to ensure airlines comply with the nations regulatory requirements which is fundamental in building solid safety practices (ICAO 2013c). However, the question has been asked; "Does the ever-increasing amount of procedures and rule making actually increase safety" (Dekker 2014, 350)? This concept is referred to as the 'the bureaucratisation of safety' and is reviewed in the following section.

#### **2.5.4 The Bureaucratisation of Safety**

The phenomenon of increasing regulations with the objective of improving safety is referred to as 'the bureaucratization of safety' (Dekker 2014). Bureaucratisation of safety is the "...administrative governing, not necessarily by representative organization members, of the relationship between the means an organization dedicates to safety and the ends it hopes to achieve with them" (Dekker 2014, 349).

This topic has attracted research, some of which indicates negative safety outcomes such as a substantial increase in the number of service providers in the areas of auditing, recruitment, consulting, publishing and training (Townsend 2013) adding to cost and compliance requirements. As well as inhibiting innovation and promoting risk aversion (Hale, Borys and Adams 2015), unwarranted legal pressure to comply with outdated regulations that have been replaced but not removed (Amalberti 2001). Bureaucratic organisations may have a tendency to self-invite and nurture adverse safety outcomes (Turner and Pidgeon 1997), organisations that have an over reliance on a bureaucratic structure may cause employees to reject problem ownership, lack initiative and not innovate (Dekker 2014; Vaughan 1996).

During the last decade, two substantial operational requirements have been imposed on the airline industry both of which are very bureaucratic, consisting of new regulations and standards, substantially increasing the cost and compliance requirements for the industry. Both of these are aimed at improving risk and safety outcomes. The first impost was certain service providers in the aviation industry are required to create and implement a SMS in accordance with ICAO requirements (ICAO 2013a) and the second was the creation and imposition of the IOSA on IATA members (IATA 2012).

As airlines are low probability high consequence organisations, they are extensively regulated as the potential loss of life from an accident is substantial, hence, the substantial amount of regulatory requirements. Determining whether the concept of safety bureaucratisation is problematic in the airline industry is a substantial research study in its own right. Subsequently, the answer to this question is beyond the scope of this thesis, however, what will be considered during the data collection and analysis phase is how bureaucratic these new regulations are viewed by industry stakeholders.

#### **2.5.5 Aviation Risk Mitigating Tools, Techniques and Audits**

The rate of airline accidents is reducing. For example, in the ten year period from 2003-2012 the industry rate for the western built jet hull loss category declined from 0.9 per million sectors flown to 0.2 per million sectors flown (IATA 2013a). There are a number of reasons for this reduction, one of which may be better uses of incident databases.

Technology has improved allowing better use of flight data analysis of incidents allowing the airline to learn from past events. IATA has created a global incident database called, Safety Trend Evaluation, Analysis and Data Exchange System (STEADES) where airlines can benchmark, make better investment decisions and discuss safety concerns (IATA 2010). These incident databases which have their origins in the aviation industry are now being looked at by other industries to improve their own level of ORM and is referred to as near-miss management (McCarthy and Flynn 2004). The aviation industry over the years has been very proactive in managing FOR. One method is the creation of a number of risk mitigating, safety enhancing products and audits, whose objective is to prevent FOR from drifting towards failure. Examples of these audits and products are contained in Appendix 2-4.

## **2.6 Risk Drift**

Incidents do occur within an airline with the type and number of incidents being signals indicating the safety health of the airline; the outcome of these signals is dependent upon the relevant monitoring of stakeholders and correctly interpreting the information the airline is providing (Westrum 1988). If these signals are not correctly interpreted, the airline will drift with this drifting period referred to as the incubation period (Turner 1978). The theory of ergonomics posits that, "...accidents and disasters do not come 'out of the blue' but are preceded by sometimes lengthy periods of gradually increasing yet unrecognised risk" (Dekker and Pruchnicki 2013, 534). During this period, warning signs are either ignored or not noticed and planned defences will fail and production pressures will rise, increasing the probability of an accident occurring. This is not the result of an individual's poor performance but rather the outcome of organisational factors at play (Woods and Cook 2001).

As a strategy to manage these multiple organisational factors, an airline utilises a collection of systems operating within a larger system and when safety is a consideration; it is constantly drifting within its safety envelope (Dekker 2004). This drift when moving towards an operational event such as an accident is referred to as 'drift into failure', which Dekker (2004, 1) defines as "...a slow, incremental movement of systems operations towards the edge of their safety envelope".

The airline industry has a record of poor profitability with all airlines facing the structural challenges where their returns are unable to match their cost of capital (Pearce 2005). Consequently, there is tension between providing risk controls preventing an accident and the desire not to inhibit profitability. The major driver of this drift is located within the tension between production and protection propelling the organisation's drift into failure (Dekker 2013).

### **2.6.1 Risk Drift and Complexity**

A large airline would be regarded as a complex system, which "... is an ensemble of many elements which are interacting in a disordered way, resulting in robust organisation and memory" (Ladyman, Lambert and Wiesner 2013, 6.1). This complexity and drift's characteristics can interact and propel the organisation to drift towards failure. The overlap between these characteristics and complexity are contained in Table 9-7 in Appendix 2-5. Three theories referred to as 'normalization of deviance', 'practical drift' and 'Vulnerable System Syndrome' (VSS) contribute to an airline drifting towards failure with these theories reviewed in the following sections.

### **2.6.2 Normalisation of Deviance**

Risk drift was identified as an issue in both space shuttle accidents. Reviewing the accidents of Challenger and Columbia, Vaughan "...noticed there were concepts from Challenger explaining data from Columbia, which were, weak, mixed, routine, and missed signals, organization culture, and the 'normalization of deviance'" (2006, 368). Normalisation of deviance refers to "...people within an organization becoming so much accustomed to a deviant behaviour that they don't consider it as deviant, despite the fact that they far exceed their own rules for the elementary safety" (Vaughan 2008, par 12). As the "...deviant behaviour is repeated without catastrophic results, it becomes the social norm for the organization. Individuals who challenge the norm from within the organization or outside it are considered nuisances or even threats" (McAteer et al. 2011, 97).

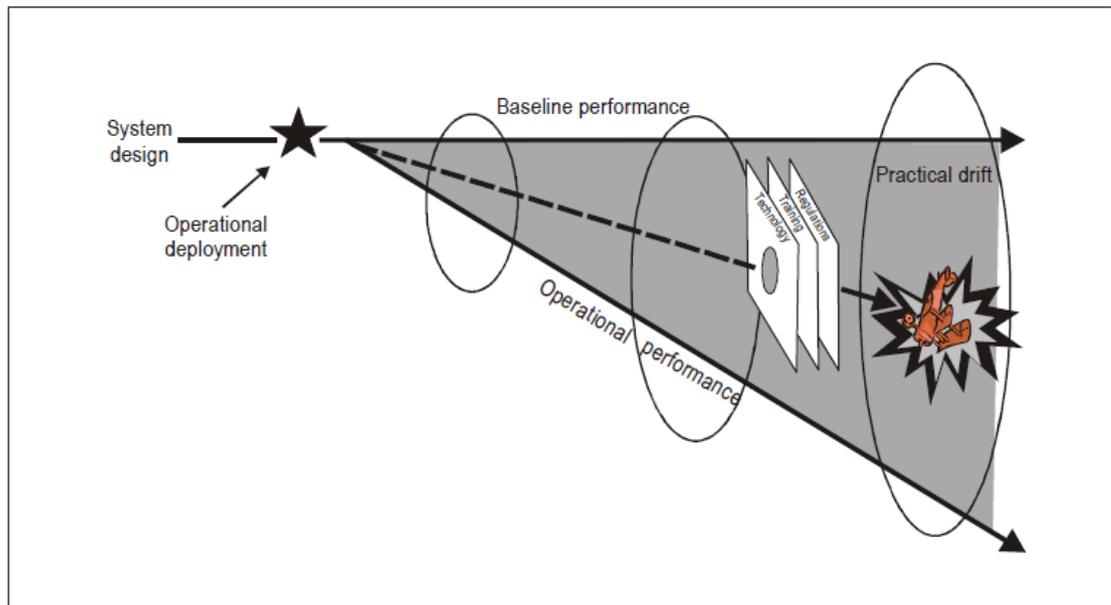
The Challenger's "...solid rocket booster problem began with the faulty design of its joint including the O-rings and increased as both National Aeronautics and Space Administration (NASA) and the contractor initially failed to recognize it as a problem, then failed to fix it and finally treated it as an acceptable flight risk" (Rogers 2006, 120).

This practise continued for a number of years and on a very cold morning, these O-rings failed during a shuttle launch resulting in the loss of the Challenger. The Columbia accident was caused by foam shedding from the an external fuel tank, damaging the insulation on the left wing causing the wing to fail during re-entry (Gehman 2003). Vaughan "...believed the organisational culture at NASA during the Challenger accident still prevailed 17 years later with the loss of Columbia" (2006, 361). This included the concept of normalisation of deviance, where risk is allowed to drift becoming routine behaviour and with the culmination of other risk factor(s), an accident occurs. This acceptance of risk drift by NASA is confirmed by the report from the Columbia Accident Investigation Board (CAIB) "NASA has not followed its own rules and requirements on foam-shedding. Although the agency continuously worked on the foam-shedding problem, the debris impact requirements have not been met on any mission. Foam shedding, which had initially raised serious safety concerns, evolved into "in-family" or "no safety-of-flight" events or were deemed an accepted risk" (Gehman 2003, 130).

### **2.6.3 Practical Drift**

The theory of 'practical drift' is based on research into the accidental shooting down of two U.S. Army UH-60 Black Hawk helicopters, killing all 26 people on board, by two U.S Air Force F-15C Eagle fighters on the 14<sup>th</sup> of April 1994 in northern Iraq (Snook 2000, 186-201). The theory of practical drift "...is the slow steady uncoupling of local practise from written procedure. It is this structural tendency for subunits to drift away from globally synchronised rule-based logics of action toward locally determined task-based procedures that places complex organisations at risk" (Snook 2000, 24).

Figure 2-1 Practical Drift



(ICAO 2013c, 2-6).

The military enquiry into this catastrophe blamed errors made by front line operational personnel as the cause of the disaster (Perry W. 1994, as quoted in Ladkin, P. B. and J. Stuphorn section 3 2003). Nonetheless, this military conclusion is not in agreement with other research into this accident. A civilian analysis conducted by Leveson, Allen and Storey (2002) adopted a systems approach to determine why this accident occurred, rather than focusing on errors made by operational personnel. Their conclusion was “...inconsistent, missing, or inaccurate information; incompatible technology; inadequate coordination; overlapping areas of control and confusion about who was responsible for what; a migration toward more efficient operational procedures over time without any controls and checks on the potential adaptations; inadequate training; and in general a control structure that did not effectively enforce the safety constraints” (Leveson, Allen and Storey 2002, 12).

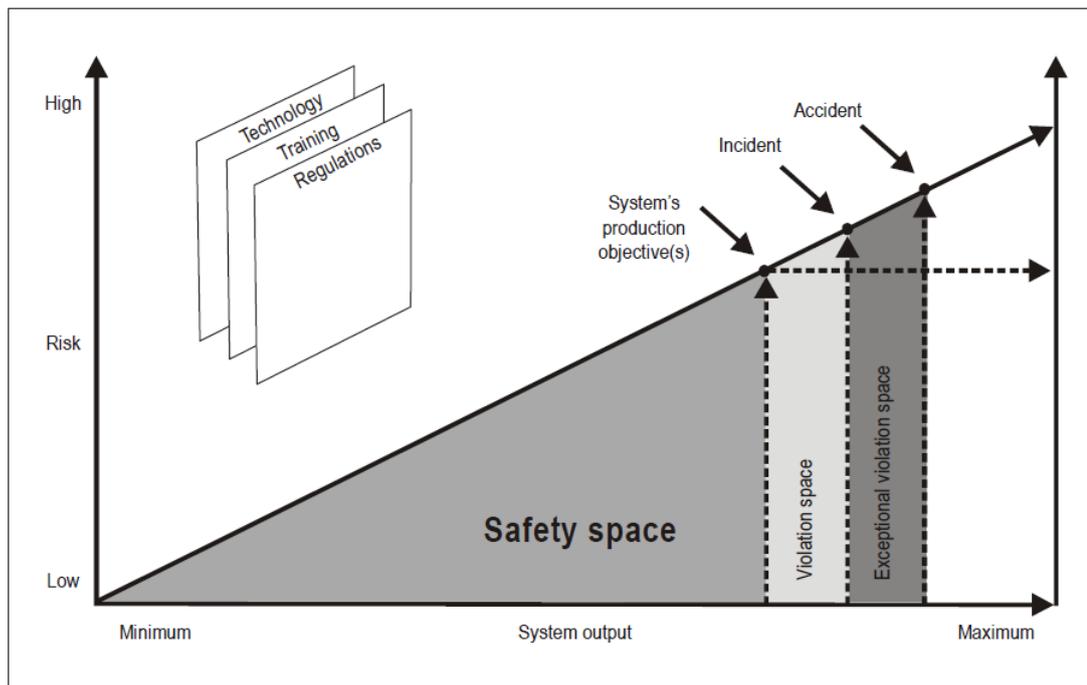
The objective of military aviation is mission-orientated and therefore task-based, and conducts the operation to satisfy the mission’s objectives. Whereas today, civilian aviation is predicated on safety being a major factor, hence it is rules-based.

An organisation's operational platform, which is rules-based, requires the operation to conform to an established set of rules, whereas a task-based organisation requires the objective(s) to be achieved, even if this requires rules or laws to be overlooked (Ladkin and Stuphorn 2003). This non-compliance to published rules or SOPs results in operational performance drifting away from baseline performance increasing the likelihood of a serious incident or accident.

ICAO (2009) believes an appropriate strategy to mitigate this drift is to install system defences into the airline, consisting of technology, training and regulations, including the airline's SOPs. An airline who embraces risk mitigating, safety enhancing technology and who has well-trained flight crews who comply with SOPs and are not fatigued, should operate with few violations. However, if the flight crew have been selected with an inadequate level of experience and have passed their respective check flights, this lack of experience may emerge when other risk factors are present, such as fatigue.

When system output exceeds production capability resulting in flight-crews consistently operating to legal flight and duty time limits over a sustained period of time, FOR will drift in an increasing direction. With an increased level of flying, tiredness becomes an issue, resulting in complacent flight crew who, although they may still be vigilant, start to lack attention to detail due to a lowered level of mindfulness (Weick and Sutcliffe 2001) resulting in an increased level of errors, thus causing an increased level of SOP non-compliance. This can result in an elevated level of incidents and, in an extreme case where multiple risk factors are present, a catastrophic event, such as a fatal accident and/or hull loss, may occur as per Figure 2-2.

Figure 2-2 Production and Violations



(ICAO 2009, 2-22).

Most violations of SOPs are non-malevolent (Reason 1997), however non-compliance to a SOP does contribute to an elevated level of accidents and incidents (Agur 2007, 36). A prevalent contributing factor in airline accidents with regards to flight crew errors was the failure of SOP adherence/cross verification (IATA 2013a). Research conducted by Helmreich, (2000) correlates with this finding, as Helmreich claims that after analysing Line Operations Safety Audit (LOSA) data, pilots who commit intentional non-compliance errors have the propensity to commit additional errors from other error categories.

Helmreich (2000) remarks that pilots from countries that are, or were, members of the British Empire score poorly on complying with rules. ICAO (2013c) believes that for a safety culture to be effective, the diverse national and professional cultures have to be integrated. With regards to the professional culture, this could take the form of the accepted norms of the profession, in this case the 'airline pilot,' or by individuals adopting a sense of infallibility whereby, irrespective of circumstances, an inflated sense of self belief exists and they believe they are not capable of committing errors (ICAO 2006b).

This personal sense of infallibility "...may increase the risk appetite on the flight deck as individuals have complex lives with multiple interconnecting worlds, and private behaviour from these worlds can influence an individual's professional life" (Alston 2003, 63). Flight crews do not operate in a vacuum but within an environment created by stakeholders, and a key component of this airline environment is compliance to SOPs. Flight crew's compliance to an airline's SOPs allows two individuals, who may have not met before the flight, to operate as a well-coordinated team, irrespective of ambient factors. Moreover, the regulator ensures the national laws of the country issuing the AOC are complied with which has approved these SOPs. Nonetheless, a problem may occur which will increase the level of risk of the flight, and consequently lower the level of safety when non-compliance to an SOP occurs (Snook 2000). This non-compliance can be a result of an honest error by the flight crew or, as Huntzinger (2007) posits, a Procedural Intentional Non-Compliance (PiNC). These PiNCs are the result of a deliberate act, referred to as a wilful violation. However, at times, flight crews intentionally fail to comply with a SOP, believing that by omitting or amending the SOP, the airline will benefit from this action (Agur 2007). The flight crew may believe this action will produce a benefit to their employer and may not view the transgression as a wilful violation. If the non-compliance to a SOP results in an event, the ensuing investigation may use a model to determine the culpability of the flight crew (Reason 1997). It is up to the investigating body to decide whether the non-compliance is a wilful violation, or a system-induced violation, because of the SOP itself being at fault, with each airline having their own decision-making processes. An example of a model to determine the culpability of flight crew is contained in Appendix 5-1.

#### **2.6.4 Vulnerable System Syndrome (VSS)**

The military enquiry blaming the front line personnel of the shooting down of the two U.S. Army UH-60 Black Hawk helicopters is one of the key aspects of the Vulnerable System Syndrome (VSS) (Reason, Carthey and de Leval 2001). Reason et al. (2001) claim "VSS has three interacting and self-perpetuating elements: blaming front line individuals, denying the existence of systemic errors, and focused on productive and financial goals.

Each element interacts with the other two creating a self-sustaining cycle that will limit the success of safety and risk management programs” (ii21-ii22). Organisations that have these three features within their operating system are considered more vulnerable to adverse events compared to organisations that are more robust with the reasons for this belief outlined in Table 9-8 in Appendix 2-6.

Most organisations have neither a robust system nor a vulnerable system; most of them are a combination of both systems. However, having stated that, organisations that are considered to have a robust system are vigilant regarding the possibility of the organisation having an adverse event by being ‘mindful of danger’. Conversely, organisations that are considered to be vulnerable may not be vigilant and drift in a zone of ‘safety comfort’. These organisations have an increased likelihood of ‘error repetition’ due to the systemic weakness as a result of a latent condition(s). Until the latent condition(s) has been removed, the error can reoccur given the same or similar circumstances with the possibility of the occurrence of a catastrophic event. A system that monitors operations as well as conducting audits with the objective of improving the quality of the organisation such as identifying flawed processes is referred to as a Quality Management System (QMS).

## **2.7 Management Systems**

A management system “...is a set of elements organised and integrated to accomplish an objective; these elements include data input, processing, storage, information output and feedback” (McKeown and Leitch 1992, 68). Management systems that are involved in the management of FOR as well as their possible integration are discussed in the following sections.

### **2.7.1 Quality Management System**

A Quality Management System (QMS) “...is a set of policies, processes and procedures required for planning and execution (production/development/service) in the core business area of an organization (Batalas 2016, par 1).

ICAO acknowledges the principles of QA and their contribution to the management of FOR in at least four areas, which are:

1. design and documentation of procedures.
2. monitoring of equipment and operations
3. internal and external audits
4. monitoring of CARs (ICAO 2009, 7-9).

Reviewing annexes 1, 6, 8, 11 and 14 “...there are no ICAO requirements regarding safety management SARPs for an airline to possess a QMS, with the sole exception of a requirement for an Approved Maintenance Organizations (AMO) in Annex 6” (ICAO 2009, 7-10). The recent addition of Annex 19 with regards to an airline’s SMS does not require a quality system within flight operations (ICAO 2013a). Indeed, ICAO does not prevent an airline from having a QMS in place; it just does not require a QMS within the SMS.

### **2.7.2 Safety Management System**

A Safety Management System (SMS) is a “...systematic approach to managing safety, including the necessary organisational structure, accountabilities, policies and procedures” (ICAO 2013a, 1-2).

ICAO as stipulated in Annex 19 (2013a) requires member countries as part of their State Safety Programme (SSP) to mandate “Operators of aeroplanes or helicopters authorised to conduct international commercial air transport, in accordance with Annex 6, Part I or Part III, Section II, respectively to implement a SMS” (ICAO 2013a, 3-1). The ICAO required SMS framework has four categories and 12 elements which are displayed in Table 9-9 in Appendix 2-7.

All airlines that are required to have a SMS shall:

1. develop and maintain a process that ensures the hazards associated with its aviation products or services are identified.
2. be based on a combination of reactive, proactive and predictive methods of safety data collection (ICAO 2013a, APP 2-3).

One objective of an SMS is the management of safety risk which "...is the projected likelihood and severity of the consequence or outcome from an existing hazard or situation" (ICAO 2013c, 2-27). A second objective is to manage risks that are associated with change.

### **2.7.2.1 Change Management and Latent Conditions**

ICAO requires airlines with a mandated SMS to identify and manage emergent risks.

The service provider shall develop and maintain a process to identify changes which may affect the level of safety risk associated with its aviation products or services, and to identify and manage the safety risks that may arise from these changes (ICAO 2013a, APP 2-3).

As the aim of most businesses is to make a profit, organisations continually strive to be more efficient, with a view to reducing costs (Kerr and Pauwels 2014). The airline industry is no exception to this, and with the industry's low profit margin the pressure to reduce operating costs is always there. However, this desire to reduce costs must be tempered with the realisation that the airline industry operates within a hazardous environment where circumstances can change very quickly. Whilst human failure is a major cause of aircraft accidents, company management is a contributory factor in aircraft accidents (Holloway and Johnson 2005). Potential failures in processes and procedures are referred to as latent conditions which can be caused by flawed decision making processes (Reason, Hollnagel and Paries 2006). An organisation with a large number of latent conditions has a high level of aleatory uncertainty with these conditions becoming apparent after an accident as a result of triggering factors (IATA 2013a). A list of latent conditions with specific examples are contained in Tables 9-5 and 9-6 in Appendix 2-3.

Changes involving safety risks require substantial risk management (ICAO 2013a). An example of a change made to an operating procedure, which was poorly managed due to inadequate risk assessment, is Qantas Airways Limited changing the standard landing flap setting from 30 degrees to 25 degrees, and the use of idle reverse thrust. On a long runway which is clear of any contaminant such as water, snow or ice which reduces the wheel braking capability, this procedural change could be acceptable.

However, a landing on a runway that is covered with a substantial amount of water, snow or ice will reduce the amount of friction between the wheels and the asphalt, requiring a substantial increase in the landing distance required.

An airline is a High Reliability Organisation (HRO) which requires its internal processes to be highly reliable, irrespective of the prevailing stress levels and on a repetitive basis; that is, they require a high level of ‘mindfulness’ (Weick and Sutcliffe 2001).

In 1996, as a cost saving measure, Qantas Airways changed the B747-400 standard landing configuration to Flap25/idle reverse thrust. It was believed at the time that as a direct consequence of this change the airline would save \$1,389,812 per annum (ATSB 2001). “On the 23rd of September 1999, at about 22:47 local time, a Qantas Airways Boeing 747-438 aircraft registered VH-OJH (call-sign Qantas One) overran runway 21Left (21L) while landing at Bangkok International Airport Thailand” (ATSB 2001, v). Initially, it was not considered financially feasible to repair the damaged aircraft, however, as Qantas Airways has never suffered a jet hull loss, the aircraft was rebuilt and became the “...biggest repair job in Australian aviation history, conservatively estimated to cost \$100 million” (Cheeseman and Sandilands 1999, 22). The ATSB investigation into this accident identified a number of significant active failures and latent conditions. One of the active failures was, “The flight crew did not use adequate risk management strategy for the approach and landing” (ATSB 2001, 117), and the latent condition to do with change management was, “The processes to manage the development, introduction, and evaluation of changes to operations were deficient” (ATSB 2001, 117).

### **2.7.3 Risk Management System**

ISO uses the term framework instead of system and defines a risk management framework as a “...set of components that provide the foundations and organisational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organisation” (2009, 2). A framework establishes how the organisation will view its exposure to risk, in addition to organising the required resources to ensure these risks are managed within the organisation’s risk criteria so as to achieve the organisation’s objectives (RMIA 2008).

The success of an organisation's risk management will depend inter alia on the ability of this framework being effective, appropriate, relevant and amenable to the various stakeholders' requirements (Talbot and Jakeman 2008). For this reason, no single framework can be applied to all organisations, and each organisation has to create their own framework in accordance with their internal and external requirements (AS/NZS 2009, 9). Unlike ICAO, who mandates what a SMS consists of, ISO (2009) does not dictate what a risk management framework contains; they do however publish an example of a framework and suggest organisations adapt it to suit their individual needs. A condensed version of this framework is in Table 9-10 contained in Appendix 2-8. In addition to the framework are the risk processes. These include the requirement for every organisation to establish its internal and external risk context; develop and implement risk assessment processes, which includes, risk identification, risk analysis and risk evaluation as well as how to treat the risk (ISO 2009). The integration of the three systems, QMS, SMS, and RMS is possible and is reviewed in the following section.

#### **2.7.4 Integrated Management System**

As a result of an airline's complexity, an airline can be described as a system of systems requiring a number of management systems to deliver their services (ICAO 2013c). ICAO (2013c) believes these separate systems could be merged into a single management system with the combined system referred to as an Integrated Management System (IMS), producing four potential benefits:

1. reduction of duplication and, therefore, of costs
2. reduction of overall organisational risks and an increase in profitability
3. balance of potentially conflicting objectives
4. elimination of potentially conflicting responsibilities and relationships (ICAO 2013c, 2-16).

As portrayed in Table 2-6, each of these management systems has a set of objectives related to their particular skill sets, as well as overlap between these systems. This may result in conflicts and uncoordinated efforts, resulting in sub-optimal results.

The development and implementation of an IMS may reduce FOR drift with the possibility of improving the likelihood of an airline achieving its objectives and its sustainability over the longer term.

**Table 2-6 Features of QMS, SMS and RMS**

System	QMS	SMS	RMS
Function	Quality	Safety	Risk
Role	Quality assurance <sup>3</sup>	Safety assurance <sup>4</sup>	Risk assurance <sup>5</sup>
Process	Quality control	Hazard identification and risk controls	Risk assessment
Culture	Quality culture	Safety culture	Risk culture
Objective	Compliance with requirements	Acceptable level of safety performance	Assessed risks remain within tolerable or acceptable regions
Guidance	Prescriptive	Performance based	Experience-subjective based
Method	Standards and specifications	Organisational and human factors	RMS framework
Strategy	Proactive	Reactive	Predictive

(ICAO 2013c, 5-29; ISO 2009).

These management systems have their individual objectives, however, collectively a key objective is to better manage operational risk and reduce risk drift. Airlines are required to provide the necessary resources to manage operational risk and if an airline's business risk is at a heightened level, that is, it has difficulty meeting its financial obligations, the funding to manage operational risk may be reduced.

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<sup>3</sup> Quality performance monitoring and measurement

<sup>4</sup> Safety performance monitoring and measurement

<sup>5</sup> Risk performance monitoring and measurement

### **2.7.5 Integrating Safety Obligations into Profit Objectives**

The airline industry must be very mindful of the hazardous environment in which it operates, and the need to generate an adequate profit to provide a level of safety to manage these hazards, in addition to providing a return to the shareholders. ICAO (2006b) understands this requirement to generate a profit as this organisation believes airlines are primarily motivated by commercial requirements and, to a lesser extent, operational safety requirements. However, it is not possible over the longer term for the airline industry to operate when these hazards have not been mitigated. This reinforces the need for safety management "...as a core business function that ensures an analysis of an organization's resources and goals and allows for a balanced and realistic allocation of resources between protection and production goals, which supports the overall service delivery needs of the organization" (ICAO 2009, 3-5).

A balanced and realistic allocation of resources in an environment today where these resources are very limited requires senior management to allocate enough resources to ensure acceptable levels of safety, but not so much that it would consume the airlines finite resources and increase the likelihood of bankruptcy. The two risks that have to be managed are:

1. FOR, where an adverse operational event may occur resulting in a loss to the airline.
2. business risk, which is the variability in an organisation's Earnings Before Interest and Taxes (EBIT). The nature of the organisation's operations causes it business risk, with this risk being affected by the firm's cost structure, product demand and competitive pressure from rivals (Petty et al. 1996, 356).

If the airline's EBIT is less than its interest payments for a sustained period of time, the business will cease to exist and bankruptcy of the firm will occur. This is especially relevant in the airline industry where a large amount of financial leverage is required due to the high capital cost of aircraft. As an example of this likelihood, in the USA, "...since the airline industry's deregulation in 1978 more than 200 airlines have filed for bankruptcy" (Yates 2013, par 2).

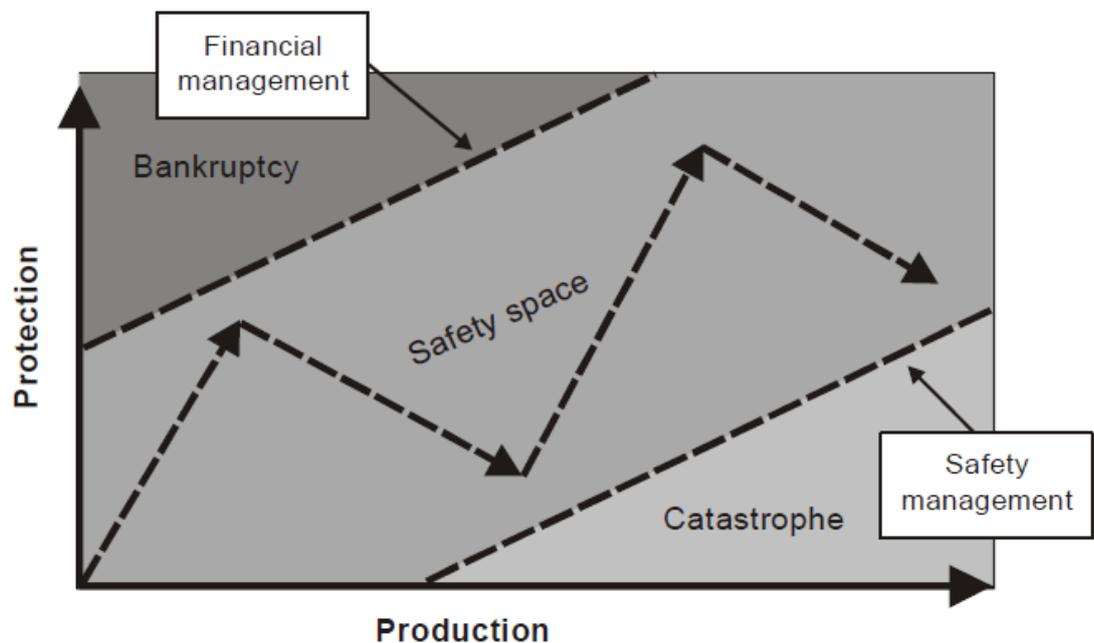
### 2.7.6 Safety Space

ICAO (2013c, 2-14), as portrayed in Figure 2-3, refers to the area between an airline suffering a hull loss or fatal accident and bankruptcy as ‘safety space.’ This space is an airline’s operational area; consequently, this study believes a more appropriate term is ‘operating space.’ This operating space consists of two parts. One part of the operating space is associated with FOR, with the outer limit delineated by an adverse flight operational event such as a hull loss or fatal accident. The other part of the operating space is associated with business risk, with the outer limit delineated by the bankruptcy of the airline.

The greater an airline’s EBIT is, inter alia, the lower the level of uncertainty regarding business risk and operational risk. Conversely, if the airline’s EBIT is negative for a sustained period of time, the airline’s financial reserves will be depleted, with the airline being debt funded with minimal equity.

Without risk management being embedded within the airline’s culture, policies and processes, and with the support of the Board of Directors and senior management, the airline will have a high propensity to maximise profit, with an associated reduction in safety resulting in an increase in operational risk and corporate governance issues.

Figure 2-3 Safety Space



(ICAO 2013c, 2-14).

## **2.8 Business Risk**

Airlines have to manage numerous risks which are ubiquitous in nature and are segregated into various categories, such as strategic, operational, financial, regulatory, information and external (McCarthy and Flynn 2004). If an airline were to mismanage these risks and negative outcomes were to occur, it is possible that at some point in the future, the airline may be unable to generate sufficient cash flow to fulfil its financial obligations and bankruptcy may occur. It has been argued that managing these risks will lower business risk by increasing cash flow and shareholder value (Amit and Wernerfelt 1990; Stulz 1996). As a consequence of these negative outcomes, such as reducing shareholder value, stakeholders increasingly require companies to identify and manage risk so as to protect and enhance shareholder value (Stulz 1996). This is extremely important in safety critical organisations where failures at the operational level can have dire financial consequences (Nomura 2003).

Two principal risks in the airline industry are operational risk and business risk, with this study focusing on FOR. These two principal risks are related as an increase in one may cause an increase in the other, consequently they must be managed in an appropriate manner for the airline to be sustainable over the longer term. An example of both of these risks emerging culminating in the collapse of the airline is Adam Air a now defunct airline as outlined in Table 2-7.

**Table 2-7 Combination of Flight Operational Risk and Business Risk at AdamAir**

Year(s)	Risk/action	Result
2006	Award winning airline	CAPA <sup>6</sup> LCC airline of the year.
2006-8	FOR, (poor safety management) (problematic flight/ops) (problematic maintenance)	Four serious incidents/accidents.
2008	Business risk (questionable management practises)	Difficulties funding insurance premiums, 12 of the 22 airline's aircraft grounded due to non-payment of leases, Significant additional debts.
2008	AOC permanently withdrawn.	Cessation of business

(Aglionby 2008; FSF. 2016; Guerin 2007).

One reason why business risk is a principal risk within the airline industry is the erosion of an airline's pricing power.

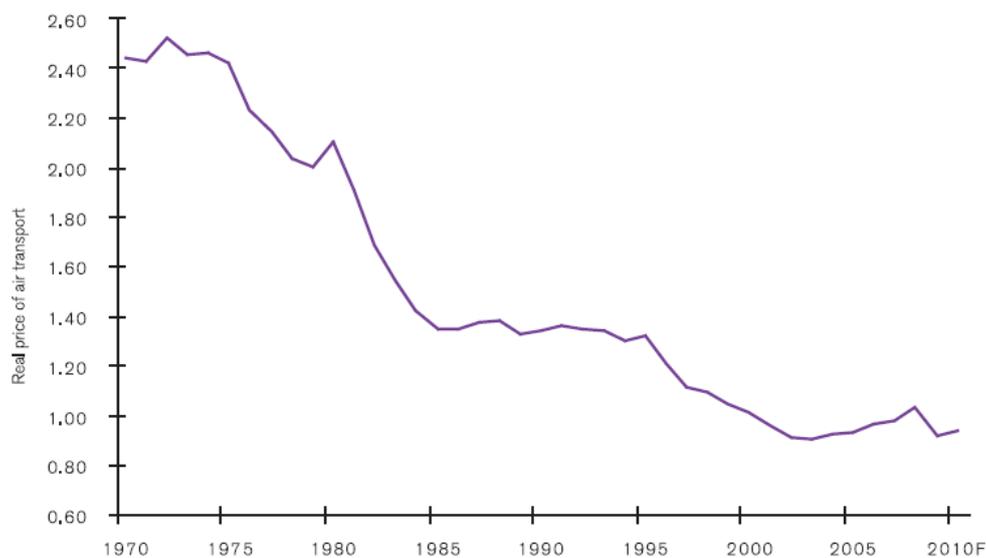
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<sup>6</sup> Centre for Asia Pacific Aviation (now referred to as CAPA-Centre for Aviation).

### 2.8.1 Erosion of Pricing Power

During the last 40 years, the global airline industry has generated a net profit of 0.1% of revenue; consequently, the shareholders of these airlines are not compensated for their cost of capital and, for this level of risk, it is approximately 8% (IATA 2011). Because of this poor financial performance, most airlines are unable to pay dividends or build equity into their balance sheets, resulting in an elevated level of business risk. With the global deregulation of the airline industry during this 40 year period, an additional 1400 airlines have been established (IATA 2011) which has led to a loss of pricing power across each of the market's segments. This reduction in pricing power, as well as dealing with established hazards such as economic recessions and new hazards such as terrorism, airlines were required to not only reconsider their yield management systems, but also their overall business model (Eldad B. Y. 2005). This reduction in pricing power has resulted in the substantial reduction in real terms of the price of air travel during this period as displayed in Figure 2-4.

**Figure 2-4 Real Price of Air Travel Over Forty Years**



(IATA 2011, 10).

A key requirement for risk management to be effective is for decision makers to make risk considered decisions (AS/NZS 2009) with this obligation being especially true in low profit margin businesses such as the airline industry.

### **2.8.2 Decision Making**

One of the principles of effective risk management is “decision makers make informed choices, prioritise actions and distinguish among alternative courses of action” Standards Australia/Standards New Zealand (2009, 7). This type of decision-making is along the lines of normative or rational decision-making theory, where the decision maker analyses a number of possible alternatives from different scenarios before making a choice using probabilities. By contrast, in descriptive theory a decision maker will utilise psychological elements to reach a decision (Oliveira 2007). In essence, normative theory is how people should make a decision and descriptive theory is how people actually make a decision (Hansson 1994). An example of a flawed decision-making process at the executive level, which can have a substantial flow-on effect with negative consequences across the airline, which inadvertently increases both the operational and business risks of an airline, is contained in Appendix 5-3.

## **2.9 Chapter Summary**

This chapter presented and discussed literature that are central to the study’s topic of managing FOR. The review is structured so the flow of information commenced with a discussion of risk and risk management including a key element of managing risk which is risk assessment. The following section reviewed operational risk management including elements such as ERM as well as organisational culture and its various sub cultures. This lead into a review of FOR management, with discussions on the various components of this risk. Regulatory compliance is a key aspect of the management of FOR which was reviewed, including the bureaucratisation of safety. The concept of risk drift was reviewed including three theories that contribute to risk drift. Airlines use management systems such as a SMS, and a QMS to help manage FOR which were reviewed including the possibility of airlines creating a RMS and integrating all three systems into a single management system referred to as an IMS. The final part of the chapter reviewed a second principal risk which airlines must manage which is business risk including a key component of risk management which is decision making.

### 3 Chapter Three Research Design and Methodology

#### 3.1 Introduction

This chapter presents an in-depth review of the methodology that was used in this study. Methodology is defined as a “...procedural framework within which research is conducted” (Remenyi et al. 1998, 285). The objective of this chapter is to articulate to the readers of the study how data was collected and analysed and, in doing so, how this data was transformed from a textual format into trustworthy findings. The journey from raw data to findings involved a large number of processes, procedures and assumptions, as well as articulating the researcher’s worldview and philosophical beliefs, all of which are included in this chapter. As “...terminology in academia is not consistent and at times can even be contradictory” (Crotty 1998, 1), the terms that were used in this study are defined, commencing with the research framework, which is reviewed in the following section.

#### 3.2 Research Framework

The research framework, which was created for this study, is outlined in the following sections and includes a detailed discussion of the research paradigm and research inquiry, in addition to the ontological, epistemological and methodological assumptions underpinning the study. The timeline outlining the key activities that were undertaken during the writing of the thesis are contained in Table 3-1.

**Table 3-1 Research Timeline**

<b>Phase</b>	<b>Activity</b>				
Year	Literature Review	Research Framework	Data Collection	Data Analysis	Thesis Writing
1- 2008	√	√			√
2 -2009	√	√	√	√	√
3 -2010	√	√	√	√	√
4 -2011	√	√	√	√	√
5 -2012	√			√	√
6- 2013	√			√	√
7- 2014	√			√	√
8- 2015	√			√	√
9-2016					√

### 3.2.1 Research Paradigm

The term paradigm within academic research is not clearly defined (Hussey and Hussey 1997), in this instance, this study's definition of a paradigm is "A philosophical and theoretical framework of a scientific school or discipline within which theories, laws, and generalisations and the experiments performed in support of them are formulated (Remenyi et al. 1998, 286).

When selecting a paradigm for a research study, Guba (1990) believes three questions must be asked:

1. what is the nature of reality?
2. what is the relationship between the researcher and the holder of knowledge?
3. what methodology will allow the researcher to obtain this knowledge?

To obtain a solid research design, the first question, which deals with the ontology of the research, must be answered so as to ensure the researcher's view on reality is compatible with the selected paradigm (Mills, Bonner and Francis 2006). Organisations such as an airline cannot exist without human involvement; hence it is difficult to measure phenomenon, in this instance the management of FOR, in an objective and universal manner (Orlikowski and Baroudi 1991). This is due to individuals employed by these airlines having differing perceptions and opinions, resulting in multiple realities. Consequently, the paradigm that is selected must accommodate the belief that there is more than a single objective reality. These different views result in the occurrence of multiple realities and, whilst it may be difficult to assess these multiple realities in an objective and universal manner, they can be interpreted. Therefore, given these multiple realities and the investigative nature of the research, as well as the noted absence of previous empirical data and the need to gain a deeper understanding of the research area or 'verstehen' as it is sometimes termed (Creswell 1998; Firestone 1987), the interpretive paradigm, in conjunction with a phenomenological inquiry, was utilised for this study.

The strength of an interpretive paradigm is that it "...describes and explains the researched phenomenon so it can be diagnosed and understood leading to the creation of knowledge through the inductive process" (Gioia and Pitre 1990, 591). This approach is also supported by Remenyi and colleagues who claim that an approach such as this "...is more likely to provide relevant and useful answers with regard to research involving people and organisations in the world of business and management (1998, 35). An airline's history and culture has an influence on interviewee's perceptions and opinions of the phenomenon being researched, resulting in subjective based realities. This paradigm, inclusive of the phenomenological inquiry, allows these realities to be collected and analysed by the researcher (O'Brien 1998; Walsham 1995). The interpretive paradigm breaks away from the constraints imposed by the positivist paradigm such as a single objective reality (O'Brien 1998) and allows the researcher and the interviewees to generate a shared understanding of the phenomenon (Rowlands 2005) through social constructions such as language and shared meanings (Berger and Luckmann 1967; Berntsen, Sampson and Østerlie 2004; Orlikowski and Baroudi 1991). This shared understanding of the phenomenon being investigated was achieved by utilising a phenomenological inquiry and is discussed next.

### **3.2.2 Research Inquiry**

During the data-gathering phase, a large amount of textual data was collected. To assist in generating an authentic and trustworthy interpretation of this information, a phenomenological inquiry was employed, with the objective of improving the "...understanding of the subjective nature of this lived experience from the perspective of those who experience it, by exploring the meanings and explanations that individuals attribute to their experiences" (Cope 2005, 168).

Phenomenology is located within the broad structure of the interpretive paradigm (Holstein and Gubrium 1994) and, whilst phenomenology can be referred to as a paradigm, a philosophy or a perspective (Patton 1990), it is utilised within this study as a research perspective where subjectivity is inextricably involved in the process of objective theory emerging (Moran 2000). Defining phenomenology in a comprehensive manner is not an easy task (Giorgi 2009, 8).

The phenomenology used in this study is a contemporary version adopting the view of Crotty (1998) where "...researchers are interested in everyday experience...presented as an essence distilled from everyday accounts of experience, a total picture synthesised from partial accounts" (Crotty 1998, 83). Crotty claims that there are two requirements in contemporary phenomenology.

1. Researchers have to be objective rather than descriptive and also uncritical; that is to set aside their own beliefs. This is to ensure the themes that emerge are from the data and not the researcher's presuppositions and to ensure this occurs, the researcher's beliefs and presuppositions have to be bracketed.
2. Researchers are required to study experiences from the perspective or point of view of the interviewee without corrupting the subject (1998, 82-83).

Remenyi and colleagues state "...the essence of phenomenology is an attempt to delve below the surface to understand the essence of what is happening"(1998, 96). To capture this essence, data from semi-structured interviews is required to be enriched by personal accounts of the phenomenon under study from participating employees (Remenyi et al. 1998). This was the case in this study as the interviewees were very forthcoming in expressing their beliefs with regard to the management of FOR within their respective airline. A phenomenological inquiry was the dominant connecting strategy used within the analytical framework and is further discussed in that section. Researchers utilising the interpretive paradigm require interpretive skills such as imagination and creativity contained within a rigorous analytical framework to produce trustworthy findings (Remenyi et al. 1998). Having stated the researcher's interpretive skills are important, it is of equal importance for the researcher to articulate their ontological and epistemological assumptions in the research (Berntsen, Sampson and Østerlie 2004) and these are disclosed in the next section.

### **3.2.3 Philosophical Assumptions**

As part of any research project, a discussion of philosophy is essential (Remenyi et al. 1998, 1) so as to allow the readers of the study to understand the philosophical assumptions of the researcher as well as the study's contribution to the body of knowledge. There are multiple ontological and epistemological assumptions within the spectrum of the interpretive paradigm (Blaikie 2007, 180). The ontology of cautious realism and the epistemology, primarily of empiricism with some rationalism, underpin this study for the following reasons.

#### **3.2.3.1 Ontological**

Ontology is a study of what is reality (Orlikowski and Baroudi 1991; Appleton and King 1997). When studying phenomenon, ontological beliefs are categorised into two groups:

1. the world is said to be objective; that is, it exists independently of human thought.
2. the world is subjective and reality only exists within human thought (Orlikowski and Baroudi 1991).

The most appropriate ontology for this study is cautious realism, as this ontology accepts an independent external reality exists; however, as the human brain has limitations, caution is required to ensure the ultimate reality has been captured (Blaikie 2007). Whilst there is an independent external reality, phenomenon can be interpreted differently by the various actors in the research, resulting in differing perceptions and opinions. This is in line with the interpretive paradigm where there is no objective social reality but rather multiple realities (Bailey 2007). These realities are derived from the researched, the researcher and the readers of the research. As a consequence of these multiple realities, cautious realism is the ontological assumption for this research as it occupies a central position on the ontological spectrum "...where reality exists independent from human cognition (noumena) as well as dependent on the human mind (phenomena)" (Becker and Niehaves 2007, 202).

### **3.2.3.2 Epistemological**

Epistemology is the science or theory of knowledge and is derived from the Greek word 'episteme' (Magee 1987).

The two dominant epistemological positions in philosophy: are "...empiricism, which relies on observations and experiments and rationalism which uses mathematics and logic to judge knowledge claims" (Blaikie 2007, 21). The epistemological assumption in this research follows the Kantian doctrine of duality of intuition and concept whereby the bulk of the knowledge that was acquired is experience based and referred to as posteriori or empirical knowledge. However, some knowledge will be rational which requires intellectual thought and is referred to as a priori knowledge (Becker and Niehaves 2007, 202). With this epistemological assumption, the researcher's pre-existing assumptions, values and beliefs guide the research and, combined with the interpreted data obtained from the research participants, knowledge is obtained (Khazanchi and Munkvold 2002) through the creation of theory from practise which is then added to the management of FOR's body of knowledge.

### **3.2.3.3 Methodological**

This study adopted a strategy of "...inductive analysis where detailed readings of the transcribed data was conducted allowing categories, concepts and knowledge in the form of trustworthy findings and theory to emerge as the analysis proceeded" (Thomas 2006, 238). This is in line with Strauss and Corbin's belief in which the researcher "...begins with an area of study and allows the theory to emerge from the data" (1998, 12). This strategy is supported by the belief that interpretive research does not assume outcomes, but rather makes sense of them as the findings emerge (Kaplan and Maxwell 1994). This process is iterative, so as to allow confirmation or otherwise of the structure and processes of the observed organisations and, in addition, allowing a substantive theory to emerge from the data (Gioia and Pitre 1990). This study was exploratory in nature and produced nominal rather than numerical data. Consequently, a qualitative method was used which is discussed next.

### **3.2.4 Qualitative Method**

A review of the attributes and limitations of both quantitative and qualitative methods was conducted to determine what method was most suitable for this study.

Quantitative research utilising the positivistic paradigm is the dominant method in conducting organisational research (Remenyi et al. 1998, 256). However, over time the interpretive paradigm utilising qualitative methods has emerged to challenge the supremacy of the positivistic-quantitative methods (Orlikowski and Baroudi 1991; Walsham 1995a). Cassell and Symon (2006) note that those researchers who are committed to the quantitative methods which utilise positivist epistemology are, at times, hostile to research conducted using qualitative methods. Quantitative methods have their origins in the natural sciences where there is a single objective reality which can be identified by using quantitative methods using statistical data. What separates the social sciences from the natural sciences is people talk (Myers 1997) and, therefore, multiple subjective realities arise, challenging the concept of a single objective reality. The information flow from interviews conducted for this study were enriched with opinions and perspectives from the interviews, supplying rich data which required a textual, rather than a numerical, method to capture the essence of what was occurring within the concerned airline regarding the management of FOR. There is however, merit in both approaches (Firestone 1987). Researchers adopting a qualitative method “...emphasise the value-laden nature of the inquiry whereas proponents of a quantitative study operate within a value-free framework” (Denzin and Lincoln 2005, 10).

The dominance of the quantitative method in business research is confirmed by a study conducted by Azorín and Cameron (2010). This study reviewed 272 empirical articles published between the years 2003-2009 in the *Journal of Organizational Behaviour*. 235 of these articles utilised the quantitative method, 20 utilised a mixed method and 17 articles adopted a qualitative method, as per Table 9-12 in Appendix 3-1. This evidence supports the belief that quantitative method is the preferred method when conducting organisational research.

Based on the evidence of quantitative method being the dominant method in organisational research, strong consideration was given to adopting a quantitative method for this study. However, this option was ultimately rejected in favour of a qualitative method which was deemed the most appropriate method due to the study's exploratory nature. This is due to the fact, many of the questions were unknown before the data collection process began and only emerged during the data gathering and analytical phases and, as a result, it was not possible to create an in-depth questionnaire. In addition, it was anticipated that during the data-gathering phase many of the interviewees would be forthcoming with their perceptions on how they perceived the phenomenon under discussion and, in doing so, would supply rich data which would be more suited to a qualitative method. Case studies is the study's methodology which is presented in the following section.

### **3.2.5 Case Studies**

This research is exploratory in nature which makes this phenomenological methodology appropriate as case studies are considered exploratory in nature which investigate topics that have few theories and a limited body of knowledge (Hussey and Hussey 1997). A case study is defined as "...an extensive examination of a single instance of a phenomenon of interest" (Hussey and Hussey 1997, 65). There are a number of reasons why a case study methodology was selected for this study. Case study research produces a large data set which requires a substantial amount of iterative data analysis. This suited the researcher as a guiding belief was to collect as large amount of data as possible and distil it through the analytical processes to concepts and findings and eventually theory. This belief of acquiring as much data as possible led to a number serendipitous discoveries both during the data collection and analysis stages.

An issue with case study based research that has to be resolved is, how many cases should be included in the study? According to Eisenhardt (1989) there is no correct number, however, "...a minimum of four is required as any less may result in the generated theory lacking complexity and not empirically grounded...and no more than ten as managing the volume and complexity of data becomes difficult" (Eisenhardt 1989, 545). The researcher's belief from the outset was gaining access to airlines for this study would be problematic, consequently the number of cases was set at four.

The objective of organisational research is to develop theory, and most empirical studies cycle from theory to data, (Eisenhardt 1989) whereas this study is inductive and moves in the opposite direction from data to theory. Case studies “...are appropriate for this type of theory generation as it new and not based on previous data or literature...and provides insights during the early stages of a research area” (Eisenhardt 1989, 545). This section described the appropriateness of the case study, with the following sections describing how the data was collected and analysed from the four cases involved in the study.

### 3.3 Data Collection

The Asia Pacific Region in this study is defined as those countries that are included in the Area of Responsibility of the Asia and Pacific Office of ICAO. This area of responsibility includes 38 countries covering a large amount of airspace containing 50 Flight Information Regions (FIRs) (ICAO 2013b). This region contains substantial diversity and with this study requiring four airlines<sup>7</sup> it is not possible to capture this extensive diversity with this limitation being documented. However, the airlines that participated in the study possess different management styles, cultural backgrounds, including national, organisational, and safety cultures from different areas of the Asia Pacific Region and service different segments of the market.

Primary data was gathered from employees of the four airlines from this region through 71 semi-structured interviews and secondary data was obtained from reviewing operational manuals such as the Flight Operations Manual (FOM).

Obtaining approval from four airlines to conduct an extensive investigative study on this topic proved to be extremely difficult. There are three reasons for this, which are:

1. the airline industry is highly competitive, consequently the management of these organisations are reluctant to expose their internal operating systems, especially to a researcher employed by a major competitor.
2. organisations that require their internal operations to have a high degree of reliability, such as an airline, are very reluctant to allow researchers access to their internal systems (Weick and Sutcliffe 2001).
3. two airlines that were approached stated they would like to be involved in the research, however due to the Global Financial Crisis (GFC) all the airline's resources, including employee's time, was focused on survival.

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<sup>7</sup> As per the candidacy proposal

At the beginning of 2009, six airlines from the Asia Pacific Region were invited to participate in the study; one of these airlines accepted the offer and was coded Airline A1. The invitations sent to the remaining five airlines were implicitly or explicitly declined. In June 2009, data collection commenced from Airline A1 with offers sent to other airlines. Eventually three more airlines accepted the invitation and, in January 2011, the data collection phase came to an end.

The four airlines involved in the study have been de-identified and are referred to as Airline A1, Airline A2, Airline A3 which includes data obtained from Airline A3-1, which operates propeller-powered aircraft and has an association with Airline A3 and Airline A4. To provide the readers of this report a limited perspective regarding these airlines, basic data are provided in Table 3-2.

**Table 3-2 Airline's Operational Information**

<b>Airline A1</b>		<b>Airline A2</b>
Domicile	Asia	Asia
Size	Medium	Large
Aircraft	Narrow and Wide Body	Wide Body
Network	Regional	Regional, Long Haul
Interviews	21	22
<b>Airline A3 and Airline A3-1</b>		<b>Airline A4</b>
Domicile	South Pacific	Australasia
Size	Small	Medium
Aircraft	Propeller, Narrow and Wide Body	Narrow and Wide Body
Network	Domestic, Regional, Long Haul	Domestic, Regional, Long Haul
Interviews	13	15

When conducting research utilising qualitative methods, the key tool to gathering data is the interview (Cassell 2005) and the processes involved in this stage of the study are presented in the next section.

### **3.3.1 Interviews**

The interview is the most common form of data collection in qualitative studies (King 2004) and was chosen as the primary method of obtaining data due to the potential for an in-depth focus on the topic (Tellis 1997). This is particularly true when additional dialogue is entered into when using the interpretive paradigm (Bailey 2007). This additional dialogue was obtained as the interviewees were very open and forthcoming in their responses to the questions. The intention when carrying out the field research component was to conduct semi-structured interviews with as many of the internal stakeholders of the management of FOR of the concerned airline as possible. The interviews were conducted on a face-to-face basis in the offices of the flight operations division of the concerned airlines, domiciled in various parts of the Asia Pacific Region. The 21 interviews conducted at Airline A1 required three separate visits to obtain access to all of the interviewees due to their respective work and travel commitments. The remaining three airlines required single visits and each visit was comprised of a period of four to five days. Prior to each visit, the management of each of the flight operations divisions and associated departments from the four airlines advised staff members of the researcher's impending visit. In the case of Airline A1, A2, and A4, a suitable room had been set aside for the interviews; with Airline A3, the interviews were conducted at the interviewee's workstation. The flow of information from the employees interviewed at their workstation was judged to be un-impeded as the interviewees were not concerned about their work colleagues being able to hear their narratives. Participation was voluntary and the employment title of the interviewees from the four airlines is contained in Table 9-13 in Appendix 3-2. The large number of interviews that were conducted is indicative of the strong interest amongst these employees in putting forward their views, opinions and perspectives on the phenomenon under study. All interviews were aurally recorded using digital technology for ease of transfer and storage. All of the interviewees were advised that the interview was going to be recorded and all interviewees agreed to this condition. Indeed, as the interviews progressed, the recording device that was turned on at the beginning of each interview appeared to be of no significance to the interviewees as they paid no attention to the device.

At the beginning of each interview, the interviewees were provided with an information package containing a participant information sheet outlining the study objectives and confirming the confidentiality and ethical requirements of the study, as well as contact details for the researcher, supervisors and Curtin University. Each interviewee completed an interviewee data sheet and signed and dated a consent form. A copy of the 'participant information sheet' and a 'consent form' are contained in Appendix 3-3. Data pertaining to the gender and education levels of the interviewees was collated and is contained in Table 9-14 in Appendix 3-4. A copy of the 'interviewee data sheet' is included within the interview guide, which is contained in Appendix 3-5.

Before the interviews started, all of the interviewees were informed that there were no correct answers to any of the questions and they should respond as if they were narrators putting forward their views and perceptions (Chase 2005) on the subject of managing FOR. As these interviews were conducted through the lens of a phenomenological inquiry it was imperative that the interviewer set aside any presuppositions, or as Moustakas refers to as 'epoche,' which "...is a Greek word meaning to refrain from judgement...and to revisit phenomena in a fresh and open sense" (1994, 33).

At the completion of each visit to the airlines the interview recordings were electronically sent to a professional transcription service and were transcribed verbatim, including the insertion of pauses, background noise and, if the transcribers were unsure of a word, a time stamp was inserted.

To improve the trustworthiness of the findings from this study, a large number of direct quotes from the interviewees are included in Chapter Four Analysis.

Each direct quote is referenced to the appropriate interviewee with an abbreviated code which are contained in Table 3-3 with the methodology to decipher this code contained in Figure 3-1.

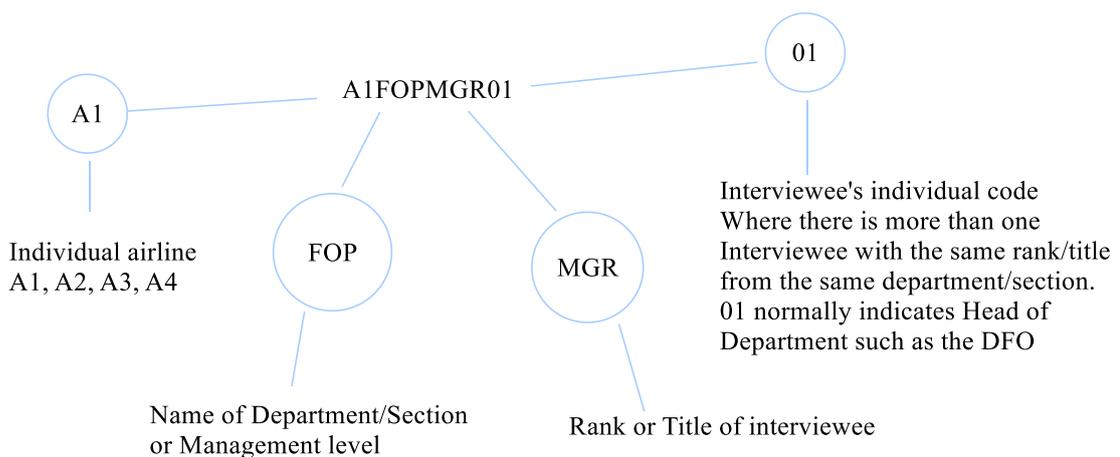
**Table 3-3 Interpreting Interviewee's Reference Code**

Code	Meaning	Code	Meaning
EXC	Executive Management	CEO	Chief Executive Officer
FOP	Flight Operations Division	COO	Chief Operating Officer
SAF	Safety Department	MGR	Manager
QLY	Quality Department (Section)	CHK	Check and/or Training Captain
RSK	Risk Department (Section)	CAP	Line Captain
HUF	Human Factors Department	COP	First Officer (Co-Pilot)
PER	Performance Department (Section)	COR	Risk Coordinator
CAB	Cabin Services Department	-----	-----

Each interviewee that is directly quoted in Chapter Four Analysis has been allocated their own reference code consisting of ten alphanumeric characters.

Using the reference *A1FOPMGR01* as an example, Figure 3-1 deciphers the ten characters.

**Figure 3-1 Deciphering an Interviewee's Reference Code**



An interview guide was developed and utilised during the interviews and is discussed in the next section.

### **3.3.2 Interview Guide**

Given the limited amount of external research in this area, the overriding requirement of the interviews was to obtain data in an exploratory manner, yet still focus on addressing the central research question. Development of the interview guide was based on existing literature, including similar previous research and industry sources such as the Checklist for Assessing Institutional Resilience (CAIR) which is a score card for assessing an organisation's safety culture (Reason 2000). The guide covered the functional areas of risk management within an airline such as risk, quality, safety, compliance and flight operations, as well as executive management, and ensured relevant questions were asked dependent upon the interviewee's job function. As a method to improve the interview guide, interviews were conducted with three experienced airline captains from the Asia Pacific Region before the commencement of data collection. In addition to their responsibilities as captains, these individuals have additional areas of expertise in the areas of training and standards, as a CRM facilitator conducting non-technical skills workshops and in quality assurance. After each interview, the guide was amended prior to the collection of any data. A copy of the interview guide is presented in Appendix 3-5.

#### **3.3.2.1 Pilot Study**

No pilot study with the airlines was conducted as obtaining approval from four airlines to enter their premises and conduct interviews with their operational staff for a period of a week was considered by the researcher to be about the limit to what an airline would accept. To include a pilot study to scope the questions would extend the visitation period by a number of days and in doing so would endanger the prospect of obtaining the required data.

Data analysis was ongoing during the data collection phase and continued for a considerable period after the collection phase concluded. Details about how the data was analysed are presented in the next section.

### 3.4 Data Analysis

As this study was exploratory in nature, investigating operational risks centric to flight operations, a thorough analysis of this subject required a deep and broad investigation canvassing the perceptions of a large number of stakeholders. The comments of these stakeholders obtained during semi-structured interviews were analysed using the phenomenological method and, to present as clear picture as possible to the readers of this study, the analysis has been distilled to a point where only essential knowledge is presented, and at the same time, retaining a broad spectrum covering the domain of these risks.

A key aspect in data analysis is to state the unit of analysis which "...in a study is the level of abstraction where you look for variability and the most commonly used unit in social-behavioural research is the individual" (Guest, Namey and Mitchell 2013, 26). When deciding on the unit of analysis, it is considered imperative that the researcher pinpoints whether the findings relate to individuals, groups, communities or organisations (Patton 2002). In this study, the perceptions and knowledge is held by the interviewees and, as a result of this, the comments of the interviewees are the units of analysis.

In this study, 71 semi-structured interviews were conducted resulting in excess of 46 hours of recorded transcripts. For this large amount of raw data to be converted into meaningful findings, a substantial amount of structured processing was required, as the human brain is not good at processing large amounts of information, especially in a printed format such as this (Just 2010). As a consequence of this limitation, a large amount of printed data should be reduced into easily understood parts and form part of an analytical framework which is discussed in the next section.

### 3.4.1 Analytical Framework

In qualitative research, methods do not have a ‘standalone integrity;’ that is, they will not produce the desired outcomes by themselves (Smith, Flowers and Larkin 2009). What is required, *inter alia* for this to occur, is the creation of an analytical framework. The framework created for this study follows a three-step process where, initially, the data was segregated into categories through fracturing processes. Secondly, this fractured data was connected by identifying relationships using a phenomenological inquiry within these categories allowing concepts to emerge. As a triangulation method, these same concepts were further analysed utilising a cognitive mapping technique producing key terms that are applicable to this study. When constructing an analytical framework Maxwell (2005) states that the method(s) and components should be compatible and coherent to ensure the research question and sub-questions are answered with valid conclusions. The research framework that was created for this study is specifically intended to answer the research question and the associated four sub-questions.

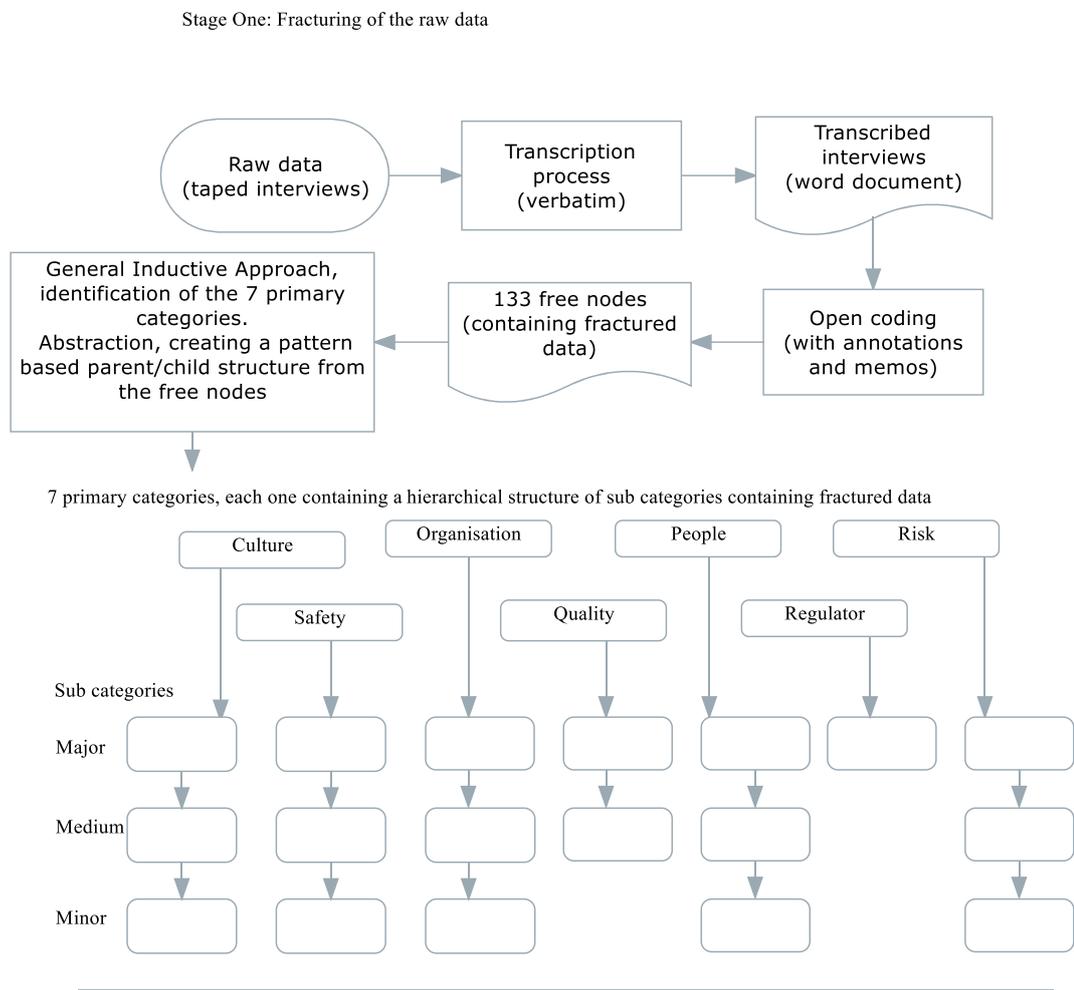
Three strategies were implemented in the analytical process:

1. memo writing: guided by Neuman (2003), extensive analytic memos and annotations were written from the beginning of data collection through to the findings emerging. This allowed for strong reflective practise to foster generation of links between the theoretical concepts.
2. categorisation: categorising through coding which is a process whereby “...data are fractured, conceptualised, and integrated to form theory” (Strauss and Corbin 1998, 3). The objective of this process is to identify categories, develop them and, in doing so, establish the building blocks of theory (Moghaddam 2006; Piantanida, Tananis and Crubs 2002). As part of the data reduction process, data was fractured using a combination of coding techniques drawn from grounded theory (Strauss and Corbin 1990) and a general inductive approach (Thomas 2006).
3. identification of relationships: the third strategy was one of connecting where, instead of ‘fracturing’ the text as in the categorizing strategy, relationships between elements from the interview transcripts were identified (Maxwell 2005).

There are a number of connecting methods available such as case studies (Stake 1995; Yin 2003), profiles and vignettes (Seidman 1998), and discourse analysis (Rapley 2007). However the researcher’s intention was to follow the advice of Remenyi and colleagues who point out that when conducting organisational research, it is necessary “...to delve below the surface to understand the essence of what is happening” (1998, 96). As a consequence of this requirement, the connecting method used in this study was the phenomenological inquiry in association with cognitive mapping.

The flow of information from raw data, in the form of transcribed interviews, through the associated processes to fractured data is depicted in Figure 3-2.

**Figure 3-2 Information Flow from Data to Findings**



### **3.4.2 Stage One-Data Fracturing**

#### **3.4.2.1 Open Coding**

Open coding is the initial phase of data analysis involving opening up lines of inquiry (Straker 2011) and the creation of categories, as well as describing the overall features of the phenomenon under investigation (Barker et al. 2002). This was achieved by reading each line of the transcribed interviews and, at the same time, questioning the data to obtain identification and naming of the nodes. In association with open coding, it is considered essential to write memos which are observations or thoughts obtained from analysing the data (Moghaddam 2006). At the completion of open coding there were 133 categories and a large number of memos and annotations. These categories are the same as free nodes used in NVivo10; that is, they do not belong to any structure. The labels of these 133 free nodes are displayed in Figure 9-3 in Appendix 3-6. Consequently, relationships and associated linkages also needed to be identified between these free nodes to create a hierarchical structure, which allowed the analysis to proceed in a structured and orderly manner.

#### **3.4.2.2 General Inductive Approach**

At the completion of the open coding phase where extensive readings of the transcripts were conducted, a process was required to identify the key categories from the 133 free nodes. The process used in this study to achieve this objective was the general inductive approach. The desired outcome of this approach was to "...identify the categories which are most relevant to the research objectives and was achieved by identifying the core meanings that are contained in the data" (Thomas 2006, 241). The objective here was to ensure that a maximum of eight categories were identified, any more than eight and this inductive coding process was considered to be incomplete (Thomas 2003). Following this advice, seven categories emerged from the 133 free nodes. This reduction was achieved by following Creswell's (2002) and Neuman's (2003) advice in terms of reading the transcripts, identifying specific segments of information, labelling these specific segments and reviewing the labels on these free nodes and, at times, the text contained within them. These seven categories required further analysis to segregate the fractured data into subcategories. This was achieved through a process referred to as 'abstraction' where data contained in the free nodes was matched with similar data from other free nodes resulting in the formation of subcategories.

This "...involved putting like with like and developing a new name for the subcategory" (Smith, Flowers and Larkin 2009, 96). Table 3-4 displays the names of the seven primary categories and the number of their subcategories referred to as major, medium and minor. The ranking of the subcategories was based on the perceived level of importance of the fractured data by the researcher. Fractured data that was considered paramount was placed in the major category, data that was subservient to this data was placed in the medium category, and data that was considered to have the least level of importance, or data that was considered subservient to data housed in the medium category, was placed in the minor category.

**Table 3-4 Primary and Associated Subcategories**

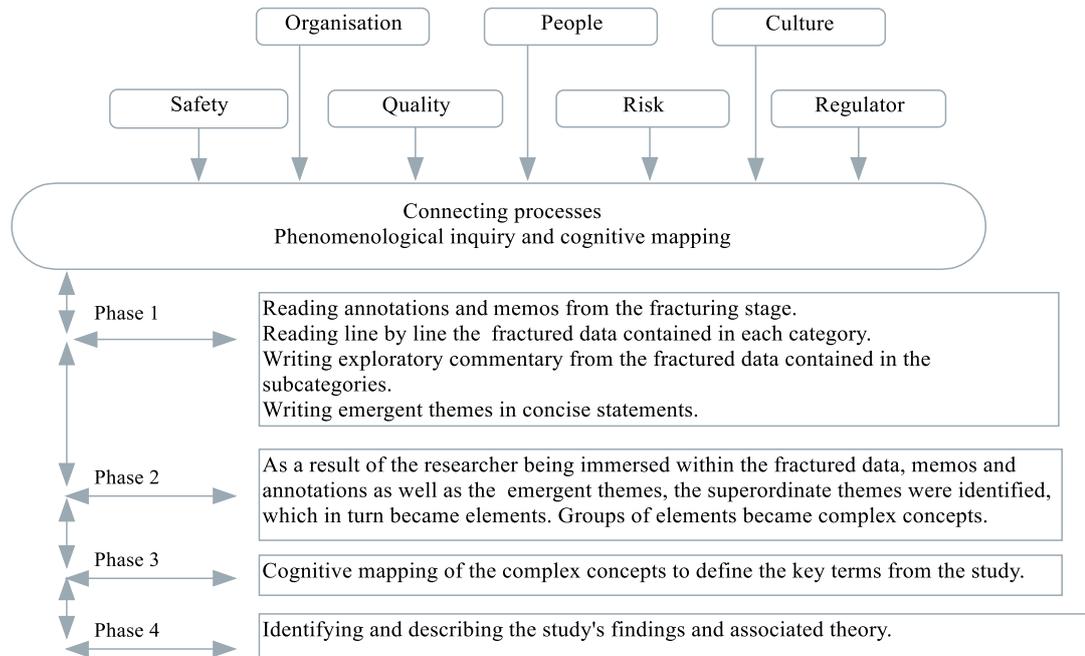
<b>Categories</b>	<b>Major</b>	<b>Medium</b>	<b>Minor</b>
Culture	3	4	1
People	8	11	15
Organisation	8	28	10
Risk	9	23	31
Safety	8	7	1
Quality	8	1	0
Regulator	2	0	0

At the completion of stage one, where a hierarchical structure of seven categories and associated subcategories containing the fractured data had been created, the analytical framework was progressing which allowed the second stage of the analysis process of connecting to commence.

### 3.4.3 Stage Two- Data Connecting

The connecting methods utilised in this study were the phenomenological inquiry and cognitive mapping. This connecting stage consisted of four phases as displayed in Figure 3-3.

**Figure 3-3 Stage Two-Data Connecting**



Phenomenology allows the researcher to delve beneath the surface to understand the essence of what is happening within the organisation with regards to a particular phenomenon (Remenyi et al. 1998). What is required for connecting methods to be successful is for the researcher to "...look for relationships that connect statements and events within a context into a coherent whole" (Maxwell 2005, 98). These connecting methods were successful in this study as the connected statements within a certain context emerged to become the elements and these elements then combined to become a coherent whole in the form of a concept. These concepts are classified as complex concepts as they consist of multiple subparts in the form of elements (Neuman 2003).

Whilst a phenomenology inquiry was selected as the dominant connecting method for this study, there is a limitation to using this method, which is “...phenomenology is notorious for the fact that practically all of the major philosophers in the movement differ substantially from one another” (Giorgi 2009, 94). For this reason, studies that utilise a phenomenological inquiry should state which version of phenomenology is used. Consequently this study has adopted Crotty’s (1998) style of phenomenology with the analytical processes adapted from Interpretive Phenomenological Analysis (IPA) (Smith, Flowers and Larkin 2009), as the research elements of IPA and this study are similar, as outlined in Table 3-5.

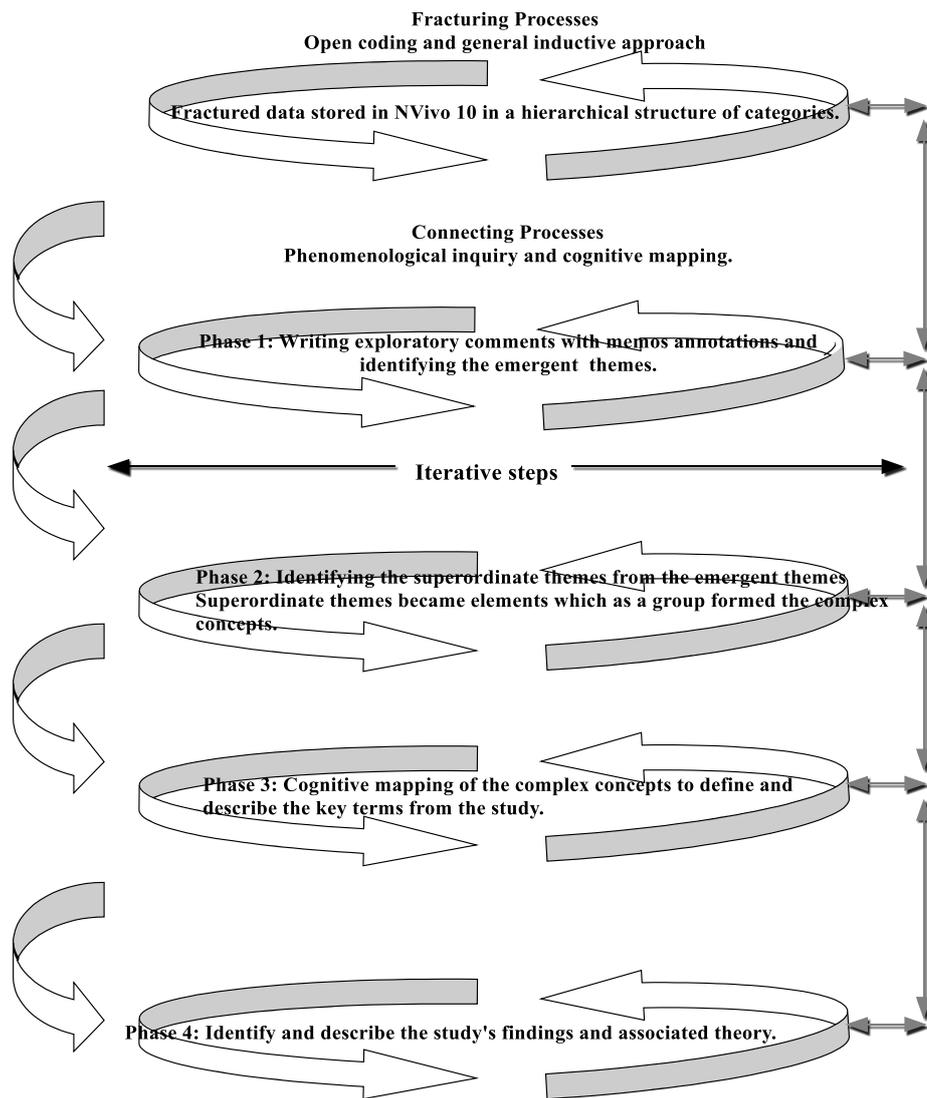
**Table 3-5 Common Elements between IPA and this Study**

<b>Research elements</b>	<b>IPA</b>	<b>This Study</b>
Inductive	√	√
Exploratory	√	√
Open research question	√	√
Small number of a priori theoretical constructs	√	√
Interpretive	√	√
Phenomenological	√	√

IPA is an interpretive phenomenological approach which is used to analyse texts; the interpretive element to this approach utilises hermeneutics. In this study, hermeneutics was limited to the use of the hermeneutic circle/spiral, which is a metaphor to describe how the researcher moves between reading and interpreting parts of the text and then interpreting it within the context of the whole text. This process of reading and interpreting was not linear but, rather, iterative, meaning that it required a large amount of reading and re-reading of the text and, in doing so, the interpreter became part of the circle with an emergent understanding of the phenomenon (Crotty 1998; Thompson, Pollio, and Locander 1994). Schokel and Bravo (1998, 74) argue that a more appropriate term should be ‘hermeneutic spiral’ rather than ‘hermeneutic circle’, as the word circle indicates circulatory or circumference which, in turn, indicates a closed sphere. On the other hand, a spiral is expanding, embracing new concepts and allowing for a heightened level of understanding.

This increased level of understanding was achieved through the iterative nature of hermeneutics whereby the researcher revisited the text both in part and as a whole on numerous occasions, increasing the interpreters understanding of the phenomenon (Dallmayr 2009). In this study, both circles and a spiral were utilised in the analytical process of interpreting the interview data. This hermeneutic spiral, with its accompanying five hermeneutic circles, is graphically portrayed in Figure 3-4.

**Figure 3-4 Hermeneutic Circle/Spiral.**



The four phases of the connecting stage are described in the following section with phase one consisting of two parts, writing the exploratory comments and identifying the emergent themes.

### **3.4.3.1 Phase One-Exploratory Comments and Emergent Themes**

#### **3.4.3.1.1 Exploratory Comments**

These exploratory comments are sourced from the fractured data contained in the major, medium and minor subcategories housed within the seven primary categories, as well as the interview transcripts themselves. They are predominately descriptive in nature, although some conceptualising of the transcripts through documentation of the thoughts of the researcher using memos and annotations was also included. So as not to taint the data, the researcher's knowledge and presuppositions were bracketed to ensure all themes were in fact sourced from the data (Crotty 1998, 83). IPA is idiographic, that is it is concerned with individuals, or small samples, rather than nomothetic which deals with larger numbers, such as within a group or population (Smith, Flowers, and Larkin 2009, 29). Researchers considering using IPA should be aware of the heavy workload that is required when dealing with a large data set. For example, the exploratory commentary document in this study contained in excess of 140,000 words. After contemplating these texts, the exploratory commentary was digitally recorded and transcribed. The word count from each of the seven primary categories is contained in Table 3-6. One advantage to such a large data set is that it improves the likelihood of producing confirmable findings as the data is triangulated, having been sourced from a large number of interviews.

The key to IPA is to have an in-depth knowledge of the data and, for this to occur, the researcher has to have an intimate knowledge of the fractured data contained within the categories.

**Table 3-6 Exploratory Word Count**

<b>Category</b>	<b>Word Count</b>
Culture	13,304
People	22,831
Organisation	23,055
Quality	5,533
Regulator	1,372
Risk	62,572
Safety	12,359
Total	141,026

The second part of the first phase of the connecting stage was to identify emergent themes from the data.

#### **3.4.3.1.2 Emergent Themes**

Creating emergent themes from data "...requires an attempt to produce a concise and pithy statement of what was important in the data. Emergent themes reflect the participants original words and thoughts and the analysts interpretations and feel like they capture and reflect an understanding" (Smith, Flowers and Larkin 2009, 92). During the writing of the exploratory commentary, memos and annotations were written allowing the researcher to conceptualise the genesis of the emergent themes. This process was aided by the researcher moving between the transcribed interviews and the exploratory commentary and, because of this iterative process of reviewing these data sources, a large number of emergent themes were identified, with each of the primary and subcategories producing a combined 1,244 emergent themes. The emergent theme count from each of the seven categories are contained in Table 9-15 in Appendix 3-7. Following the identification of these emergent themes, the second phase of connecting occurred, which identified the superordinate themes.

### **3.4.3.2 Phase Two-Superordinate Themes and Elements**

IPA uses a number of possible techniques to identify superordinate themes from the large number of emergent themes. It is, however, acknowledged by IPA that these steps do not necessarily have to be followed as there is no clear right or wrong way to conduct this analysis (Smith, Flowers and Larkin 2009). This study did not utilise techniques outlined by IPA in identifying superordinate themes. What was used was the researcher's experience by reviewing the interview transcripts, the exploratory commentary including the memos and annotations, as well as the emergent themes themselves to determine what the key points were in the analysis. These key points became the superordinate themes of the study and, in turn, these became elements which were combined as a whole to form a complex concept by grouping common elements together. Having identified the elements, the next step was to define the complex concept and write the body of the text based on the various elements.

A second connecting method was used with the express purpose of ensuring the study produced trustworthy findings. Cognitive mapping of the eleven complex concepts was the third phase of the connecting processes, which is reviewed in the following section.

### 3.4.3.3 Phase Three-Cognitive Mapping

Cognitive mapping was developed to examine and illustrate the activity of thinking with a number of different terms used to define this mapping process (McDonald, Daniels and Harris 2004). In essence it is a "...technique used to structure, analyse and make sense of accounts of problems which can be either verbal or documented" (Ackermann, Eden and Cropper 1992, 1). This study has adopted the Miles and Huberman version which "...displays the person's representation of concepts about a particular domain, showing the relationships among them with descriptive text" (1994, 134). The rationale behind the use of cognitive mapping was to confirm that the phenomenological processes utilised in the second stage of analysis<sup>8</sup> were robust. These two connecting methods were conducted as independent exercises with the results of the analysis from the phenomenological processes being reported in the first part of Chapter Four Analysis and the results in the form of the study's key terms being presented in the second part of Chapter Four Analysis.

The cognitive map model created for this study maps the same 11 complex concepts as per the 'flat reporting' section and contains in excess of 550 concepts which are documented commentary from the interviewees. An example of a 'map display' from Decision Explorer™ is displayed in Figure 9-4 in Appendix 3-8. This map displays the interviewee's cognition regarding one of the complex concepts, namely: Concept C-1: The Beliefs and Behaviour on the Flight Deck. Table 9-16 contains a sample collection of the 550 concepts used in the cognitive mapping exercise which is in Appendix 3-9.

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<sup>8</sup> Connecting the fractured data.

The concepts that are applicable to cognitive mapping are not the same as the complex concepts but are contained within the complex concepts. By mapping these concepts and applying linkages that identify relationships between concepts, the researcher described 15 emergent key terms which contributed to the developing theoretical construction (McDonald, Daniels and Harris 2004). On the completion of the mapping component, a cluster analysis was conducted with a large number of sets being created. Reviewing these sets, a number of key terms emerged, with each of these key terms becoming sets in their own right, with the relevant concepts being inserted and linkages being identified between concepts. The fourth and final phase of the connecting stage involved the identification the study's findings and associated theory, which are discussed in the following sections.

#### **3.4.3.4 Phase Four-Findings and Theory**

##### **3.4.3.4.1 Identifying and Describing the Study's Findings**

Findings are ‘...information discovered as the results of an inquiry or investigation’ (Oxford University Press 2010, 654). The number of risk owners and risk factors that have an association with FOR from the four airlines involved in this study are large in number. This resulted in the collection of a substantial amount of raw data which was analysed resulting in the creation of 11 complex concepts and 15 key terms. Consequently, Chapter Four Analysis is the largest chapter in this report containing a substantial amount of information with regard to the importance and approach these airlines adopt to the management of FOR. To manage this large amount of information, a structured approach was adopted. Firstly, for ease of understanding for the readers of the report, it was decided to limit the number of findings to a maximum of ten, and as these airlines predominately use traditional methods rather than a dedicated RMS to manage FOR, most of the findings would relate to key aspects of FOR and a few findings would relate to the emerging systemic method.

#### **3.4.3.4.2 The Creation of this Study's Theory**

A theory in organisational research is defined as a "... scientifically acceptable general principle or set of principles offered to explain a phenomenon or a group of phenomena" (Remenyi et al. 1998, 290). As this is applied research and exploratory in nature, the 'little t' concept of theories has been adopted where theory is generated which is relevant to practitioners and contains sufficient rigour to fulfil academic requirements (Schneberger, Pollard and Watson 2009). Further information regarding the characteristics of 'little t' theories are contained in Table 9-17 in Appendix 3-10.

At a conceptual level, the theory that was generated from this study was based on the 'little t' theory concept, however, at a specific level this study's theory was created using three key elements, namely: what, how and why as outlined by Whetten (1989):

1. what: which factors (variables, constructs and concepts) should be considered as part of the explanation of the phenomenon?
2. how: the relationship between these factors, how are they related?
3. why: what are the underlying dynamics that justify the selection of the factors (what) and the proposed causal relationships (how)?

The 'what' and 'how' elements describes the theory by providing a framework for interpreting patterns and the 'why' element explains the theory (Whetten 1989, 490-491).

In addition to these three elements, the construction of this theory was produced by the use of variables. A variable is a measurable version of a concept or construct that can take on two or more values (Shoemaker, Tankard and Lasorsa 2004) with this study utilising two types of variables:

1. an independent variable is a variable that is presumed to have an effect on another variable (a dependent variable).
2. a dependent variable is, quite simply, dependent, in that it depends, in some sense, on an independent variable (Flannelly, Flannelly and Jankowski 2014, 162).

Theory is about cause and effect, the independent variable is the cause and the dependent variable has the effect, put slightly different the presumed cause is from the independent variable and the presumed effect is to the dependent variable, where the dependent variable depends on what value the independent variable takes.

This section has provided an overview of the methodology of this study's theoretical contribution to the body of knowledge of FOR. The theory itself and supporting information are contained in Chapter Six Discussion from a Theoretical Perspective.

### 3.5 Research Evaluation

A key aspect of research is rigour, which conceptually, relates “...to thoroughness, to attention to detail, to consistency or to conformation with the chosen research strategy” (Remenyi et al. 1998, 260). Criteria that are used to assess rigour are different between the positivist and interpretive paradigms due to differences in ontology and epistemology. An appropriate approach to assess the quality of the findings in a study which has adopted a qualitative methodology, is trustworthiness (Lincoln and Guba 1985; Rolfe 2006; Emden and Sandelowski 1999; Tobin and Begley 2004). For a research report to be considered trustworthy it is required that the findings mirror the participant’s views as close as possible (Lincoln and Guba 1985). As this study has adopted the interpretive paradigm as opposed to a positivist paradigm, the findings must be trustworthy.

The criteria used to assess the trustworthiness of this research report are contained in Table 3-7.

**Table 3-7 Criteria to Assess Quantitative and Qualitative Research**

<b>Positivist Paradigm Terms</b>	<b>Interpretive Paradigm Terms</b>
External Validity	Transferability
Reliability	Dependability
Objectivity	Confirmability
Internal Validity	Credibility

(Denzin and Lincoln 2005, 24).

An explanation of these four criteria are reviewed in the following section.

Claims of transferability of the findings are made by the readers of the report (Tuckett 2005) and refers to consumers of the report being able to relate to the report if the situation in their organisation is similar to the researched organisations (Bassey 1981).

One method to achieve this is to provide a thick description of the researched organisation housed within the report. Shenton (2004, 70) believes the following six points should be included in the thick description of the researched organisations:

1. the number of organisations taking part in the study and where they are based
2. any restrictions in the type of people who contributed data
3. the number of participants involved in the fieldwork
4. the data collection methods that were employed
5. the number and length of the data collection sessions
6. the time period over which the data was collected

All of these points are included in Chapter Three Methodology.

A research report is considered dependable when the quality control aspect of the study ensures the processes of the study are consistent and reasonably stable over time (Smith and Robbins 1984), which is the case with this study.

Confirmability “Refers to the degree to which the results can be collaborated or confirmed by others” (Murphy and Yelder 2010, 65). A key aspect of this criterion is how objective the researcher has been and to what extent the researcher’s own bias influences the report. One method to test for bias on the part of the researcher is to subject the coding to reliability analysis which was conducted for this study by Associate Professor Pat Bazeley PhD. The report on the reliability analysis regarding the bias or otherwise by the candidate during the coding process is contained in Appendix 3-11.

Credibility refers to how harmonious the findings are with reality (Merriam 1998), Lincoln and Guba (1985) note that it is left to the readers to determine if the findings are credible before they can be considered trustworthy. In the field of business and management research “...one of the most important criteria is, are the results of the study of some practical use” (Remenyi et al. 1998, 257)? As indicated in Table 3-7 validity is an issue when the design includes the positivist paradigm, however in this study validity is not concerned with objective truth in the sense of trying to obtain ultimate truth, but with credibility; that is are the findings of the study useful and believable (Maxwell 2005, 106)?

A test to determine if the findings from the study are credible, that is, are they useful, believable and in harmony with others airlines, is to see if they can be generalised against the wider community of airlines from the Asia Pacific Region; to achieve this, a survey instrument was created. The survey instrument, a copy of the candidacy proposal and a cover letter were emailed to the safety departments of 13 airlines from the region, a single airline responded with a completed survey instrument. 10 days after the emails were sent, a reminder email was sent with no responses. Using personal industry contacts, three more airlines were approached with two responding with a completed survey instrument. The third airline's response was "*Regrettably, we are only supporting company-sponsored research and doctoral studies*" (name of airline deleted). This statement probably explains why only three airlines out of 16 responded with a completed survey instrument. A copy of the survey instrument including the responses from the three airlines is contained in Appendix 3-12. Based on three completed surveys, the findings cannot be generalised into the wider community of airlines from the region, however, they can be used as a guide. The three airlines who responded, two were large well-established legacy airlines and the third was a younger, less established and smaller airline. Of the 27 responses to the nine statements, six were strongly agree, 13 were somewhat agree, six were somewhat disagree and two were strongly disagree. 19 out of 27 responses were in some form of agreement to the statements, and eight out of 27 did not agree, however only two of these were strongly disagree which was from the same airline regarding S-7 and S-8. Another two of the eight also relating to S-7 and S-8 was somewhat disagree. These four disagree responses to these two statements may be the result of the six years between data collection and the survey. During this period, it is quite possible for an airline to increase the resources and management expertise allocated to a RMS. The rationale for this possibility is the introduction of the ICAO mandated SMS, which is risk assessment centric, occurred during the data collection phase. One of the legacy airlines who completed the survey also included a commentary on each statement. A copy of this commentary is included in Appendix 3-13 to provide the readers of this report a clearer understanding how one of the legacy carriers from the region views this study's findings.

The following section of this chapter discusses the qualitative data analytical software that was utilised during the writing of this thesis.

### 3.6 Qualitative Data Analysis Software

Qualitative Data Analysis Software (QDAS) programs that assist in the analysis of qualitative data have been around since 1984 (Tesch 1991). However, it was understood from the beginning of this study, "...these programs do not define conceptual categories or themes, develop conceptual diagrams, write memos or gain insight into the phenomena, or develop theoretical understandings" (John and Johnson 2000, 394). The categories, concepts, findings and the theoretical contribution to the topic's body of knowledge emerged from the critical thinking of the researcher sourced from both the data and the literature.

James (2012) maintains that if the raw data consists of more than 10,000 words a QDAS package should be considered and, as the word count for the raw data in this study was in excess of 370,000 words, this view was adopted. Whilst the technology allows for improved data management, Kelle (1996) points out that the software must be complementary with the methodological approaches used in the research. This view is supported by James (2012) who comments that using the wrong software, or using it incorrectly, may lower the methodological rigour of the research. These issues have been addressed as this research contains both thick and rich data, which required a substantial amount of coding to be completed during the data-fracturing phase, in addition to conducting queries and searches during the connecting phase. The ability of the software to store the data in both its raw and coded form, and its retrieval, assisted the researcher during the analysis. Initially, the QDAS software utilised in this research was NVivo 8™ which was later upgraded to NVivo 10™. The use of this software assisted in the management of the data and ideas, allowing access to conceptual and theoretical knowledge created during the analysis and querying the databases to answer questions from the researcher and model building (Bazeley 2007, 2-3).

### 3.7 Chapter Summary

This chapter explained in detail the methodology that was created to ensure that readers of the study are able to understand how the various components of the research framework combined to collect and analyse the data and, in doing so, produce trustworthy findings. The research paradigm in this study is interpretive as this paradigm describes and explains the researched phenomenon so it can be diagnosed and understood leading to the creation of knowledge through an inductive process (Gioia and Pitre 1990, 591). This approach is also supported by Remenyi and colleagues who claim "...that an approach such as this is more likely to provide relevant and useful answers with regards to research involving people and organisations in the world of business and management" (1998, 35). During the data-gathering phase, a large amount of textual data was collected. To assist in generating an authentic and trustworthy interpretation of this information, a phenomenological inquiry was employed with the objective of improving the "...understanding of the subjective nature of this lived experience from the perspective of those who experience it, by exploring the meanings and explanations that individuals attribute to their experiences" (Cope 2005, 168). The three philosophical assumptions underpinning this study are; 1) Ontological-Cautious realism 2) Epistemological-primarily empirical with some rational knowledge, and 3) Methodological-Inductive analysis.

Qualitative methodology was regarded as the most appropriate method due to the study's exploratory nature where many of the questions were unknown before the data collection process began and only emerged during the data gathering and analytical phases and, as a result, it was not possible to create an in-depth questionnaire. Data from the interviews was analysed, initially by being fractured and stored in a hierarchical structure of categories, with this data containing commonalities which was connected with the emergence of complex concepts and their associated elements, thus producing the study's findings and theory. These complex concepts were cognitive mapped as a second analytical method to confirm the robustness of the phenomenological method. The findings of the study were evaluated using the Denzin and Lincoln (2005) terms of credibility, transferability, dependability and confirmability.

## **4 Chapter Four Analysis**

### **4.1 Introduction**

This chapter is written in two parts; the first part consists of the 11 complex concepts and the second part involves cognitive mapping of these 11 complex concepts, with the key terms of the study being defined. The first section of the chapter is written in a 'flat reporting' style utilising the phenomenological enquiry method and contains minimal reflective thought by the researcher, as the objective of this chapter is to present the views of the interviewees. Where the researcher's reflective thought does appear, this text is bracketed in line with the protocols of phenomenology. These concepts contain a large number of direct quotes to ensure the voice of the interviewees are heard and to support the claim that the findings are trustworthy.

These airlines use systems to manage certain operational functions within the airline, such as a SMS to manage safety issues. Apart from the management of safety risk and those risks associated with change management, these airlines do not use a system to manage FOR. Traditional methods such as reports, regulations, stakeholder requirements, corporate knowledge, organisational culture and management's decisions are the primary means in the management of this risk and its associated risk factors. The method could be described as a system when no system exists using reporting channels to which the various components that are required in the management of this risk are connected. Operational risks are those risks that are associated with operations, involving, but not limited to, systems, processes procedures, and people.

This chapter is the largest chapter in the report so as to comply with the requirement that ample evidence from the concepts be provided to the readers of the report and allow them to determine the applicability of the study's findings and theory (Eisenhardt 1989). This evidence is the analysed narratives from a large number of risk owners from the four airlines. These risk owners have to manage a multitude of disparate risk factors, covering a broad range of topics.

To help the reader of the report, **the 11 complex concepts are in bold font** and associated elements are underlined. These concepts and elements presented in this chapter represent this collection of risk factors, strategies and methods that have to be managed or are utilised in the management of FOR. As an example, the risk of a loss because of error(s) committed by flight crews has to be managed and how these airlines manage this risk is discussed in Concept C-1 as well as other risk factors.

All of these concepts deal with the approach these airlines use in the management of FOR, with the last three concepts reviewing these airlines moving from the current non-systemic method towards the implementation of a RMS.

A list of the 11 complex concepts, with a brief description of each concept is described in this section to provide an overview with the aim of improving the readers understanding of what is contained within the Analysis chapter.

#### **Concept C-1 The Beliefs and Behaviour on the Flight Deck.**

This concept deals with issues such as the selection of flight crew, the training of these people and the standards they are expected to achieve and maintain. Other factors such as compliance to SOPs, the level of risky behaviour, if any, by the flight crew during a flight, as well as the issue of complacency these flight crews may have and the impact this may have on other factors, such as fatigue, professional commitment and engagement with these airlines is reviewed.

#### **Concept C-2 The Variability of a Reporting Culture.**

This concept relates to the reporting culture of these airlines; the motivating factors behind flight crews submitting voluntary reports, and management's effect on the quality of these airline's reporting culture.

#### **Concept C-3 The Importance of Non-Technical Skills.**

The quality of the NTSs of an airline's flight crew has an impact on the level of an airline's safety record. Concept C-3 involves the features of these NTSs, including how these NTSs are assessed, such as via an external audit referred to as LOSA, how these skills are monitored internally via Flight Data Analysis (FDA), the trust issues this involves, why flight crews perform as they do, and the contribution to SOP compliance.

**Concept C-4 Operational Expenditure.**

Flight operation division's budgets within these airlines are considered acceptable by the senior managers of these divisions, however there is always pressure to reduce costs. Issues such as the impact of the emergence of Low Cost Carriers (LCCs) are examined and areas where costs, such as maintenance, may be reduced, which can lead to safety issues.

**Concept C-5 The 'Management Dilemma' Has Been Dealt with.**

Concept C-5 relates to what is referred to as the 'management dilemma.' Airlines operate in a hazardous environment and, if these hazards are not managed correctly, a serious incident or accident can occur. To prevent this occurrence, management is required to invest in safety management practises referred to as 'protection.' The dilemma is if too much protection is given, inadequate revenue referred to as 'production' will be generated, resulting in the possible financial bankruptcy of the airline, whereas providing inadequate protection may result in the occurrence of a catastrophic event. As well as analysing the manager's responses to this topic, the responses from employees was also analysed to determine the level of push back from this group, if any, that may occur if inadequate protection was provided.

**Concept C-6 Change Management Processes Are Improving.**

Concept C-6 involves the change management practises that are in place within these airlines, whether these practises have improved over time, what some interviewees believe is wrong with the current practises, and the amount of change undertaken by these airlines.

**Concept C-7 The Role of QMS Within a SMS World.**

These airlines are required to have a SMS in place, which must achieve a minimum legal standard in line with ICAO requirements. With the implementation of the airlines SMS, there is no legal requirement for a flight operations division to be involved with a QMS; subsequently the possibility exists that senior airline management may terminate the funding for this function.

Interviewees from this study believe some form of quality management will prevail within their airline, as functions such as hosting external audits, for example IOSA, and compliance issues, was considered a large function of quality management, as well as improving processes via the Deming cycle of Plan-Do-Check-Act (PDCA).

All four airlines use the same software for their quality requirements with a variety of opinions on its functionality, especially with regard to managing risk. What these airlines would like is a fully functioning integrated software package that would cater for both their risk and quality requirements, instead of a quality software package with an attached risk management module.

### **Concept C-8 The Regulator and the Airlines.**

This concept is presented in a different format than the others due to the specific nature of the concept. All other concepts are presented on an issue basis and, where appropriate, the airlines become enmeshed within each issue, whereas with this concept, each airline is treated as an individual. The rationale for this is each airline's relationship with its regulator is unique. The role of each of the four airline's regulator was reviewed and the relationship between the Regulator's Flight Operations Inspector (FOI), and the management of each airline, was analysed to determine the type of relationship between both parties.

### **Concept C-9 A RMS is not yet Embedded Within These Airlines.**

These airlines are required to have a functioning SMS in place, which at a minimum must comply with the requirements of ICAO Annex 19. Apart from the safety related risks that are included within this annex, in addition to occupational health and safety risks, these airlines are not required to implement a RMS. This concept examines to what extent these airlines have implemented a RMS, if at all. These airlines have managed their FORs in the traditional manner along informal lines and are slowly moving towards a more formalised system with regard to the management of these risks.

**Concept C-10 Resources for a RMS are problematic.**

The allocation of resources for the implementation of a flight operational RMS is minimal as these airlines have well-articulated and published safety policies as required by law (ICAO 2013a). However, these airline's risk policies are vague and not always signed by an executive manager. The employees responsible for implementing a RMS complain that the resources they have to work with are limited and require leveraging resources from other projects and departments.

**Concept C-11 RMS and Flight Operational Risk Owners.**

Many of the line managers within these airline's flight operations divisions have never seen a functioning RMS. Some of these managers are unsure what benefits such a system would deliver and others believe a RMS would be beneficial in managing their own risks and also the airlines risks in a number of areas. However, other managers are somewhat doubtful of the benefits that a RMS would deliver and prefer to manage their risks along the traditional informal methods.

This concludes the introduction section of the chapter with the next section consisting of an in-depth discussion of the 11 concepts and their associated elements.

## **4.2 Concept C-1 The Beliefs and Behaviour on the Flight Deck**

C1E1 Flight crew selection, training and required standard are key issues and can be problematic for the four airlines.

1. Achieving and maintaining the required standard,
2. Adapting to the airline's culture

Each of the airlines has its unique organisational culture based on its history and operating environment and, consequently, their own selection and training requirements.

Airline A1 sources most of its pilots from the local population or expatriates, predominately from Australia or Europe. Airline A2 has the same recruiting sources, however, with regard to expatriate pilots, this airline recruits from a vast array of countries, resulting in this airline having pilots from 55 nationalities within its flight crew group. Airline A3 also sources its pilots from the local population, either from a smaller airline or via a cadetship as well as expatriates. Airline A4 does not employ expatriate pilots and sources all pilots from the local population, with the majority joining the airline possessing regional airline experience. The management teams from three of the airlines were satisfied with the quality of pilots that were selected, however, with Airline A2, there was considerable dissent between junior line managers and senior managers from the flight operations division, as well as with the Human Resources (HR) department. Senior managers from Airline A2 cite one reason why the airline has an outstanding safety record is the pilot selection process, as they are always looking for high calibre pilots. This view is not shared by junior managers who believe the quality of pilots employed today is inferior to those pilots Airline A2 employed previously. An example is that Airline A2 previously only employed pilots who were deemed suitable to pass the airline's command course, whereas today the airline has adopted an employment philosophy of accepting pilots who will make a good first officer, but may not pass the command course. Junior managers believe the HR department has too much involvement in the selection of pilots and the flight operations division has too little involvement in this process. With this arrangement in place, a junior manager believes that the airline has accepted an unacceptable risk by employing pilots with limited airline jet experience, for example, pilots with only regional airline jet experience.

C1E2 The majority of the airlines have a strong commitment to flight crew training.

All four of the airlines believe the training they provide to their pilots, both on an initial and recurrent basis, fulfils the requirement for pilots to achieve the required standard. The standard of pilot training in Airline A1 is perceived to be a major input into the airline successfully managing its FOR, as the pilot group believe the route network of Airline A1 contains a large number of threats. Pilot training in Airline A1 is considered to be of a good to very good standard, depending upon the interviewee, and has improved over the years. The rationale behind the belief of pilot training being of a very good standard with an emphasis on safety in Airline A1 is the experience gained by the core of the training captains who have been with the airline for many years. This experience was obtained when flying into the People's Republic of China (PRC) was considered very hazardous, and managing these hazards with respect, created the safety aspect of the flight deck culture that prevails within Airline A1. An issue that was raised within Airline A2 was, after having trained the pilots to the required standard, it was observed that some of the pilots who live on bases away from this airline's country of domicile allowed their standard to decline. Airline A2 is guided by the belief that the airline requires a high operating standard from their flight crew and, today, it is more challenging to maintain the required standard because of these offshore bases. This was not an issue with the other three airlines, as their pilots are all based within their respective airline's country of domicile. A line manager from Airline A4 commented that there are no shortcuts on the endorsement and training of its flight crews and that it is all done to a good standard. Airline A4 believes that if a pilot is not performing as expected during the training process, the tendency is to retain the pilot and apply additional training resources. If financial resources for the flight operations division are reduced, for example during an economic recession, the inclination is to reduce flight crew expenses, such as hotels and transport, but not to reduce pilot training. The rationale for this view, as put forward by a line manager, is that it is more expensive over the longer term if the airline were to reduce the level of training as a cost cutting measure, only to fund additional training for these pilots in the future.

An issue that was raised by some of the first officers from Airline A3 regarding the quality of the captains from that airline was that some captains' performances were experience dependent, whereas new captains didn't perform as expected. (This could be the result of a lower assessment level for a new captain in this airline, as opposed to the other three airlines, as first officers from the other airlines did not raise this issue). Another area of concern regarding the performance of captains from Airline A3 was SOP compliance, which is reviewed in the following section.

C1E3 SOP compliance is an integral component of the flight deck culture but not always achieved within these four airlines.

All airlines require their pilots to fly the aircraft in accordance with the published SOPs. Airline A2 sources their flight crew from a large number of countries and claim that they have assessed the various countries and their airlines procedures, adopted the best parts, and incorporated them into their airline's SOPs. Having written these SOPs and updated them as required, strict adherence to these SOPs is part of the airline's core DNA. *"We are absolutely fanatical about using the right expressions, the right term for the pilot flying and the pilot monitoring. If you don't call correctly and call back correctly, you're not going to get through a line check"* (A2FOPMGR01). This belief that adherence to SOPs is part of an organisation's culture was confirmed by the human factors manager from Airline A4 who linked professional culture to the culture of the organisation. This manager claims, *"...SOP adherence or non-SOP adherence is also a cultural thing within an airline"* (A4HUFMGR01). This cultural aspect of SOP compliance, or lack of, was noted during the interviews with Airlines A2 and A3, where it was observed by managers from both of these airlines that pilots from the USA were reluctant to comply with the airline's SOPs.

So that if guys turn up from America for example and it's a good example, have had a lot of challenges integrating pilots from the US. So they tend to be a little more colloquial or casual with their SOPs and they don't get through a [Name of Airline A2 deleted] line check (A2FOPMGR01).

Airline A2 believes a basic operational requirement to maintain a high operating standard is to be 100% SOP compliant.

The safety manager from Airline A3 declared that one of the problems with the pilots in the airline is the high rate of non-compliance to SOPs, which was observed during a LOSA. This finding dismayed one manager who believes that this sort of behaviour is unprofessional and is contrary to good airmanship. One view put forward is the airline employs a number of expatriate pilots who have worked for one airline for a long time. These pilots commence employment with Airline A3 and are not interested in changing to the new SOPs. Indeed, non-compliance by flight crew to SOPs is indicative of risky behaviour occurring on the flight deck, which is contrary to ideal norms. The risk appetite of the airline, which is reviewed next, partly influences the beliefs and behaviour on the flight deck.

#### C1E4 Risk appetite on the flight deck.

The overall view of the interviewees from the four airlines indicated that the flight crews are risk averse, and have a low tolerance for risky behaviour in line with the airline's low risk appetite. The overriding view of the interviewees from Airline A1 is that they believe the organisation's risk appetite is low. An example of this low appetite for risky behaviour is observed in the airline's culture of compliance where the pilots from Airline A1 will delay an approach if the visibility is less than the required minimum, whereas other airlines will continue to conduct approach and landings.

To the average Chinese operator [airline], [name of airline deleted] is seen as a bit of— we're a bit 'old woman-ish'. We'll enter a holding pattern and wait for the visibility to rise. Whereas all the other Chinese operators are getting in beneath us (A1FOPMGR02).

This conservative nature is confirmed by flight crew who do not depart or arrive into an area of thunderstorms, with one management pilot confirming "...*they have never punished anyone for not doing an approach or departing into the weather and if the crew aren't happy, then that's the captain's decision*" (A1FOPMGR03). A line pilot's view on the risk appetite in Airline A1 is, "...*it's not risky, no. It's a very conservative operation. We are always encouraged and taught to be conservative*" (A1FOPCOP01). A check captain from Airline A1 believes the current risk appetite from both a flight deck and organisational perspective is low, however he believes the risk appetite from an organisational point of view is increasing, as management is prepared to accept a higher level of risk.

The Deputy Director of Flight Operations (DDFO) of Airline A2 states that the route network of the airline is from one major city to another major city. If required, flight operations would review other airports such as Kathmandu; however, the airline predominately flies from capital city to capital city with the appropriate navigation aids and Air Traffic Services (ATS). However, this type of network is not without threats, with the largest number of these threats stemming from North American destinations. Indeed, six out of the top ten event ports are from this region. This manager believes the risk appetite of the airline is overall quite low, but they will look at opportunities, such as with regard to Kathmandu, as previously stated.

I think overall it is, but we'll clearly look at options and revenue generating opportunities should they arise, but overall I think [name of airline deleted] is conservative and reasonably risk averse (A2FOPMGR02).

The Director of Flight Operations (DFO) of Airline A2 agrees with the low risk appetite of the airline and he believes the airline is very conservative and has a low risk appetite. *"We're terribly conservative. I think we take a very conservative approach. If there's any doubt we tend to sort of err on the side of caution. I mean no, there's no question in mind. We are incredibly risk averse"* (A2FOPMGR01). This belief of Airline A2 being risk averse is supported by a number of other managers. The Air Safety Manager (ASM) also believes the airline is very conservative with regard to risk and safety issues. An example of the low risk appetite within Airline A2 is the reluctance to be involved in relationships where the airline's control is less than what the airline considers desirable. In the past, the airline has looked at wet leasing arrangements and, after doing a risk assessment on the venture, decided, *"it's just too hazardous. If we do, we can put all this in place and the residual risk is still too much for us to take"* (A2SAFMGR01). An area of concern for Airline A2 with regards to risk appetite is the risk the airline is exposed to when dealing with external stakeholders outside the direct control of the airline. The airline classifies this risk as third party risk, with examples given that include threats from ATS, loaders from other companies that damage the airline's aircraft, and runway and taxiway incursions. Airline A2 believe that they manage their risks well and are risk averse.

The problem, according to one of the interviewees, is being involved “...with stuff that’s sort of not within your control is what keeps me awake at night and whether the [name of airline deleted] crew are sufficiently well trained to pick up on these errors of other parties. I think that’s a hard risk to summarise in a little risk matrix, but we summarise it under third party risk” (A2FOPMGR01).

The quality manager from Airline A3 is not able to determine what the risk appetite of the airline and divisions are (this may be as a result of the Airline A3 not having a formal risk assessment framework), however he claims that each of the operational managers are now required to conduct a risk assessment on changes and introductions.

I would not be able to rate it. But the mentality of each operational manager is such, is that, if there is any change[s] or introductions to our operations now, they do the proper risk assessment, they go through change management and this is something that we would look for as evidence during our audits (A3QLYMGR01).

The flight crew from this airline believe that the airline is conservative with regards to the acceptance of FOR with a line captain and first officer’s perspectives being that the airline professionally manages the risk of the route network and are safety conscious, with a low level of residual risk.

A line manager from Airline A4 noted that the risk appetite of the airline is quite low as the airline operates within an area of low threats. One check captain believes the airline has a low risk appetite and if the commercial department started pressuring the airline to conduct flights above what the pilot group believed was the upper limit of acceptable risk, the pilot group would start talking and pushback. The rationale for this pushback is, “...there’s too many guys here to ask questions. And they’re allowed to ask questions. Now, if something goes out that’s a little bit risky, every pilot starts talking, and so, and they can go in and talk, so that, you’re not told what to do” (A4FOPCHK02). The risk appetite during the formative years of Airline A4 was high to very high, which reflected the philosophy of the airline at the time of “Let’s just get on and let’s do the thing” (A4RSKMGR02). The new CEO who chairs the Safety Management Group (SMG) meetings reviews the reports of the divisional managers and challenges them to look at their reports from a different perspective.

The new CEO has placed a greater emphasis on systems and is changing the culture “...to make us more professional (A4RSKCOR01) with the airline’s risk appetite reducing “...because we have a lot more to lose now than what we did when we first started” (A4RSKMGR02). The DDFO of Airline A1 asserts that the airline is risk averse, but is concerned that the level of risk the airline is exposed to can increase because of complacency. This manager also maintains that the flight crew are risk averse on a conscious level. However, complacency can set in and, almost by stealth, the risk appetite of the airline increases.

C1E5 Complacency is a serious emergent flight operational risk and can unwittingly increase the risk appetite of an airline.

Complacent flight crews are not always mindful of danger. Consequently, this emergent risk was discussed by managers from three of the airlines, with the management of Airline A1 being very concerned with this risk. The DDFO of Airline A1 cites a number of examples where errors made by pilots were attributed to complacency and he believes the root cause of the two significant events in this airline’s previous ten years was complacency. This manager and others from Airline A1 declared that the airline is risk averse and the pilots are focused on their tasks, however, at times, flight crew can become complacent, which is observed by pilots becoming blasé and indifferent, with increasing levels of absenteeism through sick leave. One view put forward by a check captain at Airline A1 is that a major cause of complacency by the flight crew group is a deterioration in the relationship between the pilots and management. An example given was the flight crews were very fatigued on the operations into and out of the PRC and the pilots saw this as a major problem. Moreover, the managers from the safety department saw it as a major problem, although the flight operations management did not, which resulted in deterioration of the industrial relationship between the pilots and management. Pilots were very annoyed at the high level of fatigue which resulted in a reduced level of motivation, which then led to complacent behaviour by these employees where they performed their tasks with the same level of confidence, although with a reduced level of attention to detail. This resulted in the airline having an increased level of incidents (in this instance, the management of flight operations did not appear to identify the causal linkage between fatigue → demotivation → complacency → errors).

Management of Airline A1 are concerned with flight crew complacency because of modern aircraft technology, repetitive sectors, and pilots tuning out and simply going through the motions. This is such an issue that during their pilot selection process the airline looks for pilots who do not display this trait.

What worries me is the level of complacency, and that's, yeah, that's a function of the new generation of aircraft, and you know, guys on their fourth sector, on a day, you know, doing stuff that, you know, they're starting to become complacent. In other words, they're just running through the motions, rather than thinking about—we want people who think about what they do (A1FOPMGR02).

The DFO of Airline A2 remarked that the airline is as safe as it can be, although there is danger in complacency and one accident can ruin years of hard work by many people. Another management pilot within Airline A2 who has total faith and trust that the pilots will do the right thing, supports this view. The ASM at Airline A2 believes complacency does not just belong in flight operations; it is a risk that could be present in all operational areas, and no single department thinks of complacency as a risk. This airline believes complacency is a serious issue and has inserted, for the first time, the risk known as 'the un-rocked boat' onto their corporate safety risk register. In addition, complacency was not only identified as a risk in the large airlines. A manager from Airline A3-1 believes the route network of the airline is well known by its pilots and, whilst local knowledge improves the level of safety, it can cause the pilots to become complacent which, in turn, has a tendency to lower the level of safety. Another factor that has an impact on the level of complacency amongst flight crews is fatigue resulting in an elevated risk appetite. How the airlines deal with the risk associated with a fatigued flight crew is reviewed in the following section.

#### C1E7 Fatigued flight crews are an acknowledged risk.

Flight crew fatigue is a serious issue for all four airlines and all of them were either about to, or had already, introduced a Fatigue Risk Management System (FRMS). At the time of the data collection Airline A1 was about to introduce a FRMS, with one of the motivating reasons being fatigued crews had become complacent and complacency is a serious concern for the management of Airline A1.

A check captain from Airline A1 believes the airline has not managed fatigue risk successfully, thus resulting in industrial unrest during the last two to three years. The pilot group became disengaged, resulting in a reduction in the submission of voluntary reports, an increasing level of complacency and a lowering of professional standards.

When we were doing those work leases with China, the China work leases were very, very demanding flying. You're on your own, you had no Flight Ops support from [name of airline deleted], you're dealing with [name of airline deleted] issues and you're dealing with everything from passengers punching each other over seats in first class to technical issues, to language problems, to different cultural problems and every day was a [deleted] fight. What happened is guys were losing interest in the job, being complacent, not caring, [and] not making a big effort. We were having incidents then. I think our incident rate went up during that time. (A1FOPCHK01).

The commercial department from Airline A2 wanted to know why the flight crews do not fly to the legal Flight Time Limitations (FTL) by using the minimum number of pilots, as dictated by these regulations, with the managers from flight operations responding that safety was the overriding concern. The management from flight operations within Airline A2 acknowledges flight crew fatigue risk is a large risk for the airline and that it needs to be better managed. *"It is an emerging science and we want to be one of the first ones to get involved if there's a science to managing fatigue risk. We've always tried to manage fatigue risk, but it's not been as scientific. So I think the science behind it seems to be quite new"* (A2FOPMGR01).

Airline A3 has acknowledged fatigue as a risk although, at the time of data collection, they had only implemented a rudimentary FRMS with the support of an Australian university, with the intention to improve this system at some time in the future. Currently this system is limited to *"...where, it really just looks to see if the roster is providing each person with sufficient sleep opportunity"* (A3SAFMGR01).

Airline A4 introduced their computerised FRMS in 2007 after the regulator indicated that the risk of flight crew fatigue had to be improved. This FRMS is a computerised rostering system with multiple benefits to the airline of not only being able to identify flight pairings that produce fatigued crews, but also improving operational efficiency, as hotel and transportation costs are reduced, as well as flight crews being more engaged as a consequence of having greater control over their lives.

If a flight crew member believes they are fatigued they *“could stand down, and we also needed to provide oversight for the roster production and pairing production for the company to make sure we weren’t exposing ourselves to either high fatigue risk or high operational risk by producing pairings that couldn’t be flown”* (A4FOPMGR02).

### 4.3 Concept C-2 The Variability of a Reporting Culture

#### C2E1 Flight crews are reluctant to submit reports.

Of all the various cultures discussed by the interviewees, the reporting culture was the most widely talked about culture. The safety manager from Airline A1 believes that one reason for this is, *“I think the [reporting] culture is most important. Yeah. You can have the most brilliant system, database, in an airline. If the crews don’t report, they don’t have this safety mindset, then you might as well throw all the tools out of the window”* (A1SAFMGR01). The reporting culture was observed to be quite strong at Airlines A1, A2 and A4, however the reporting culture in Airline A3 was observed to be not as strong. A possible reason for this weakness is Airline A3 is moving from a punitive culture towards a just culture and, when the interviewees were questioned about whether they submitted reports, there appeared to be some reluctance to do so. For example, one of the interviewees replied, *“I guess no. We talk about it, but yeah, not in the mindset.”* (A3FOPFOF03) In addition, in the five years working for Airline A3, another interviewee commented, *“I have done one. That’s the crew. I have done one myself on fatigue, but that’s about it at this stage”* (A3FOPFOF02). Asking operational managers at Airline A3 whether they were happy with the level of reporting by the flight crew, the DFO’s response was, *“It’s improving. There’s been a steady increase in the rate, but we still feel that there’s a lot more that, perhaps, could be reported for the benefit of safety”* (A3FOPMGR01).

Airline A3 has been proactive in its attempts to improve the level of voluntary reporting by implementing electronic reporting and having easier access to paper reports, as well as verbally encouraging flight crews to report, as increased reporting results in an increased level of safety for the airline, which is a benefit to both the airline and to its employees. This reluctance by the flight crew in Airline A3 to submit reports could possibly be a result of a punitive culture. In the case of Airline A2, which has an established just culture including a policy to support this culture, this reluctance may be a result of pilots only wanting to submit reports on company time, such as during the cruise component of the flight.

Where the flight is of short duration, “...to complete an ASR [Air Safety Report], there is very little time and often the guys get back and they have moved on. If that sector was another 30 minutes longer, I think that reporting culture would be a lot more thorough” (A2FOPCHK04). (This concept of only submitting reports on company time may be indicative of the lack of engagement within the pilot group of Airline A2 as outlined in a previous section).

C2E2 Management actions lowers an airline’s reporting culture.

The four airlines primarily use the reporting system(s) to obtain knowledge of what is happening ‘out there’. The narratives across the spectrum from senior management to line personnel indicate that the primary purpose of the reporting system is for the airline to acquire knowledge for the betterment of both the airline and employees. An example of this belief, as espoused by the DFO of Airline A2, who stated the primary objective of the reporting system, “...is to have as much open reporting and learning from the incident as possible, such that it will never happen again” (A2FOPMGR01).

One method to determine if the level of reporting is acceptable is to crosscheck it with other reporting methods, such as FDA and LOSA reports. This belief is articulated by the DDFO of Airline A2 who believes the reporting culture of his airline is acceptable as the information supplied by flight crew in the form of voluntary reports ties in with other information channels that are available to management, such as FDA and LOSA. The safety manager from Airline A1 concurs with the belief of a FDA and a LOSA being used as metrics to gauge the level of voluntary reports capturing knowledge as to what is happening on the line. When asked to estimate the capture rate of the operational safety information through the reporting system, this manager provided a guesstimate, “...at over 50%... we have the open reporting, the mandatory, if you like, ASRs. We have confidential reporting...And we have the FOQA. So therefore, you bring the whole lot together” (A1SAFMGR01).

A low capture rate of over 50 % could indicate a weak reporting culture and one possible reason why reporting cultures may not be as strong as they could be, could be a result of industrial unrest. This was the case with Airline A1 where, for a prolonged period there was a poor industrial relations environment between the pilot group and the airline, which is detrimental to safety as the flight crew’s focus is not on the task.

This poor industrial relations atmosphere resulted in a decline in the level of reporting which management of the airline had to rectify due to the detrimental effect on safety. The level of safety within the airline deteriorated due to the reduced level of operational information being obtained by the airline, as well as the lack of focus by the flight crew on their duties during the flight, causing an increased level of incidents.

People's minds are elsewhere than perhaps where they should be because they're constantly thinking of industrial things. It even goes back to sorting out industrial issues. If you have to put money in, which we did, that's hardly reducing costs. But it did sort out a lot of issues in terms of pilots and getting them on side and getting the safety reporting culture back (A1FOPMGR01).

When operational reports are submitted within an airline they are sent to the appropriate person(s) for processing. Depending on the information contained in the report, it may have an impact on the strength of the reporting culture, as relevant information for one person may be considered irrelevant to another. At Airline A1, some of the managers from flight operations noted that a number of the reports being submitted by flight crew were inconsequential, effectively considered of no importance, with this message being relayed back to the writers of the reports. This led to a reduction in the number of reports written by the pilot group, with one interviewee believing this has led to a self-filtering process by individual pilots who believed the low-level reports they had been writing in the past were superfluous.

In the past crews felt free to write about anything and some of the reports are what you might call inconsequential. But by having all the reports included, including inconsequential ones, it meant that you had a wide base. Crews now I think restrict their reporting more than they did in the past because they're trying to think "Is this valid?" They're doing self-filtering at the primary stage where maybe the filtering should be done further in. In other words, the company is not getting as much information now to work with as they did before (A1FOPCHK02).

This self-filtering by the flight crew, and subsequent reduction in the number of submitted reports, is the result of management wanting to control the type of reports submitted. Moreover, they were not interested in reading reports regarding accommodation issues, such as the quality of a hotel bed.

Whilst managers from flight operations considered these reports as complaints, safety managers held the opposite opinion and viewed these reports seriously, as these managers linked poor bedding to poor quality of rest and, therefore, to fatigued flight crews.

It was not the ideal hotel, and people complained of fatigue. So that was reported through the confidential reporting system. So what do we do? The crew doesn't say, "Look, because of this, I made this error on the line." It's not that specific. We nevertheless took it very seriously. We got out of the hotel. We could solve the problem (A1SAFMGR01).

Another factor causing changes in the strength of a reporting culture is related to changes in the organisational culture where established beliefs and values change. This occurred at Airline A1 where ownership of the airline changed and the reporting culture weakened. As a result, in the past, pilots submitted a report detailing where they may have committed an honest error and self-reported it for the benefit of the airline to learn from the occurrence. However, today, some of the flight crew believe these reports are now used as a possible reason to punish the writer.

Since the takeover...and some of the personnel changes, there's definitely a perception...amongst myself and amongst the average line pilot that that reporting culture has been attacked and was being used against, or for disciplinary rather than safety promotion (A1FOPCHK01).

### C2E3 The journey towards achieving a just culture.

When asking the interviewees what their perception of a just culture is, and how far their airline is on the journey of acquiring a just culture, the view of a senior flight operations manager from Airline A1 is, "*I understand what a just culture is, but we're not quite there yet*" (A1FOPMGR06). The ASM from Airline A2 asserted that a just culture is "*...a policy and it actually has procedures underneath it in that there's things that we say, "If you make errors and mistakes there's these concepts"*" (A2SAFMGR01). With regards to Airline A3 which is in the process of transitioning to a just culture, the safety manager from this airline claims, "*...we are working towards having a really genuine, just culture in place*" (A3SAFMGR01). In the case of Airline A4, a senior manager described the prevailing safety culture as, "*it's a just culture*" (A4FOPMGR02).

(The term just culture has become broadly accepted, although not a universally defined term, to describe the context in which safety practices are fostered within an organization). Some degree of confusion was observed during the interview process regarding what constitutes a just culture and a ‘no blame’ culture. This confusion was observed during interviews at Airline A4 where a line manager claimed that the airline has a “...no blame culture. Well I think the no blame culture is good. So [the pilots] they’re comfortable that if an SOP is broken, even let’s say “There’s a wilful break in an SOP, but the reason I did it was because of this, this and this,” and we can see “Well, okay yeah, that’s fair enough” (A4FOPMGR05). This belief that the airline has a ‘no blame’ culture was refuted by a more senior manager who stated in a response to a question regarding the airline’s ‘no blame’ culture that the airline does not in fact have a ‘no blame’ culture but, rather, a just culture. When asked what causes the confusion within the management ranks, the senior manager claimed that the airline previously had a ‘no blame’ policy, but not a ‘no blame’ culture. However, the flight crew believed they could do what they liked as long as it was reported, which is not what the airline desired, and the ‘no blame’ policy was removed and replaced by instilling a just culture.

We had a no blame policy, but that was being misinterpreted by guys as “I can go and do what I like. So I’m going to put my hand up. It’s okay.” So it’s a just culture (A4FOPMGR02).

Airlines A1, A2 and A4 appear to have an established just culture where the primary purpose of an investigation into a flight operational event is to establish the facts and then absorb this obtained knowledge back into the airline to reduce the likelihood of a re-occurrence. In the case of Airline A3, this airline’s culture is moving from a culture of punishment to a just culture. However, certain members of flight operations management still appear to be motivated by controlling employees through fear and punishing all errors.

It is certainly something we’ve been striving for. If you go back more than five years, we were getting a lot of people immediately sacked, whatever for, events that resulted in bad outcomes for the airline (A3SAFMGR01).

In an airline that utilised punishment as an employee motivator, the question was asked would removal of this negative motivation result in employees taking advantage of the situation, or would the objectives of a just culture prevail?

The safety manager from Airline A3 believes that, in their experience, when a punishment culture has been replaced by a just culture the employees will respect the new just culture. (Nonetheless, introducing a just culture may result in negative safety outcomes for an airline that is transiting from a punitive culture to a just culture, as employees may not react to the lack of negative motivation as expected). It is possible that people who are raised in an environment where the national culture is one of punishment may not be as motivated to carry out their assigned tasks as expected, leading to a deterioration of safety standards rather than improving them. This appears not to be the case with Airline A3 as this view was put to the safety manager of the airline and was aggressively refuted.

I would say just the opposite. I would say people are becoming more motivated. Because we're starting to encourage people to look at the systemic issues that lead to these incidents, they are becoming more aware of the sort of latent failures in the system. When they see those, they tend to report them more, and I think we're raising the awareness that, first of all, they're being aware that all people are going to make mistakes. They're people. They will make errors. But we need to have the defences in the systems to identify these errors as they come to light (A3SAFMGR01).

This concludes the analysis of Concept C-2 regarding reporting cultures. The third concept is reviewed in the following section, which focuses on NTSs.

#### **4.4 Concept C-3 The Importance of Non-Technical Skills**

An issue that was identified regarding these NTSs, in both Airline A2 and Airline A4, which underpins the importance these airlines place on NTSs was the CRM model. Indeed, this model, as it was presented by the industry, wasn't working. They believed the underlying philosophy was more democratic and not command-centric enough. Consequently, they amended the generic version of CRM to suit their requirements.

One of the problems with CRM training was "it was hijacked by psychologists and it became all about being nice to one another and being all touchy feely and playing games with the cabin crew" (A2FOPMGR04).

CRM went through a bit of a period where it got all warm and fuzzy... get rid of the warm and fuzzy stuff and put a hard edge back on to it again, to make people realise: you get this stuff wrong, you die. You and your passengers die in the accident. So we put a hard edge back onto it (A4HUFMGR01).

This concept relates to the level of importance these airlines place on their flight crews NTSs. A common method to assess these NTSs is during check flights, however a single approach on assessing what is considered an important skill set can be fraught with danger where the flight crew, both individually and collectively, may not possess the required standard of NTSs, contrary to what the airline's standards department believes. An example of an airline's flight crews exhibiting poor airmanship resulting in risky behaviour and the airline's standards department not identifying the weakness, was in the area of non-compliance to SOPs within Airline A3, with this weakness being identified when this airline conducted a LOSA. Apart from an airline's internal checking system, there are two additional methods to assess an airline's flight crews NTSs, both of which are included in this concept; namely, FDA and by conducting an audit referred to as a LOSA.

C3E1 Assessing flight crew's NTSs by conducting a LOSA is regarded as a good investment.

An example of the level of importance these airlines place on their flight crews NTSs is, three of them have conducted at least one LOSA at a considerable expense to the airline. Airline A2, A3 and A4 believe that there is a cost benefit to conducting a LOSA.

On the other hand, Airline A1 has never conducted a LOSA, and the reasons proffered for why the airline has never conducted a LOSA were various, such as due to cost factors; they could not identify a tangible reason to conduct one; and no senior stakeholder had pushed for a LOSA to be conducted.

It's something we've always wanted to do. We're a very cost-conscious airline; cost is one of the elements that the time involved in doing it...It's got to have some impact on the operation for the better. It's got to provide some benefit. And the benefit has to be in meaningful results that you can then act upon (A1FOPMGR02).

This is not to say Airline A1 does not take NTSs seriously, as it is possible for the flight crew to fail a line or Proficiency Check (PC). *"It's assessed at all training details, all checking details. We've failed Captains through CRM"* (A1FOPMGR02). It is also difficult to determine the exact cost of an airline conducting a LOSA. In the case of Airline A2, the LOSA service provider charged Airline A2 USD\$100,000, which included one observer. There were twenty-five airline-employed observers and their time and expenses have to be included. Airline A2 does not state what the cost of each LOSA was, however *"the DFO was prepared to just take that out of the operating budget and say, "Don't worry about that, just get the University to sort out a price"* (A2HUFMGR01). As the airline industry has very low operating margins, all funds that are expended have to produce a return and allocating resources to NTSs, such as conducting a LOSA to assess the flight crews NTSs or other resources that are required to improve the flight crews NTSs, is deemed acceptable.

I've been the non-technical skills program manager for about six or seven years now. But in all the time I've had that, I've never really had to fight battles in terms of resources or money to go to places. I'm released to do things that I need to do in the organisation. I think they put quite a lot of emphasis on it [Non-technical skills]" (A4HUFMGR01).

To provide an example of the importance Airline A2 places on its flight crew's NTSs, it separates these skills into eight core competencies, with each competency being assessed on a check flight, resulting in 85% of the assessment of a pilot's performance on a check flight being focused on NTSs. This airline places 'monitoring,' which is a NTS, as a top five risk within flight operations which is indicative of the importance Airline A2 places on the training and assessment of flight-crews NTSs.

The airlines consider conducting a LOSA as cheap insurance, as a report from this audit advises the management of the airline where the airline's flight crew's NTSs weaknesses are. It also observes exemplary behaviour that can be used as a model for future training and how the airline compares with other airlines. These weaknesses are different from airline to airline, an example being with Airline A2, the airline itself was a threat to the flight crew by utilising the practise of dispatching aircraft with a large number of mechanical defects, which imposed an additional workload on the flight crew. However, the flight crew were commended for their exemplary performance in managing this internal threat. Airline A3 has completed two LOSAs, one centred on flight operations and the other on cabin services. A key finding from these LOSAs surprised the airline regarding non-compliance to SOPs. The report stated that the SOPs were confusing; crews were implementing the SOPs contrary to what was intended and because of this finding Airline A3 has completed a major re-write of their SOPs. Airline A3 asserts that there was a cost-benefit to conducting a LOSA which included identifying risky behaviour by some of the flight crews who were performing actions contrary to the SOPs, as well as contrary to good airmanship, and, in doing so, identified a serious risk.

Airline A4 has conducted a LOSA on three occasions, with the main findings relating to automation issues and the authority gradient on the flight deck not being steep enough at times. The LOSA finding of the flight deck authority gradient being too shallow has caused a number of issues for the airline, as the organisational culture of the airline is egalitarian. Because of this egalitarian culture, the authority gradient between the flight crew and the cabin crew was found to be too shallow.

We've done a fair amount of work in [name of airline deleted] over the last few weeks to actually steepen it up a bit...it sounds all very nice and fluffy and fuzzy, but in reality, it doesn't work... We always encourage the cabin crew to come up the front, talk, but equally, it's very clear who's running the show (A4HUFMGR01).

A LOSA is conducted once in a number of years and provides a 'snapshot' in the form of an audit report to the airline's management team of what the flight crew are doing with regards to managing the flight. What is required on an ongoing basis is a passive monitoring system that records a number of metrics during each flight and the analysing of this flight data.

C3E2 Flight-crew's NTSS are constantly monitored with FDA.

FDA is referred to in some regions of the world as Flight Operational Quality Assurance (FOQA) or Flight Data Monitoring (FDM). FDA has become an important tool in the airline industry's efforts to lower FOR, with a consequential improvement in safety. Whilst all four airlines have a FDA program in place, the genesis and operational aspects of this program varies between these airlines.

Establishing and maintaining a FDA program like a LOSA is an expense that does not provide a cash return on the investment and, without a regulatory requirement to have a system in place, some airlines would be hesitant to implement one. Two of these airlines implemented their FDA program after a shortcoming concerning their flight crew's managerial skills was observed to be deficient.

In 1999, Airline A1 implemented their FDA program, not at the regulator's direction but, rather, on its own volition. The rationale behind this introduction was the high number of unstable approaches being conducted by the flight crew, where the flight path was mismanaged. Unstable approaches in aircraft are dangerous and are classified as an Undesired Aircraft State (UAS), which has the possibility of resulting in an End State (ES), such as a CFIT event, with an outcome of both loss of life and the aircraft. Whilst this eventuality did not occur to Airline A1, the possibility existed and the FDA program is credited with dramatically lowering this airline's number of unstable approaches. Airline A4's FDA program started two or three years after the airline had a serious incident; at the time the regulator had no requirement for airlines to implement a FDA program. The managers from flight operations were the initial motivators to obtain the funding for the FDA program, however senior management could not see the value in the program and were reluctant to allocate the funds. It took some time to convince senior management to allocate the funding to mitigate the heightened level of risk the airline was encountering as a result of introducing "...*new airplanes. We've got new routes. We've got brand new captains, brand new first officers,*" (A4FOPMGR05). Senior management at the time believed the safety department was robust enough to deal with these new threats and delayed the implementation for some time, but eventually implemented the FDA program a year before the regulatory requirement came into effect.

Having implemented a FDA program, an issue of trust, or lack of, arises between the flight crew and management, which can have a negative impact on the pilot's performance. Pilots may believe that they are being spied on, resulting in possible punitive outcomes for the flight crew and a belief from management that they may not be fully informed about safety issues because of flight crews being protected under the protocols of FDA.

C3E3 Lack of trust between management and flight-crew can be an issue with FDA.

Airline flight crews are subject to a high level of work place monitoring, via both their voices and their inputs of manipulation and management of the aircraft's flight path. All of this monitoring can lead to a lack of trust by the flight crew, causing issues to arise that may lead to a reduction in their performance and, consequently, management is forced to address the issues that arise from this lack of trust.

Airline A1 addresses this concern by stating that FDA is about trends and is not there to pursue and punish individuals. Consequently, only the safety department has access to the names and, hence, access to the flight crew with regards to an FDA only identified event. However, if another reporting mechanism, such as an operations report (OR), were to report it, the event is outside the protective scope of FDA. The FDA program will tell the safety department about the event, but not why the event happened. To understand why the event occurred, the safety department has to investigate the event, including interviewing the flight crew to determine the facts.

If there was any deliberate violation. Obviously, by breaking an SOP, is that instantly wilful violation? There must be circumstantial evidence that led them to do it? What is that? Is it a purely technical one? Is it a human factor one? You know, we have to understand exactly what happened. In the time I've been here, as Head of Safety, I have not seen a case where there was a wilful violation. (A1SAFMGR01).

Airline A1 believes the FDA program is an essential tool in managing FOR and improving safety and claims the reason why FDA has been so successful in this endeavour is the trust that is bestowed upon it, by both the flight crew and management alike. As the safety manager is the only person who can release the names of the flight crew, this manager can be subject to accusations of protectionism from management.

In response to this, the safety manager from Airline A1 claims that if the event is serious enough, an ASR must be submitted informing management of the event through a separate reporting channel.

It's got to be trusted by the line crews and the fleet management. It's not just there to protect the crew. There are some critics who say, "Well, yeah, it's just there to protect everyone." If you had an event, and you haven't reported it, and it's discovered through FOQA [FDA], you get guys – "Oh, all right, so it's under the FOQA [FDA] program, so I'm protected," I would say to the crew members, "Why didn't you report it as an ASR? Why didn't you report it to Fleet Office?" I don't want also the FOQA [FDA] program to be an umbrella for people covering themselves (A1SAFMGR01).

Trust is a serious issue for Airline A3, particularly as the organisational culture moves from one of punishment to a just culture. Consequently, trust in the FDA program by Airline A3's flight crew was identified as a serious issue.

The airline's safety department oversees the FDA program and, when an investigation is being conducted regarding a FDA event that has not been reported by other means according to an internal agreement, the names of the flight crew can only be released with the approval of the FDA committee. To protect the identity of the flight crew during the investigative processes, the safety department would bring the flight crew into the office through a rear entrance and out of sight of the flight operations management. This action may appear to be excessive, however the safety department is aware of the concern that the flight crew have with regards to FDA and the negative consequences that may befall them. Airline A3 claims that FDA is a valuable tool and note that they have not punished a pilot because of a FDA identified event. The flight crews dispute this assertion however, as the pilots refer to a FDA event where the flight crew were punished, although the airline counter claims this by stating that the flight crew involved in this event committed a wilful violation.

Now, they [the pilot group] may believe that the information came from FOQA [FDA], but it actually didn't. It was outside. But there could be a perception there that it could be used at some stage against someone. Now, that could be also a hangover from the more punitive issues in the past on pilots for operating outside SOPs (A3FOPMGR01).

Unlike the other three airlines, Airline A4 houses the FDA program within flight operations and limits the data access to five people, which include the FDA Manager, an analyst and three gate keepers, with the identification of the flight crew being governed by both regulatory requirements and airline policy.

At Airline A4, there are three levels of review with regards to a FDA event: level one is a gatekeeper review; the second requires a more comprehensive review involving questions from management which the flight crew are required to answer; and the third level is a flight operations investigation. Pilots in Airline A4 have not been punished because of FDA events, as punishment can only occur where there has been a wilful violation and no wilful violations have occurred within the FDA program. The primary purpose of the FDA program for Airline A4 is to deliver visibility to the entire operating environment. If a stakeholder were to identify a problem within the operation, the FDA data can confirm it and, if required, implement a procedure to eradicate the error.

Additional benefits are to identify trends, provide feedback to the training department, and support the safety department. If the safety department require data from a flight, the flight operations department will release the data, as long as the flight crew have reported it and identified themselves in the event.

C3E4 FDA is not an issue if flight-crews always comply with the SOPs.

If the flight crew of an airline complies with the SOPs of that airline, the event rate should be very low. This is the message conveyed to the pilots at Airline A4 because these pilots are very interested in obtaining the parameters that cause an event to be recorded, with management responding, *“We want you to fly with Standard Operating Procedures. If you operate to the Standard Operating Procedures, these events are designed to get the edges of Standard Operating Procedures”* (A4FOPMGR05). The number of significant events at Airline A4 is down to 1-2% and the reason the event rate is low is because pilots comply with the SOPs, with the most common event identified by the FDA program as flying at an incorrect speed during a turn. Airline A3’s flight crew’s non-compliance to SOPs was a finding in a LOSA where the flight crew were operating the aircraft contrary to published SOPs.

The fear of punishment was noted by a number of first officers with Airline A3 who stated that they focused on flying the aircraft very much aware of ‘big brother’ in the form of FDA watching over their shoulder, rather than focusing on flying the aircraft as it should be flown. *“We just slow down a lot earlier. So it is limiting us on a number of aspects, and a lot of those are starting to fly the FOQA [FDA], rather than the aeroplane”* (A3FOPFOF01). The first officers believe that the company benefits from the FDA program as well as improving the pilots’ flying skills. However, because of the still prevailing punishment culture as the airline transitions to a just culture, these pilots stated that they self-reported any event, such as exceeding a company-imposed speed limit below certain altitudes, before the company became aware of it, to protect themselves.

#### **4.5 Concept C-4 Operational Expenditure**

C4E1 Flight operations budgets are acceptable but are always under pressure.

All of the operational managers from the four airlines were satisfied with the budgets they were given to run their various departments or divisions and none of them believed that during periods of financial hardship their budgets would be reduced, resulting in negative impacts on safety. In the past we had *“...big [operating] margin[s], money was never an issue now we felt [feel] the full force of competition”* (A2QLYMGR01). This competition was the result of new entrants entering the market, as well as established airlines improving their product.

The DFO of Airline A1 claims that he is comfortable with the budget that has been allocated to run the operations division of the airline. The DDFO agrees with this sentiment who remarked that the airline is adequately resourced to carry out the job that they’re charged to do, which is to provide safe, efficient flight operations and, at times, *“we have to push hard to justify resources, but that’s no different to any other company. Do we compromise safety because of lack of resources? No, I wouldn’t say so”* (A1FOPMGR02). The Quality & Standards Manager (Q&SM) who claims that the operations division has always been well supported and resourced also supports this view. When the safety manager at Airline A1 was asked whether his department was well-resourced, the response was, *“Definitely, definitely”* (A1SAFMGR01).

A training manager from the airline believes there should be more training given to pilots coming into the airline, however he maintains that on a day-to-day basis, there are adequate resources given to the airline to maintain their safety standard. A line captain with ten years' experience with the airline commented that resources are better today than they were in the past with regards to training. *"I think that has improved a lot...there's been a lot more training involved which in the past, I don't believe probably would have been there"* (A1FOPCAP01). Nonetheless, not all interviewees agree that Airline A1 is well resourced. One senior captain believes that the airline could be better resourced, however, in line with the constraints of a commercial organisation, he asserts that the resources are acceptable. A check captain believes that the resources allocated to the operations division are adequate now, although pressure from the new owner remains. For example, there is now a heavy emphasis on the monitoring of fuel on board an aircraft at departure.

The DDFO of Airline A2 claims that, with regard to resources, they do not have free reign; they must operate within the budget and are expected to be efficient. Training is a very large part of the budget and, consequently, each pilot's training has to be reasonable and sensible. Moreover, senior management are open to requirements for additional funding where it has been justified. An example is Airline A2, who has identified manipulative skills, or lack of manipulative skills by the pilots, as a major risk because Airline A2 is predominately a long haul airline where some pilots may only perform one take off and one landing per month. As a result, they insisted that their level of operational risk was increasing due to the pilot's manipulative skills atrophying over time. Instead of accepting the risk, Airline A2 mitigated the risk and consequently increased their operating costs by allocating additional simulator training to the airline's long haul flight crews as, *"it worries me that guys aren't getting enough time at the controls. So we try and mitigate that through handling sims [simulator sessions] and more work in the sim [simulator]"* (A2FOPMGR01). One senior flight operations manager believes that an area where the funding of a resource is limited is risk management. The services of the Group Risk Manager (GRM) are utilised across the entire group, *"whereas really, his core role should be here until it is embedded completely and it becomes a way of life"* (A2FOPMGR03).

The flight operations division at Airline A2 has two objectives which are used as a proxy for the other three airlines which are to improve the level of safety and lower the cost per block hour. In addition, these two objectives are not mutually exclusive and are to be pursued collectively, as it is about acquiring balance. An issue that was raised regarding the downward pressure on operating budgets was the emergence of the LCCs. Airline A2 and Airline A4 argue that these airlines are not having an impact on the flight operations budget. The DFO from Airline A4 believes the passengers who fly on these LCCs are very price sensitive and, therefore, are not loyal to any individual airline, whereas “...*the research that we’ve done so far shows that our clients tend to be a little more loyal to the brand, because of the way that we actually treat the passengers*” (A4FOPMGR01).

The DFO from Airline A2 claims that there is no pressure from senior management to reduce the flight operations budget as a result of this new business model.

I don’t think that the introduction of low cost carriers in Asia is putting any pressure on us as an airline or me as a director or flight ops as a department to cut costs to a level where we’re reducing the standard of safety. There’s no pressure like that at all (A2FOPMGR01).

The emergence of LCCs at Airlines A1 and A3 did not appear to be an issue, however the DFO from Airline A1 stated that, irrespective of what is happening, there is always pressure to reduce costs as, “*I don’t know any business in the world that doesn’t reduce costs. We all have pressure to reduce costs.*” (A1FOPMGR01). The newly appointed CEO from Airline A3 wanted to reduce costs by reducing the number of PCs conducted in the simulator to once per year, in line with the regulatory requirements of the USA. The DFO of Airline A3’s response to this was “*“Absolutely not!” and [I] explained to him the reasons behind it, the regulatory requirements and our own company requirements.*” (A3FOPMGR01).

With the constant pressure to reduce costs, one area within an airline that can be exposed to budget constraints is engineering and maintenance, where flight crews can be pressured to accept a non-airworthy aircraft.

C4E2 Aircraft are acceptably maintained and apart from an oversight issue, maintenance is not a problem with these airlines.

In its formative years, Airline A1 was a ‘can-do’ airline “...because in all honesty, when we first started operating into China, if we weren’t of a can-do mentality, we would have never operated” (A1FOPMGR05). An example of this ‘can-do’ attitude and where the line between legal and illegal can become blurred during these formative years was proffered by an interviewee when he explained how, many years earlier, an aircraft became AOG (Aircraft on Ground) in the PRC and the captain was pressured by a manager to bring the aircraft home in an un-airworthy state. This manager is no longer employed by the airline and, as the airline evolved over the years, this ‘can-do’ mentality declined and was replaced by a culture of doing it correctly. “I think now the group, or the company, is proactive now, that as soon as we’ve got an aircraft AOG, they will set about trying to solve the problem, rather than trying to browbeat the crew into taking the aircraft” (A1FOPMGR06). This view is shared by a senior manager from Airline A1 whose response to a question regarding pressure applied to the flight crew to depart when it is unsafe to do so, stated, “There’s never been any punitive action taken against individuals that have not done action like that. We’ve never taken action in that regard” (A1FOPMGR02).

None of the interviewees indicated that maintenance was an issue for them or the airline, except when this function was outsourced. For Airline A1, “in the early days, sometimes you’d have anything up to ten defects on the aircraft” (A1FOPMGR02). Currently, maintenance issues in the company have improved, however there is still room for improvement as, “we’ve had quite a few incidents recently with things like, you know, spanners left in engines, screwdrivers, covers left undone, that sort of stuff” (A1FOPMGR02). Airline A1 outsources all of its engineering and maintenance requirements to a third party supplier, thus increasing the level of operational risk the airline is exposed to. It is standard procedure for dual checks to be conducted after maintenance actions have been carried out so as to ensure tools are not left in engines, and covers are closed. These checks have not always been completed to a satisfactory standard due to a lack of “...oversight of the work, I think, that is the problem” (A1FOPMGR02). These errors did not result in safety-related events, as they are identified before the flight.

The internal problems with this supplier are numerous and are caused by the maintenance organisation's culture and training.

Lack of training...the quality of the individuals they're getting is, I think, low, inexperienced, overworked. They've got the quality systems in place, but I don't think they have the culture yet that believes in the quality systems. So rather than instil a sense of what the threats are to us, they just try and put more procedures in place which work around the main issue (A1FOPMGR02).

Because of the airline carrying minimal spare parts, Airline A2 previously carried a large number of defects in accordance with the Minimum Equipment List (MEL), which provides criteria to allow the aircraft to be dispatched with defect(s). This practise increases the level of operational risk as the flight crew had to deal with the lowered level of redundancy on the aircraft. *"We had the highest number of aircraft malfunction defects than any airline that's been LOSA'd" [conducted a LOSA]* (A2FOPMGR05). This large number of defects carried by Airline A2 has since been reduced, *"as talking about numbers of defects, I think engineering have made great strides"* (A2FOPMGR06). One exercise that Airline A2 does, although this was not discussed by interviewees from the other three airlines, is test flights on aircraft after undergoing maintenance. Airline A2 conducts a number of full test flights involving shutting down engines on randomly selected aircraft. This is an expensive exercise and used to be standard procedure.

Some of the airlines started phasing it out probably ten years ago, because they couldn't see a benefit on it. We see a benefit on it from an audit perspective of our fleet. We know we can benchmark our fleets and see where they're going and then drive that information back into the system to make sure our Engineering Support Services identify if there's a threat, and fix it (A2FOPMGR07).

(One reason why Airline A2 continues to conduct full test flights after maintenance could be a result of this airline having the same engineering and maintenance supplier as Airline A1.)

Interviewees from Airline A3 indicated that they were happy with the standard of maintenance on their various fleets. One fleet in particular was subject to a number of defects due to the age of the aircraft and, if it could not be dispatched in accordance with the MEL, there may have been some pressure to depart with the defect. However, *“in instances where there was pressure to depart or to do the flight, all the Captains were pretty much onto their procedures, and so nothing ever proceeded”* (A3FOPCOP01). Regarding other fleets at Airline A3, the maintenance is considered *“excellent. I really don’t have any qualms on maintenance”* (A3FOPCOP02).

Interviewees from Airline A4 claimed maintenance was not an issue and that all defects are *“signed off and they’re actioned [and]...if I were to show you my roster for the last 12 months and how many delays were caused due to technical problems, it would be 1%”* (A4FOPCHK01). One practise that some operators of aircraft undertake is if an aircraft suffers from a malfunction on a flight to an airport without engineering support, the defect is not entered into the maintenance log until that aircraft arrives at an airport with these facilities. When discussing maintenance issues at Airline A4, a line manager’s response to this practise was, *“No, I think, if you look at our maintenance write-ups, you won’t see them all done at 8.00pm on the last sector of every flight. If someone flies into Hamilton Island and it’s a maintenance action required, then the aircraft is grounded there until it’s signed off”* (A4FOPMGR05).

#### 4.6 Concept C-5 The ‘Management Dilemma’ Has Been Dealt With

Organisations such as airlines operating within a hazardous environment are required to manage their safety risks. The airline industry’s operating profit margin is considered poor; consequently, the problem arises as to what is the optimum level of resources that should be allocated to the management of safety. Making the airline too safe (protection) inhibits the generation of revenue (production) and increases the operating expenses of the airline, both of which may result in financial bankruptcy for the airline. On the other hand, providing inadequate protection may result in the airline having an elevated risk appetite in the pursuit of production without the necessary protection measures in place, resulting in the airline suffering a catastrophic event. This concept relates to the management of the airlines having dealt with the ‘management dilemma’ of providing the required amount of protection whilst still allowing the required amount of production.

##### C5E1 These airlines balance their production and protection goals.

Three of the four airlines are owned by the private sector and both the private and public sector jointly own the fourth airline; consequently, they are required to generate a profit. Senior management within the four airlines supports operational management’s and flight crew’s decisions to cancel and/or delay flights. Operations reports are required to be submitted explaining the reasons behind the cancellation of flights as “...we need to stand up now and again and say, “No that flight didn’t go because of these issues” and they [commercial managers] will understand that” (A3FOPMGR01). In the past, Airline A2 had a tendency to continue operations during adverse weather, such as typhoons, and they also left the operational decisions up to the captain. For example, “...in the old days you would be coming in and going out in typhoons and if you diverted, you diverted and the company did not actually know where you were” (A2FOPCHK05). Presently, for both commercial and safety reasons, the airline will suspend flight operations for an appropriate period, allowing the hazardous weather to pass, “...then we try and restore the schedule as quickly as possible. We know there’s a cost to that, but we think that that’s a wise and safe way of managing the airline” (A2FOPMGR02). The dual objectives of providing an acceptable level of protection whilst achieving as much production as possible without an adequate management structure may result in these objectives coming in to conflict.

What is required is to achieve a balance between these goals. *“I mean you can be the safest airline in the world and go out of business quite quickly. Or you can be a very low cost airline and have an accident quickly. So there’s always going to be a balance”* (A2FOPMGR01). An example of excessive production where protection measures could be undermined, leading to a catastrophic event, was proffered by a check captain from Airline A2 who claimed a number of years earlier, the airline employed pilots who were considered by the standards department to be inferior to the normal selection criteria. The rationale for this occurrence was an attempt to reduce the operating costs of the airline and a manager of the airline at the time put forward the view that the airline could withstand a hull loss. (This belief of a hull loss being acceptable to commercial management of airlines is occasionally heard within the industry with the view that there may be too much protection in place, with a desire to reset the balance in favour of production).

This reduction in protection resulting in a possible hull loss for Airline A2 was strongly refuted by another check captain from the airline who stated that it was purely hearsay and came from a manager without any real basis in fact.

That was the mythology if that’s the right word. There was that amongst the pilots that there was one particular senior flight ops manager and we’re going back 15 years, who may have said in a bar somewhere that we can afford to lose an airplane and we can afford one hull loss and go on. Now that was just bar talk and you know what pilots are like, that sort of goes, you know, it takes its own trail from that point on. It’s certainly never, ever been anything official, nothing outside bar talk (A2FOPCHK04).

The business model of Airline A1 is based on safety and Airline A1 promotes this advantage over its competitors, *“when [flying] to China, when you talk about [name of Airline A1 deleted], most of the people from Asia-Pacific area, they would just definitely choose [name of Airline A1 deleted] because of their safety records”* (A1FOPMGR05). The safety manager at Airline A1 previously regarded production and protection as opposing forces, however he now sees them as complementary to each other and accepts that too much protection is detrimental to the survivability of the airline. *“I’m a believer that we complement, assist, in the commercial delivery. If you set out to compete with that, then you will fail, as a safety man. It’s not either/or. It’s both”* (A1SAFMGR01).

The interviewees from Airline A1 insist that the airline achieves an acceptable balance between protection and production which is best summarised by one interviewee as, *“They certainly take safety seriously...cost will impinge perhaps safety to a level but we don't want it as perfection... there's no utopia effectively”* (A1FOPCAP03).

Protection refers to all facets of safety resources available to the airline. An example from Airline A4 is where its flight crew's CRM training is used as a strategy to push back against production forces and increase protection if and when required. Airlines may believe that they have the correct balance between production and protection as a result of established policies and culture. However, due to commercial pressures, protection can, at times, be eroded, with On Time Performance (OTP) used as an example where the captain is the last line of defence against organisational pressures causing flight crews to rush and, therefore, making errors in both judgement and procedures, with an increase in the likelihood of an adverse safety outcome.

Airline A4 stresses the point that the captain is one of the airline's last defensive barriers and, during Threat and Error Management (TEM) courses, they are made aware of the position that they occupy within the schema. They are to protect the system and to employ measures that, when they do feel like they are being pushed by the system in terms of OTP, to stand their ground, *“...to be assertive, and always remind themselves that they are it, if it's pushed beyond them, then the system is ready to fail”* (A4HUFMGR01). For this 'management dilemma' to remain in balance, the employees of the airlines must be of the same mindset as management.

C5E2 Employee's opinion on the balance of protection-production is predominately in agreement with that of management.

A visual method to instil a safety mindset into employees is with safety posters. Safety posters were on display in the offices of Airlines A2 and A3, although they were not observed at Airlines A1 and A4. This observation was commented on at Airline A1, where an operational manager stated that he was *“...quite remiss on this, you know, because I've never sort of made an issue of it...in all other places I've been to, safety posters [are] all over the place. It's not really all apparent here”* (A1FOPMGR05).

When asking the employees of these airlines to describe the safety culture, only one of the 71 interviewees mentioned their airline's safety culture as generative. *"I think [we] are hoping to move to a generative culture, but we still have a lot of the yesteryears type of culture here"* (A3CABMGR01). This reply was more aspirational than descriptive of the current culture and was interpreted as an indicator of junior management's frustrations at the slowness of the maturation of the safety culture. Asking other employees about the culture of safety evolving within the airline, the yesteryear type of culture referred to previously was considered a very punitive culture. This belief was reinforced by the safety manager at Airline A3 when asked about the transformation of the safety culture. *"...in the last five years, the culture has changed from being a very punitive culture and working through the bureaucratic stage. We are working towards having a really genuine, just culture in place and a safety culture in place within the airline. This is certainly something we've been striving for"* (A3SAFMGR01). Airline A3 has a commitment from operational management to develop, implement and embed a just culture. However, not everybody is convinced the goal has been achieved. Whilst the first officers can see changes for the better, they do not believe the transitioning of the safety culture is complete, as they are observed after landing to check if any reportable events occurred during the flight. *"I notice the First Officers are doing that in particular. As soon as they get on the ground they want to print out the forms to make sure everything is okay"* (A3FOPCAP01).

Nevertheless, there are two main reasons why safety is improving at Airline A3. Firstly, generational change, where the DFO, the safety manager and the quality manager are both reasonably new to these positions and bring with them a different mindset to previous titleholders. With the previous *"...management, years gone by, if you're called up into flight operations, it's because you've done something wrong, and you know, you're in a spot of bother over that"* (A3FOPMGR01). The second reason is the implementation of the legally required SMS, coupled with IOSA, which requires the safety management principles to be embedded throughout the organisation *"...and driving it down and getting that implementation at the lower levels of the organisation, to manage risk, to identify hazards, identify change, manage change, these sort of things"* (A3SAFMGR01).

A long-term employee who stated that there was very little documentation on safety and emergency procedures in the cabin best gauges this change and improvement and *“if it wasn’t documented, then there was no need, you know, to review the risk, yeah. So, and then, we functioned in a sort of a bureaucratic type management”* (A3CABMGR01). Whilst the employees from Airline A3 have trouble with their airline’s evolving safety culture, the employees from the other three airlines considered safety to be well managed and expressed minimal concerns in this area. The flight crews within these airlines maintain that they have the trust from management to make the required decisions for the flight. Because of this trust, the flight crews believe they will not be punished if a flight is delayed or diverted, due to the decisions made by the flight crew because of threats or hazards. Owing to this shared belief, these pilots also share a common understanding of the ‘management dilemma’ with management, whereby *“an airline’s primary objective has to be to be commercial. You accept that we’re a commercial company that has to be commercial. Then our aim is to do that as safely and efficiently as possible”* (A1FOPMGR02).

The flight crew appreciate the commercial nature of the industry, however what was noted was the willingness of the flight crew to push back against management if they believed the protection-production balance had moved towards greater production, with the perception held by these employees that the airline was becoming less risk averse, with possible safety implications. An example from Airline A1 is when these flight crews became fatigued and did not receive an appropriate response from management, industrial action by these employees was initiated in an attempt to resolve this issue. Another example, this time from Airline A4, was that if the perception by the flight crews was that the airline was taking on an elevated level of risk, these employees would start asking questions and would want to obtain information from management.

If something goes out that’s a little bit risky, every pilot starts talking, and so, and they can go in and talk, so that, you’re not told what to do. If the group came back and said— This is— People started hearing about it, and then we’ve got to justify why we’re doing it. And to justify it, you’ve got to be reasonable about it (A4FOPCHK02).

#### **4.7 Concept C-6 Change Management Processes are Improving**

The airline industry is constantly changing its procedures, whether this is a result of technological, regulatory, commercial, or any other reason, is unclear. Previously, some of these changes have inadvertently resulted in both serious incidents and accidents. ICAO now requires airlines, via their SMS, to manage the safety risks associated with any change. The safety manager from Airline A3 agrees with the requirement to manage these safety risks on a formal basis, as he believes risk management in its basic form is quite straightforward and most airlines can, and should, address safety risks. However, when an airline conducts operational changes to a process or procedure, the possibility exists for unknown risks to be inadvertently introduced. Previously, this airline failed to identify these new risks and when these risks materialised the airline had to go back and redo the process, with the associated additional costs.

The key in risk assessment with regard to change management is determining “...*what is the risk associated with this change? And failing to identify all the hazards associated with that can quite often cost us time in going back, re-doing things and fixing things that should have been done right in the first place. That’s where the weaknesses are at the moment within our risk management system*” (A3SAFMGR01). This lack of identification of all the hazards and issues may have resulted from a lack of consultation and communication with the stakeholders.

C6E1 At times, there is inadequate consultation and communication with stakeholders.

Interviewees from the four airlines previously claimed that their airline did not manage change well, but they acknowledge their airline is improving in this area. An example is Airline A1 where, today, the airline change management processes have improved as a result of learning from their previous mistakes. This airline changed its procedures regarding obtaining the take-off performance calculations and these calculations are now routine and are completed before every departure. However, if these calculations contain error(s), the result can range from being a minor incident to a serious accident.

During the development phase of this change, a number of senior captains voiced their concerns about the lack of post implementation monitoring and assessment on these new procedures. The responsible manager considered these concerns unnecessary and dismissed this feedback. A few months after these procedures were implemented; a flight crew erroneously entered incorrect data into the aircraft's performance computers as a consequence of a lack of understanding regarding the back-up function for these new procedures resulting in the aircraft taking off with incorrect take off speeds.

How do we know that guys are doing this procedure properly? There's no feedback. They've been told to do the procedure, but there's no assessment. There's no control to see whether they've learnt the procedure properly, whether they understand it, or even if they bothered to learn it at all. The training manager at the time said "Not necessary...this is easy stuff. They don't need to do it." I remember the feeling of the trainers at the time was very unhappy about it (A1FOPCHK01).

A line manager from Airline A2 was concerned there was the lack of consultation with stakeholders regarding change management. This manager's concern is that the airline limits its change management processes to a small number of senior stakeholders and does not consult widely enough, leaving junior stakeholders outside of the change processes. These junior stakeholders, in the example proffered by this manager, were the junior line managers and flight crew who have to implement and comply with the changes. Another issue raised within Airline A2 was the lack of communication from the creators of the change to the compliers of the change which, in this study, would normally be the flight crew. This perceived poor level of communication was centred on the lack of background information regarding the change and, if additional information was forthcoming, it didn't always explain the change. This line manager believes changes could be implemented for the better rather than the airline issuing the new procedure and requiring flight crew to comply with it.

I think if we could explain the rationale behind some of these changes more effectively, then crew would understand them a lot better and be able to adapt to the new procedures a lot. I think that's a big part of change management, is communication and effective communication to the workforce and to the other managers so that you know what's going on (A2FOPMGR05).

The manager of line operations at Airline A2 has acknowledged this concern regarding inadequate stakeholder consultation, especially with regards to operational manuals.

In the past, this airline added changes to what this airline refers to as legacy manuals. In an attempt to overcome this lack of consultation, Airline A2 has adopted the European Aviation Safety Agency (EASA) format, where it is not possible to change a manual unless all concerned stakeholders have agreed to the changes, as these manuals are electronically tagged to stakeholders. The processes involved with these operational manual changes included a human factors overlay to ensure it was human friendly for the end users, as well as input from managers from the QMS and RMS.

You go to the EASA format where there is set holes for things to go into. What we've done there as well, is we've tagged stakeholders onto it electronically. So I can't go and change information, if you're a stakeholder, without consulting with you first to make sure that if you've got it in your documentation, it's linked. So when you sign off on it, it changes yours automatically (A2FOPMGR03).

A number of the interviewees from the four airlines believe their airline did not manage change as well as they should have, however their airline's ability to manage change has improved over time. There are a number of reasons for this, such as learning from their past mistakes, the formalising of change management as part of a SMS, and advances in technology, such as electronic tagging. An area that was discussed at length was the change from an informal to a formal process, which included the requirement for documentation whereas, previously, managers partly conducted changes on an intuitive basis.

This additional requirement for documentation regarding change management processes includes the possibility of senior stakeholders documenting change management processes to fulfil a regulatory requirement, and operational stakeholders, such as junior line managers, treating this manual as shelf-ware due to a lack of understanding of these new processes. This was observed with Airline A4, where a finding from the regulator during an audit noted that documented change management processes were not being followed.

That's one of the things the regulators had a swing at us about is we've got these processes there and they're not followed. We've got change management guidelines that are quite well laid out, but they are not followed and it's not a matter of guys just knowing the procedures and so we're ignoring it (A4FOPMGR02).

Another cause of concern with regards to change management is the large amount of changes that are occurring within an airline, with a large number of the interviewees expressing their concern that large scale changes can be hazardous for two reasons. Firstly, the claim is that it causes confusion within the flight deck when complying with these SOPs and, secondly, a large amount of change puts pressure on flight crews, with an associated detrimental impact on safety.

The biggest concern I have with this airline at the moment is the amount of change we're going through in the last say two years. There's been a phenomenal amount of change. It puts a great deal of pressure on the people operating in the front line, the line crews and it is a significant threat to our safety (A1FOPCHK03).

#### 4.8 Concept C-7 The Role of QMS Within a SMS World

##### C7E1 Overview of QMS within these airlines.

All four airlines have a QMS, however the limitation in this section is that no person from the QMS in Airline A4 was interviewed and, subsequently, there is no data from that airline with regard to its QMS. Some of these airlines have an embedded QA structure across the airline, whereas others are limited to certain divisions. QMS analysis in this study excludes the *“Aircraft Maintenance Organisation as they have an internal QA by law and their safety outcome is managed by the QA team and they do their own investigations, they use a media process”* (A2QLYMGR01). As such, this study’s review of QMS is limited to flight operations.

Airlines A1, A2 and A3 have a quality representative within flight operations, with this position having dual reporting lines; a solid line to the DFO and a dashed line to the quality manager. This position was occupied at Airlines A1 and A2, however for Airline A3, the position is unfilled due to financial constraints. Airlines A1 and A3 has QA housed either within, or associated with, the safety department, whereas at Airline A2 the QMS is independent of the safety department.

##### C7E2 The role of QMS within these airlines.

Airlines A1 and A2 have similar roles with regards to quality. The objective of the QA section within Airline A1 is to ensure the airline’s objectives are achieved, by lowering the variance in process outcomes through documentation and confirming compliance through the audit program. These audits are both internal and external, with a quality representative within flight operations conducting an *“...internal audit for every 12 months for the whole section, Operations Section”* (A1QLYMGR02). The role of QMS within Airline A2 is to deliver integrity by ensuring process integrity which, in turn, produces system integrity and minimises variation in the output of these systems and processes. This integrity is achieved through policies on documentation control, as well as auditing the operational areas. In the case of Airline A3, where the position of quality coordinator for flight operations is vacant, this airline has adopted a policy *“...where we have given the independence to the various process owners to do self-audits”* (A3QLYMGR01). A key function of quality within these airlines is to ensure the operational areas of the airlines comply with the relevant regulations, which are achieved through the audit program.

### C7E3 Ensuring operational compliance via the audit program.

A motivating factor in the establishment of these airline's QA programs was the wide variance in the output of processes within the operational areas. There were a number of reasons for this variance, such as inadequate policies, a lack of oversight and the quality of the outcome being dependent upon the individual abilities of each of the process owners.

So there was a lot of variance in the way that we delivered it [outputs from the airline's internal processes] when I came here, [1996] [name of airline deleted] was basically run on the basis of individuals' personal capability. If you had a bad day, you had a bad day, or if you didn't turn up nobody knew what to do (A2QLYMGR01).

With the ICAO SMS not having a requirement for a QMS within flight operations, some airlines may disband their QMS. Under domestic legislation, none of the three airlines are required to have a QA program in place, however they must have "...*safety assurance, though not a separate quality assurance*" (A3QLYMGR01). Not having a requirement for a QMS in the ICAO SMS has created some derision from the airline industry. The quality manager from Airline A2 commented, "*I've got to say ICAO have not thought about integration at all – it's very academic and nobody sat down and said, "What do the airlines have and how can we build SMS on it" some academic guy has said, "This is an SMS"*" (A2QLYMGR01).

ICAO does not prevent an airline from having a QMS in place; it just does not require a QMS within the SMS. Without a legal requirement to have a QMS in place, senior managers within an airline may consider withdrawing funding for the QMS. One quality manager asked whether the senior managers from his airline requires him to justify the existence of the QMS, as there is no regulatory requirement for the airline to fund a QMS. This manager responded by stating, "*They ask this question a lot. What do you bring to the table?*" (A2QLYMGR01).

The quality manager from Airline A2 believes organisational control is a key function of a QMS through the control of documentation and in areas such as assisting in the defence of litigation. Without this organisational control in place, audit trails of an acceptable quality are not possible, with the possible resultant loss of legal challenges.

There was a lot of variance in the way that we delivered it. 20 years ago you could get away with it. Now, there has to be an audit trail, you have to basically stand up and say “This is how we do it, this is how we manage it, this is how we control it, this is your documentation, these are our records”. So the world has changed hasn’t it? Now you have to basically be able to front up with all the evidence. We’ve got a number of Court cases running through on the cabin crew side which are still going on from the days when our processes weren’t particularly well defined and we’re just losing them one after the other (A2QLYMGR01).

When asked whether his airline would keep a quality system or discard it as no legislation requires such as a system, the quality manager from Airline A3 responded that a stand-alone QMS is not required. However, an airline does require a quality system, which can be housed within a management system, such as a SMS. The functions that would be conducted by this quality system include the audit program, with its findings and associated Corrective Action Required (CAR), with closure and document control; and integrating and supporting the role of risk management. In addition to these roles, the quality manager believes an important reason for keeping the function of quality within the airline is its role in reviewing an action via the PDCA cycle, with the benefit of reducing waste. This manager believes the functions of safety, risk and quality overlap with each other and should be integrated.

Quality is an integral part of safety management. Your Plan-Do-Check-Act, you can never phase that out. That’s just, you know, we’ve got to plan it well, we’ve got to do it, we’ve got to see what went well and what didn’t go so well, alter it, fine-tune it (A3QLYMGR01).

The DDFO from Airline A1 remarked that the airline uses both reactive and proactive strategies in its risk management, with the safety manager from Airline A1 confirming that the airline is conducting more proactive strategies as a result of including QA in the process. This safety manager would like to see the “...*industry developing into a more risk assessment process, because safety, by nature, is reactive. But what I have to take up with QA, this is a more proactive system*” (A1SAFMGR01).

The QMS in Airline A2 has also embraced risk as an input component when they produce their annual audit plan by identifying the top five risks for flight operations in Airline A2.

So we do top five causes risk breakdown, so these will be our top five – this is for the 2009 audit year. So we've got organisation factors, inadequate control and monitoring, - this is the James Reason model here – inadequate checking, hazard risk misperception, task unfamiliarity and procedures not followed, so those are the areas that we'll build our plan around (A2QLYMGR01).

Whilst ICAO does not require a SMS to contain a QMS, a number of the interviewees raised the concept of integrating a RMS and a QMS within a SMS.

#### C7E4 Integration of all three systems-SMS-QMS-RMS.

A risk manager at Airline A4 believes risk, safety, and quality should be integrated within the same structure, as they complement each other:

So when they go to the auditor, the auditor would say "I've got five findings. My risk level for each finding is as such." So that's also part of the safety system, and also the full risk reporting, looking ahead, without any audits, without any investigations or new initiatives, that's also part of the Safety Management System (A4RSKMGR02).

There may be a managerial problem in terms of integrating all of these functions within a single department, however this risk manager does not see that as a problem, as all of their functions have to be completed. A possibility was raised regarding integrating the QMS and the RMS in a single department external to the SMS, however a risk manager from Airline A4 believed that, with the contemporary legislation, this is not possible.

Maybe 20 years ago, 10 years ago you could, but when you look at the legal requirements, the way they identify Safety Management System now...Under ICAO, under all of them. They include both sides; the reactive and the proactive (A4RSKMGR02).

Another possibility is to combine the SMS and QMS as integrated management systems and accommodate the RMS separately. Originally, the concept of the RMS at Airline A4 was designed around safety-related risks and, as the RMS matured, it was realised that when risks across the airline were presented to senior management it became obvious that a common framework was required.

Consequently, non-operational departments such as finance and information technology were included.

So when we published our [name of airline deleted] risk standard, it actually does account for the financial, the strategic, [and] all those other things. And we have what we call “risk dimensions”. We have 17 separate categories if you like that cuts across the whole company that looks at the human resource type issues etc (A4RSKMGR02).

This common framework for Airline A4 covered all risks and not just those that were related to safety or quality issues, nonetheless, over time, the risk framework was merged with the SMS.

The quality manager from Airline A2 believes the three systems are complementary as each one has their strength: SMS is reactive, a QMS is proactive and a RMS is predictive. However, this manager claims that a predictive system has limitations as it is based on limited information and is driven by the severity of the outcome. An example proffered is an accident where the consequence is catastrophic and the focus is on severity of the risk materialising, *“rather than the likelihood of its occurrence and likelihood is like throwing dice, it’s about probability which is a very imperfect science”* (A2QLYMGR01). What is required is all three of these systems working together *“with your emergency response or your contingency planning sitting underneath it just in case the unexpected happens as it’s going to, and somebody has got to pick up the pieces”* (A2QLYMGR01).

Apart from conducting its own internal audits, a QMS also hosts external audits of an operational nature. One of these external audits is referred to as the ISO 9001-2004, which is an audit on the organisation’s quality system, focusing on customer requirements of quality and consistency. This audit was not discussed by any of the interviewees, with the exception of the safety manager at Airline A3, whose stated position with regard to this audit is, *“Well, our Engineering section used to be ISO [9001-2004] certified, but it doesn’t mean anything to anybody in the aviation industry, and it’s expensive to maintain”* (A3SAFMGR01). An external audit that is very significant in the aviation industry is the IOSA. As a result of this significance, the analysis of this audit is presented in its own section.

C7E5 IOSA-strong positives with some negativity.

The interviewees were questioned about the role of the IOSA in managing FOR and, for the most part, all of the interviewees spoke positively with regards to the benefits this external audit brings to their respective airlines. With the deregulation of the airline industry, new entrants to the industry are established and, apart from employing experienced industry professionals, these entrants lack accumulated corporate knowledge. This lack of airline knowledge restricts the development of these airlines, as the regulator's requirements are purely legal and not prescriptive. An example of this is Airline A1 which is not a legacy carrier, is relatively new to the industry and is an airline that *“grew on the back of, let's say, the [name deleted] [Regulator's] requirements. Dare I say it was not much prescriptive in terms of [the] organisation. We just grew and grew and it stemmed from there. So there wasn't much guidance in terms of organisation structure”* (A1QLYMGR01).

Airline A1's first IOSA resulted in 80 findings being recorded, which is a large number of findings when compared to Airline A2 whose *“Last Audit went 17 yeah [and] the industry average is around 25”* (A2QLYMGR01). Of the 80 findings, *“I would say, a good proportion of them, a good 50 of them were purely [related to] documentation”* (A1QLYMGR01). IOSA findings have to be closed within a twelve-month period following the audit's closing meeting. During this period, Airline A1 amended their manuals to bring them in line with the industry's best practice. This Airline's subsequent IOSA resulted in *“10 findings. None of them were documentation, because then we'd cleared all our so-called documentation findings”* (A1QLYMGR01). There are, however, possible downsides to IOSA; one is possible collusion between the Audit Organisation (AO) and an airline. This credibility issue was raised, with only one of the interviewees forthcoming with a response who stated.

One of the things I've heard – I mean, I've no personal experience of it – is depends on which AO you get. Some are a lot tougher than others. It's no secret we use [name of AO deleted], and they have quite a good reputation in the industry for being fair and being fairly tough. So we don't choose somebody that we're going to have an easy ride (A1QLYMGR01).

An IOSA is very comprehensive, requiring an airline to demonstrate that all the standards contained within the IOSA Standards Manual (ISM) are conformed with, are documented correctly and include evidence to show that all standards are implemented. Another possible negative aspect of the IOSA is the writing of standards that airlines have to comply with, but are reluctant to do so.

What's important for us is to recognise that this change is not about doing it for IOSA, it's about trying to make the manuals more readable and more understandable, more workable for the people who have to use them. And I think we tend to lose sight of that. IOSA tends to be, it's the classic tail waving the dog, and it's driving a lot of people's manuals (A1FOPMGR02).

Airline A2 adopts the view that the IOSA is a second regulator. The first regulator is the national regulator where Airline A2 is domiciled and the second regulator is the industry via the IOSA. *"We're audited by IOSA once every two years as well. So it's almost like having two bosses"* (A2FOPMGR02).

Interviewees from QA from Airline A3 believe the IOSA was very beneficial to the airline as it was the catalyst for driving change within the airline with regards to safety and risk outcomes, as this audit *"...identified the various failings and other resources that we need"* (A3QLYMGR02).

#### C7E6 Functionality of the quality software.

All four airlines use the same software for their quality requirements. The opinions on the functionality of this software are dependent upon both the airline and the interviewees.

At Airline A1, the view of one quality manager is that the software is very basic in its functionality. Still, this belief may be the result of Airline A1 having limited knowledge of this software, as the airline has been using it for a period of 12 months.

Airline A2 was the first company to purchase this software, which included testing the beta version of it. Consequently, it has extensive knowledge of its functionality. The view of the quality manager from Airline A2 is that it is a database, and this manager is aware that some end users in Airline A2 do not like it, as they consider it too complicated.

This software has a risk module attached to it, making it suitable to be used for quality, and risk. The ASM from Airline A2 believes the risk module for this software is simply there to assess risk and that the process should be not complicated. *“Yes and it should be [simple] and I think one of the problems that people get into is they want to make it too complex, they want to make risk too complex, they want to make risk assessment too complex”* (A2SAFMGR01). This manager believes that one of the inadequacies in a RMS within the airline industry today is that there is no fully integrated software that combines all of the requirements across the board. It should be possible to have quality, safety and risk integrated into a single piece of software, rather than just having pure risk software, or quality software with a bolt-on risk module. *“I know people have tried for it and it’s all been a little bit rubbish so far but I would like to see some sort of completely integrated risk software, not risk software, SMS software that can combine the flight data and all of this stuff together”* (A2SAFMGR01). From a purely risk management perspective, the GRM from Airline A2 believes there is no risk software that is appropriate for the airline industry. Consequently, all tools, such as risk registers from the GRM at Airline A2, are created in-house.

Airline A4 has extensive knowledge about the functionality of this software as they have been using it for eight years in areas such as safety, investigations, audits and compliance. A large number of interviewees within Airline A4 expressed disappointment with this software and the airline is going to replace it, primarily because it does not effectively integrate risk management into the overall system. This is due to the application of risk management processes and capabilities within this software being limited.

It provides you with limited reporting; the framework in there is not customisable. So it’s basically what they supply, the new version coming out is a little bit more customisable, but it still wouldn’t allow us to use our model. We’d have to use the [name of software deleted] model. The accessibility of a produce, its useability, I couldn’t give [name of software deleted] to the people that use our risk management system now and deploy it as broadly, because it just doesn’t lend itself to that (A4RSKMGR01).

The current problem with both risk and quality software in the airline industry is they are single functional and what these airlines want is a fully integrated system.

Airline A4 believes the cost to the airline to change their quality software is close to a million dollars, plus staff training costs. This negative view of the available software is widespread in Airline A4; one manager believes the airline's biggest problem is the software itself as the airline is being held back by its lack of functionality, such as an inability to data mine and the large amount of support resources it requires.

The biggest problem with [name of Airline A4 deleted], I think, is their crippled by [name of software deleted], because it's such a piece of garbage, and it absorbs so much, in terms of resources to feed it and to look after it, and you can't data-mine, so you can't get in and extract data out of the thing. They actually have to extract it out and feed it into an excel spreadsheet or some other bloody thing to get any data out of it, which is just appalling (A4HUFMGR01).

Airline A4 uses dedicated risk software for the airline's risk management functions which is separate from the software used for its QA requirements. End-users of this software within Airline A4 claim it is, *"Very basic, is not the most functional system, it's very basic"* (A4RSKMGR03). The problem with the risk software used by Airline A4 is it is not very functional, has trouble looking for information and, when the RMS was audited, this software was a finding. The biggest problem the flight operation's risk coordinator has on a daily basis regarding risk management is *"...the software, I don't like the software. It's time-consuming. I put off doing things in [name of risk software deleted] because I just don't like the system"* (A4RSKMGR03). Another risk manager from Airline A4 is not as critical of the software as other end-users, as he believes both types of software have their limitations, such as having to run the risk software through an internal server which results in a very slow output. This manager believes the quality software is delivering below expectations and the risk software is delivering, although it is not optimal. He believes operating separate software for risk and quality is not desirable as the software does not deliver optimal performance, requires two licences, and doubles the employee's educational requirements. The key is for the Information Technology (IT) industry to deliver a fully integrated risk and quality program which, this manager believes, should be available soon.

## 4.9 Concept C-8 The Regulators and the Airlines

### C8E1 Role and relationship of the regulator.

Of the seven primary categories, the smallest data set was that of the regulator. The rationale for this is that most of the interviewees do not have an association with the regulator. The primary role of the regulator is to ensure the country's aviation safety regulations are enforced. Whilst providing oversight to ensure regulatory compliance by the aviation service providers is achieved, it is believed that the regulator by being open and communicative will foster a constructive dialogue between both parties. The results of the analysis of this concept are presented in a different style to the other concepts, as the relationship between each airline and its respective regulator is unique and cannot be condensed into a key point's format. Consequently, the analysis of each relationship between airline and regulator are presented on an airline-by-airline basis.

#### 4.9.1 Airline A1

This airline is audited for the renewal of the AOC which is *"...done in a very professional manner, and we do have one or two findings, which is good"* (A1SAFMGR01), as well as documentation audits which are conducted every few months. The relationship Airline A1 has with the regulator is described as *"Very good. It's, as is in Asia, to a degree, outside of Australia, it's quite a personable relationship that you have...approachable"* (A1FOPMGR05). This approachability is acknowledged by the DDFO in response to the possibility that the relationship between Airline A1 and the regulator could become too approachable and end up being 'cosy.' *"Cosy implies that we're all great mates and we go drinking together, perhaps. That's not what happens. It's cosy in that our FOI can come here, and, "Oh, [name deleted], come in, sit down! What are you talking about?"* This opinion is shared by other managers within Airline A1 as the safety manager describes his relationship with the regulator as *"Professional and friendly, I would say. I wouldn't say its cosy"*. Airline A1 regards the regulator as being *"... a little bit old-fashioned. It's sort of 1980s, early 1990s British CAA"* (A1FOPMGR02).

Airline A1 regards the FOI responsible for the airline, as being knowledgeable and practicable, and is prepared to show common sense on some issues but, at times, the inspectors exceed their mandate regarding compliance and “...we feel they’re just, they tend to micro-manage, almost. Sometimes, they’re more than a regulator. They want to manage our airline as well” (A1FOPMGR02). Another manager who was asked whether the regulator could be compromised, supports the belief that the regulator wants to micromanage Airline A1. The regulator will try and make Airline A1, at times, document a procedure that is not required by law. However, when “...you wish to question them, they’re quite happy if they have to substantiate why they’re requiring something put in the book, or do something. They sometimes back down from that, of course, because they’ve done it on a whim” (A1FOPMGR05). The considered opinion of the relationship between the regulator and Airline A1 is summed up as, the “Regulator is a rigid administrative machine... it’s still very much regulator and operator” (A1FOPMGR02).

#### **4.9.2 Airline A2**

The regulator for the renewal of the AOC audits this airline. The relationship is “definitely arm’s length. Neither is in each other’s pocket...we know each other on first name terms” (A2FOPMGR02). Airline A2 is the largest airline in the country and they believe that they do not receive any preferential treatment and that they operate well above the required compliance standard “...as I think [name of airline deleted] is a very solid self-regulating airline” (A2FOPMGR02). The relationship requires constant communication and there has been no reduction in oversight by the regulator. The FOIs have gone from being expatriates to nationals, and they fly in the first officer’s seat with a training captain to remain current on the aircraft.

### 4.9.3 Airline A3

The regulator for the renewal of the AOC audits this airline. The relationship that Airline A3 has with the regulator is described as, “*A good working relationship...the Senior Flight Ops Inspector that’s nominated to oversight [name of airline deleted] has extensive experience with Qantas*” (A3FOPMGR01). Communication between both parties is extensive and, at times, on a daily basis. As a result of the personality of the FOI, the relationship can sometimes be strained “*...and discussion gets quite robust at times...because the Flight Ops Inspector is quite rigid in some of his attitudes and requires a fair bit of persuasion if we want to deviate from anything which is not in his favour*” (A3FOPMGR01). An example of an issue that creates stress between Airline A3 and the regulator is the FOI’s insistence that the FOI conducts all initial issue type rating check flights. This is different to the industry norm where “*...in many airlines, it’s delegated to the airline check-and-trainers and the establishment to ensure the standards have been met, and of course the paperwork is then sent to the regulator*” (A3FOPMGR01). Airline A3 is trying to change this policy as there is considerable cost imposed on the airline and they believe it will change at some point in the future. Airline A3 has had “*in the past, issues with them [regulator]*” (A3SAFMGR01), where the airline had internally identified issues which they were in the process of correcting and, in the support of full and open reporting, advised the regulator, “*...then they come and jump all over us so you tend to think well, you should keep quiet. But we never have*” (A3SAFMGR01). This behaviour by the regulator “*...seems to be a thing of the past, and we seem to have a very good rapport worked out now. They understand that we’ve found the problem, we’ve putting the corrective action in place, and they might just assist us to think about something, a mitigating action, that we haven’t considered*” (A3SAFMGR01). Currently, the relationship is described as a good relationship. With this good relationship in place, and with Airline A3 being one of the largest companies in the country, it may be possible for the airline to leverage this relationship to obtain preferential treatment from the regulator. This belief was very strongly refuted, “*...certainly not...it’s very much the industry and the regulator. However, to a large extent, we have to work together. But they are the regulator, there’s no two ways about that*” (A3SAFMGR01).

#### 4.9.4 Airline A4

Previously, this airline has had issues with the regulator when resources were limited and auditing was conducted on a snapshot basis. There were no standards regarding documentation control and the regulator “...were absolutely nailing us with CARs and we were about to get a safety alert, basically, because our documentation was out of control” (A4SAFMGR03). There has never been any legal proceeding initiated by the regulator against Airline A4 although, on one occasion, an incident “...where dangerous goods were carried on one of our aircraft, put on there by an engineer, and the regulator launched a[n] [investigation]...I don’t believe it ever went to court, finally, but it came close” (A4SAFMGR03). Today Airline A4 has systems in place, “...making sure that the organisation’s quality and safety and regulatory requirements [are met]” (A4SAFMGR03). The regulator was a motivating factor in the creation of the risk management framework within Airline A4 and on a recent audit for the renewal of the AOC, the regulator “wants us to do a risk assessment on everything... CASA [Civil Aviation Safety Authority] has a very high visibility over us, and they want us to assess risk on a much higher level” (A4FOPMGR04). As Airline A4 has matured, so has its relationship with the regulator and now the regulator looks to the airline for guidance from this airline on various industry issues. One example is in the area of assessing NTSs, “where CASA will wait to see what [name of Airline deleted] does here and take strong guidance from us because it’s one area that we are leaders in” (A4FOPMGR02).

#### **4.10 Concept C-9 A RMS is not yet Embedded Within These Airlines**

C9E1 Flight operational risk is managed on an informal basis.

Airline A1 manages its risks within flight operations primarily on an informal basis, with this traditional style being part of this airline's culture from the beginning. The flight operations management team are very comfortable with this airline's adherence to these traditional methods of managing its FOR. The concerns associated with implementing a system of formalised processes include the possibility of risks not being identified, selecting the types of educational programs required to train the staff in risk management, and the possibility of replacing an informal system that has worked for the airline from the beginning with an unknown, formal one.

You can spend a lot of time doing all the analysis and the inputs and the outputs, but if it is done by a bunch of automatons who aren't really sure what they're looking at; you end up with gobble-de-gook (A1FOPMGR02).

If the airline were to implement a RMS, managers believe it should be integrated within the corporate safety and quality department who would provide oversight for this function and the management of FOR, such as risk assessment, being conducted by the risk owners themselves.

Only the people who are involved in the operation, who will understand what's the significance of that risk and how serious is that risk, and how likelihood it will happen. I do not think a group of people who are sitting in the front area could do the risk assessment and do perfect risk management. (A1QLYMGR02).

Whilst some of the flight operational managers from Airline A1 are reluctant to formalise an informal system that has served the airline well, the safety manager at Airline A1 is motivated to formalise operational risk management and agrees that the SMS is a driver of this process. As part of this formalising process, this manager has been looking for the right tools and believes tools are required to solve these problems. He declares that it would be ideal if you could find a magic bullet that could implement a RMS which met the stakeholder's requirements, but acknowledges that this is not possible.

Risk, at the end of the day, it still relies on experience. There's a lot of subjectivity to it. I don't think there's a magic bullet somewhere...it's the culture in the organisation that helps you to unravel the hazards, you know, and therefore you can sort of identify risk better (A1SAFMGR01).

This manager is unsure of what tools the airline will use, however he was positive that one of the tools this airline will not be implementing is the ‘bow tie analysis,’ because “...it’s very cumbersome to use. The thing we’ve got to look at in the airline environment, you know, is a tool where it’s got to be efficient and it’s practical to use. It’s not practical in the airline environment” (A1SAFMGR01). All of the pilots interviewed from Airline A1 maintain that the management team manages FOR well, albeit based on informal traditional methods.

This informal risk management process was discussed at the other airlines and a manager from Airline A2 gave an example of how FOR was managed along informal lines 25 years ago. The then DFO would use his ‘gut instinct’ with the belief of not reaching for the ‘poison dollar,’ that is to say not to overreach, and “...he would always look for ways of just pulling back. If a job was offered that might have some risk he would always pull back from it” (A2FOPCKR04). If there were too many risk factors involved in the flight, some would be removed, such as conducting the flight during the daylight hours rather than at night to lower the level of risk to what the DFO himself would consider to be an acceptable level, rather than an organisationally accepted risk criteria.

A quality manager from Airline A1 believes what they have done so far regarding formal risk management is only what is required by regulation within the SMS. “At the moment the only formal risk management that’s put in place is what’s required by the regulator.” (A1QLYMGR02). This view is supported by the GRM from Airline A2 who is new to the airline industry and whose primary job function focuses on business risk, rather than operational risk. This manager believes one of the biggest problems facing the aviation industry, which is similar to the nuclear industry, are the extensive amounts of regulations that are required to be complied with, the outcome being, these industries become reliant upon regulatory compliance to manage their operational risks.

The nuclear industry and the aviation industries are pretty similar in a lot of ways, very heavily regulated. But one of the big risks I think for both industries is because they’re so heavily regulated; they tend to depend on the regulations for what they should do and say (A2RSKMGR01).

This belief that regulatory compliance is the change agent driving the formalisation of risk management is supported by the management team within Airline A3, as these managers believe that both state and industry regulatory requirements in the form of a SMS and IOSA are the agents of change. Because of these changes, managers at Airline A3 insist that formal risk management is progressing within the airline, with risk assessments being conducted more frequently and associated terminology being heard with increasing frequency. Formal risk assessments are carried out on new routes and new airports, with risk management being reactive, as well as proactively looking for possible events that may occur through the audit process.

Airline A2 has a formal structure to manage its FOR via a committee system. The superordinate committee is known as the Safety Review Committee, is chaired by the Head of Safety and is attended by three directors: The Director of Engineering, Director of Flights Operations and Director of Service Delivery. The Air Safety Review Committee is also attended by subordinate managers from the different areas and they monitor all safety aspects of the airline, including occupational hazards. They look at the Mandatory Occurrence Reports (MOR) and each division is answerable to the other divisions, explaining what happened, why it happened and what they are doing about it to stop it from happening in the future. This increases the visibility external to the divisions, resulting in an increased level of scrutiny by fellow managers. Whilst the airline has a formal risk management structure, not all of the flight operations division's risk owners manage their risk on a formal basis. One department that has adopted formal risk management processes is the line operations department, due to the perceived elevated level of risk this department deals with.

Probably because we're dealing with databases, we're dealing with terrain. Maybe they would feel-and I don't want to speak for them-but maybe they feel, "oh we've seen this, we know how it works." Whereas everything we do, normally the first time anyone's looked at it. So you can't be off the cuff, you have to have a process that hopefully you won't miss anything (A2FOPMGR04).

The manager responsible for this department believes the biggest contemporary operational risk the aviation industry faces is electronic and can include any electronic instrument such as a navigation database. This manager believes the formal management of those navigation databases is very loose within the aviation industry (navigation databases can have errors and with monitoring being a top five risk, this issue is exacerbated). An example proffered was an instrument approach referred to as a Required Navigation Performance Authorisation Required (RNP AR).

Even ICAO recognise[s] that it's major problem, particularly when you go to RNP AR approaches that it's not very well done. So that's probably one of the biggest risks for the industry at the moment, is all that electronic material, management of that, and the processes (A2FOPMGR05).

The formalised RMS at Airline A3 is similar to that of Airline A2 with regards to its structure, whereby the management of the risk lies with the process owner, the owner of the risk and then their supervisor, as well as the heads of department. Still, overall responsibility lies with the divisional heads and, ultimately, the manager who is accountable is the CEO. The Chief Operating Officer (COO) of Airline A3 states that risk is managed throughout the airline on the Position Description (PD) of about five or six managers. This manager confirms that the airline's intent is to create a new position referred to as the Manager of Safety and Risk (MSR), as he reasons that everything the airline does has an element of risk involved in it and, if this risk is mismanaged, the consequences could be catastrophic.

In our view, risk management is probably the key to our business. Everything we do has a risk element to it. If you get it wrong, then it's pretty unforgiving. So in that, I guess that philosophy has to be embedded in the company at a high level, and I guess that's what's driving us (A3EXCCOO).

The COO of Airline A3 wants to expand the risk management aspects of the SMS, from looking at the operational areas to an organisational-wide risk management, including non-operational departments. The objective is to expand risk management from what is required by legislation within the SMS to an organisational-wide ERM, with risk management domiciled within the safety department, and with most of the compliance requirements and day-to-day responsibilities remaining within the SMS.

Risk management is documented in Airline A3, however, now not all departmental and divisional managers take responsibility for the risks they own. Indeed, this ownership issue will be resolved by re-writing each of these manager's PD's. The current structure at Airline A3 has the safety manager answerable to the DFO, whereas in the future it is anticipated that the new position will be a General Manager (GM) position, an equivalent rank in the organisation as the DFO. Moreover, the DFO of Airline A3 believes risk management is not embedded within the airline, however he claims that the newly created position of the MSR will assist in risk management becoming embedded. The subsidiary airline from Airline A3, referred to in this study as Airline A3-1 which operates propeller powered aircraft, manages FOR from the cockpit perspective through the experience of the captain. From the organisation's perspective, risk is starting to be managed on a formal basis with the introduction of Safety Action Groups (SAG) but is still very much managed along traditional lines, based on legal requirements and the more traditional informal management practises. *"We've commenced our SAG meetings – Safety Action Group meetings – however the processes are still being developed. I suppose in that sense it's still in [its] infancy"* (A3-1FOPMGR01). These processes are adopted from the parent airline's SMS. Indeed, processes and other risk assessment tools and techniques are being discussed at greater lengths. *"...we actually used the [name of airline deleted] risk assessment form and a fairly thorough risk assessment of the aerodrome before we went there. That was my first formal introduction to it...January 2007 I believe"* (A3-1FOPMGR01).

The quality manager at Airline A3 believes that formal risk management is expanding and has its genesis in the SMS, where it was initially introduced to the operational group. It has now expanded into non-operational areas, such as the finance department. Risk assessment is documented, although at this stage it still lacks maturity as a fully-fledged management system and, because of this immaturity, the implementation process is still a work in progress.

It's very well-documented for us, but the challenge that we have now is for each management and division heads to take ownership of the responsibilities. We are trying to go through each standards and regulations, and then assigning to various people the responsibility and to get it as a sign off in their PDs. Those are some of the strategies that we are working towards to get more maturity into the system (A3QLYMGR01).

The safety manager at Airline A3 indicated that the airline has been managing risk for a long time, albeit on an informal basis, within the flight operations and engineering divisions and, as they perform this function quite well, the intention is to expand this knowledge to include non-operational parts of the airline.

The DFO from Airline 3 claimed that there is a generational change in the management of the airline, with associated changes to culture and processes in relation to the management of risk. Risk assessment is new and is yet to be embedded within the structure of the airline and the employees have had minimal exposure to the formal processes.

C9E2 There is some disconnect between the providers of a formal RMS and the risk owners.

There appears to be a dividing line between junior and senior managers within the flight operations divisions of the airlines, as well as between the managers responsible for risk management and line managers regarding the functionality of the RMS.

A senior flight operations manager from Airline A4 claims that formal “...*risk management’s still maturing...we always make risk assessment...but it’s not formal, it’s not identified and that’s one of the problems a regulator has and one of the problems the company has*” (A4FOPMGR02). A risk manager from Airline A4 disputes this claim as outdated and believes that the risk management framework the airline has in place used to be immature and was implemented a number of years ago. Initially the SMS and the risk management framework were separate systems but over time they were merged. The objective was to build risk management capability within the operational areas, as risk identification at the time was deemed to be inadequate and, without risks being identified, controls could not be put in place.

It was a learning experience for the organisation, and the organisation itself had to mature. So I remember saying that this organisation, in my view, was, in terms of risk management, at a kindergarten level (A4SAFMGR01).

When asked to describe risk management, one of the managers from Airline A1 responded, “...it’s a very nebulous task. It’s a nebulous science and it’s new” (A1FOPMGR04), with a number of junior managers being unsure of what a risk management framework would look like. Thus, from an operational point of view, risk management on a formal basis is very much in its infancy within Airline A1.

The term ‘risk management’ is now heard frequently at Airline A2 and during the last three to four years, the frequency of the term has increased substantially. A junior line manager from Airline A2 believes the concept of a RMS is a valid management system, however care must be taken with regards to how it is implemented because, “...you have got such strict guidelines in that everybody is scared to do anything because they are not sure” (A2FOPMGR07). This belief is indicative of the RMS being conceptually accepted but operationally non-functional at the line manager level. Another junior line manager at Airline A2 declared that risk is being managed informally on a reactive basis, similar to the SMS, as the airline is always looking at its exposure to risk. “Our whole management process is based on reports... [Which] are largely reactive and the only proactive stuff we use is LOSA” (A2FOPMGR06). A senior captain from Airline A2, who also believes risk is being managed on a reactive basis similar to the SMS, supports this view. Moreover, many senior managers from flight operations disagree with this view of informal reactive-based risk management style as they believe risk is managed on a formal basis. An example is the DFO from Airline A2 who pointed out that the airline today has formalised its risk management.

I think definitely now you’ve formalised the risk assessment or risk management. In the past it was a lot more informal. It was more [a] finger in the air. “Is this going to be okay? Is this going to be safe to do this? Has anyone got any concerns?” But now you have to sit down and come up with a risk matrix and really analyse the risk. It does help. It helps structure your thinking really (A2FOPMGR01).

The DDFO from Airline A2 agrees with this sentiment and claims that risk assessment on a formal basis has been conducted for the last five years within flight operations and was motivated by the realisation that “...the time has come. It’s almost obvious. It’s common sense that you would do it” (A2FOPMGR02).

C9E3 It is unusual for line managers to use formal risk management processes.

One of the problems with implementing a formal RMS that was identified is that risk assessment is sometimes undertaken to satisfy a stakeholder requirement, rather than to realistically assess the risks and report the findings. An example of this was observed with Airline A1 where, due to the requirement of the new owner, the airline had to change their SOPs, with a risk assessment being conducted and completed the day before the introduction of the new SOPs. As a result of this late completion of the risk assessment, it was viewed with some cynicism.

So yesterday they completed the risk assessment, today they start the SOPs...well, what if the outcome of that risk assessment was say, “no, you can’t implement these new procedures because of...” for whatever reason. Of course they would implement it, irrespective of what that report said. It gets done, but its lip service (A1FOPMGR03).

The safety and quality department at Airline A1 has a corporate risk register and this department wants to see the airline develop more risk assessment tools. This department believes that combining safety with QA processes would make the overall system more proactive, with the improvement towards 100% conformance. The incident rate will decrease as, “...we’ve got all those tools in place, and I think the risk assessment tool, if ever, is a standard one or a computer-based one, yeah, next step, next step for safety management in an airline. (A1SAFMGR01). Whilst this department has a corporate risk register, some of the line managers in flight operations within Airline A1 have had limited exposure to formal risk management processes; subsequently, they have never heard of the term ‘risk register’. When asking these line managers about risk registers, a manager claimed that he was not “*aware of a formalised mechanism as such...it’s probably done informally, when we flag something that’s risk— Yeah, there’s no sort of risk matrix or anything like that*” (A1FOPMGR03). The quality manager from the operations division says they do not have a risk register per se; they do however, as is the case with Airline A3, use the quality software for the storage of the risks where “...everything will be in the database. We can always search and query it. It will come up” (A1QLYMGR02).

The GRM for Airline A2 believes the airline had a corporate and an operational risk list, rather than risk registers before he commenced employment with the airline. The lowest level of risk register that they have in Airline A2 is the sectional risk registers that are contained within the engineering department. With regard to the risk register within flight operations of Airline A2, the DDFO is responsible for this risk register and assesses the top five and, unlike Airline A4 where the risks within the divisional risk register have to change on a monthly basis, Airline A2 has to change these top five risks on a six monthly basis.

The GRM from Airline A2 requires each division to compile a risk register and to assist in the identification processes. He commences with teams and moves onto the departmental level using the departmental risk coordinators and then, on an individual basis, with the directors of the airline. This manager uses “...*a brainstorming process [and asking] What do you think are the best ones to push onto this year’s corporate register?*” and then that’s how we come up with the top list” (A2RSKMGR01). In the case of flight operations, the DFO and three senior managers from the flight operations division identify the risks and assess how significant they are, both numerically and with colour, as a team. A number of line managers from Airline A2 claim that they have no contact with their division’s risk register, or use any of the processes of the RMS. A line manager stated that he has had contact on an ad-hoc basis with the GRM. However, his preference is to use the traditional methods of managing his risks, such as feedback from the safety department investigations, and through the various reporting mechanisms.

We don’t get involved terribly much with the risk register ad hoc contact with [name of GRM deleted]. If anything new is happening, we might do a basic risk analysis on it. In terms of the desired outcomes, it is through our training records that we ensure that the flight crew are performing to standard and we do get information from corporate safety (A2FOPMGR03).

A senior manager from Airline A2 shares this view of his colleague and has no interest in formal risk management. This manager claims the DDFO, who controls the risk register, has never mentioned it and he has not seen the risk register and would not ask to see it, *“unless he asked me to go and talk to him, or he brought it up at the Flying Manager’s Meeting. I don’t, to put it bluntly, I don’t lie awake at night thinking about [airline name deleted] being a risk airline. I think about other things at night, but not it being risky.* (A2FOPMGR05). The manager of line operations for Airline A2 is aware of the flight operations risk register and, at this stage, he has not created a separate risk register for the line operations department as he believes there are other tasks to complete with a higher priority. This manager believes all risk registers that are housed within flight operations should be formalised, so there is a complete record of the division’s risks.

I think if you’re going to do it, do it formalised so that there’s a proper structure and a record of what’s been done. I think it should be probably more widely circulated. A formal risk document, and circulate it...For the managers, you should have the full process, because that then makes you think like that as well (A2FOPMGR04).

The ASM at Airline A2 agrees that risk assessment is primarily undertaken on an informal basis, with an insufficient level of documentation. If the airline was to have an event and the documentation is found to be lacking, the airline may have a serious problem.

I think that the really formal systemic risk assessments are not done that well but I think that like Flight Operations and a lot of departments it’s managed on a more informal way. So what we’d like to see some of that informality become better documented because that’s what you need for audit trails, accident investigation (A2SAFMGR01).

Airline A4 has a risk register for the flight operations division and, previously, the register was not used in the lower levels of management. Today, however, due to a finding on an audit by the regulator, there is an improved awareness of the risk register at the lower levels of management.

The risk register in Airline A4 appears to be focused on generating reports initially for the flight operations SMG and, subsequently, for higher level safety committees. The risks from the register “...are used every month for the generation of the risk report that goes to our safety management group, and the risks. So, all changes to operational procedure and operational circumstance actually bring a risk-related outcome, and those risks are then used to update the risk register” (A4FOPMGR01).

The most senior risk manager interviewed from Airline A4 claims all operational departments within the airline has a risk register, which are populated and are reported on a monthly basis to the SMG. There is a requirement to include newly identified risks and to remove risks that are no longer relevant on a monthly basis from these departmental risk registers. There are times where it is difficult to populate the risk register due to a lack of identification of new risks. (May indicate inadequate risk assessment processes) This results in risks appearing on a register with low relevance, one example proffered was an Occupational Health & Safety (OH&S) issue such as objects and a bookcase causing an injury to an employee.

Your register has to change month to month. If it hasn't changed, then you have to have a reason why nothing's come off or gone on. [The top risks] For Flight Ops? I would say facilities and IT would be number one...have you seen the big bookcase on the wall at the end of the office? That's been hard, there's a huge risk associated from something falling (A4RSKCOR01).

All the airlines use a risk matrix and the only observation regarding the use of this process was with Airline A2, where the quality manager believes the airline industry is extremely complicated and, by using a simple risk matrix (either a three by three or a five by five) is too simplistic. The rationale for this manager's belief is that one-of-a-kind events are a result of a string of events that, in all probability, will not reoccur.

Well we just found a serious weak spot in the risk matrix...there are many, many very complex processes and interactions that result in a safe outcome...it's a very complicated... When they're doing an investigation, they're investigating a string of events that are so unlikely to happen again that actually some of the recommendations are probably quite pointless (A2QLYMGR01).

This manager's equivalent in Airline A1 has a different view and, in his opinion, "*Risk, [assessment] at the end of the day, it still relies on experience. There's a lot of subjectivity*" (A1QLYMGR01). Other people in the risk field say you want to keep it simple, you don't want to over complicate it, because risk "*management is as much art as it is science. There has to be a judgement element in there*" (A4SAFMGR01).

#### 4.11 Concept C-10 Resources for a RMS are Problematic

##### C10E1 Risk policies are vague and resources for a RMS are limited.

An organisation's risk policy is normally associated with the RMS framework. However, it has been included in this section as an indicator of the level of resourcing allocated to risk management which has been provided by each airline. As part of an airline's SMS, each airline has a safety policy whereas, with the airline's risk policy, the responses to questions regarding their airline's risk policy were vague and indicated a lack of willingness by senior management to commit resources to a RMS. The safety manager at Airline A1 responded when answering a question regarding whether or not his airlines has a risk policy by stating, *"At the moment, to be honest, not a clear-cut one"* (A1SAFMGR01). The GRM of Airline A2 was equally as vague when responding to the same question by claiming the airline had a risk policy, *"Yeah. It's all on the internal website"* (A2RSKMGR01). The safety manager from Airline A3 stated *"...the airline had a risk policy and was signed by the CEO."* The lack of a positive response from this manager regarding the risk policy may have been a result of this policy still being in its draft format, as changes to the wording were required. This manager responded to the question by stating, *"Yes, it is. But I'll just— it's just been— it's right there. I think we might have made a few small changes to that"* (A3SAFMGR01).

The risk manager from Airline A4 claimed that the airline has a risk policy but it was not signed by executive management. The policy was written and forwarded to the executive management level, but was not signed. This operational level manager interprets this non-response as a de-facto approval of the policy.

Business continuity policy is authorised by the Group Executive Operations, and the risk management policy is authorised by the CEO and executive. Now, if you asked for the signatures on that, this is what I was alluding to earlier, previously we would update it, we would send copies, and we'd say, unless we hear back from you, we take this as approved (A4RSKMGR01).

The Manager Line Operations (MLO) from Airline A4 noted that, with regards to formalising risk management, the airline has to be smarter and increase the allocation of resources to this function.

He also believes the airline is moving towards this goal, but that it will take time to incorporate risk into the mindset of the employees and into the business processes.

Risk management is still maturing and it is maturing in a procedural way. So what I mean by that is we always make risk assessment. We always, when something happens we go “What’s the bloody thing outside here?” but it’s not formal, it’s not identified and that’s one of the problems a regulator has and one of the problems the company has. So we’ve got to get smarter and more procedural and allocate more resource to doing that (A4FOPMGR02).

The risk manager from Airline A4 maintains that the problem in implementing risk management is caused by a lack of resources and what is required is to build risk capability. Currently, there are only two risk managers within this airline that risk owners can approach for advice with regards to managing their risks. One of the impediments to building capability is that senior managers have a tendency not to agree to an expansion in risk management within the airline. To obtain resources in achieving risk management objectives within this airline requires creativity by utilising resources that have been allocated to an adjacent function. An example proffered by this manager is when resources have been allocated to the training of employees with regards to safety issues via online media, an opportunity exists to include a risk management component as well.

C10E2 Human resources employed in overseeing operational risk are minimal.

A senior line manager in Airline A1 claims that the airline does not have a developed risk policy and the person responsible for risk within flight operations has no training in risk. The main role of the GRM from Airline A2 is to ensure corporate governance requirements are achieved, rather than ensuring risk owners from the operational level are catered for.

Some line managers within the flight operations division of Airline A2 believe risk management is inadequately resourced, with an example being that the GRM is difficult to access as his role is very diverse and his sphere of activity is broad, covering not only Airline A2, but all other organisations within the group.

He gets tasked by [name deleted] to go and do other organisations within the group. He's been up to Beijing, down to Australia, whereas really, his core role should be here until it is embedded completely and it becomes a way of life, you just do it without thinking" (A2FOPMGR05).

The role of the ASM in Airline A2 with regards to the management of operational risk is more closely aligned with the owners of operational risk, as opposed to the GRM whose primary role is as an advisor for business risk. The risk owners long term objective is to conduct risk identification, designing and implementing controls, managing risk registers, all on a formal basis, and the safety department oversees these processes. Airline A2 overlaps in the QMS and RMS functions by using the "*Quality assurance managers and nominees... [Are [also]...departmental risk coordinators so they would manage the departmental risk register*" (A2QLYMGR01). Airline A2 has a comprehensive network of risk coordinators whereby the GRM has appointed a risk coordinator within each department and subsidiary, resulting in 31 risk management coordinators, as well as one for each of the airports the airline operates to. Whilst this airline has a large number of risk coordinators, the level of resources allocated to a formal RMS is limited, based on the authority and responsibility afforded to the GRM. This may be a reason why a number of the line managers in Airline A2 are not motivated to adopt formal risk management processes and prefer to continue to use the more trusted traditional methods which restricts the embedment of a RMS. An example of this is a line manager on the B747 fleet in Airline A2 claims that he has very rarely ever heard the term risk management mentioned on a formal basis and, at this level, and from a risk management perspective, it is treated on an informal basis.

There may be risk managers at corporate level that are employing those tools. But I've never heard of any of those tool mentioned at operational, at flight ops level. Our whole management process is based on reports...are largely reactive and the only proactive stuff we use is LOSA (A2FOPMGR05).

The GRM from Airline A2 acknowledges formal risk management is not embedded at the operational level, which is due to his primary focus being at the corporate level, managing the corporate risk register and answering to the Chief Financial Officer (CFO). A pilot training manager from Airline A2 does not manage his risks on a formal basis but, rather, on a traditional informal basis and is comfortable that all of his risks are managed appropriately. Consequently, this manager is not concerned with any of the risks he owns. With regards to which level the formal RMS is embedded within flight operations of Airline A2, the manager responsible for this section claimed, *“I’ve got nothing to benchmark it with”* (A2FOPMGR05) and, with regard to his section’s exposure to a RMS, *“...I would say none at all, day to day”* (A2FOPMGR05). From a documentation perspective, the RMS is about two thirds completed and, implementation-wise, about one third complete. The extent of a RMS being embedded within Airline A2 varies depending on the individual manager. Some managers whose role it is to be involved with the RMS, such as the DFO and DDFO, believe the RMS is maturing, whereas other managers, such as the ASM, have a different view.

The really formal systemic risk assessments are not done that well but I think that like Flight Operations and a lot of departments it’s managed on a more informal way. So what we’d like to see some of that informality become better documented because that’s what you need for audit trails, accident investigation, that’s what you need for your manual (A2SAFMGR01).

Another line manager from flight operations who does not have any dealings with risk management on a formal basis manages his risks using conventional processes, such as reports and FDA. This line manager is aware of the GRM but has made no attempt to seek his advice on formal risk management processes, or to observe any of the processes the GRM has produced, and claims formal risk management is very rarely discussed at his level. *“Well, we have a risk manager; we have a corporate risk manager. I don’t have any dealings with him. Yeah. I don’t have any dealings with [formal] risk management in the company”* (A2FOPMGR04). A possible reason for this rejection of adopting a formalised RMS by some of the managers from Airline A2 is proffered by the GRM from Airline A2 himself, who believes there was a lot of resistance to him when he came here three years earlier.

The GRM tried to create and implement a formal RMS within the airline and claims that there was, and still is, a lot of resistance from the risk owners, with one of the problems exacerbating this issue is that the office of the GRM has an inadequate level of resources. *“I’m constantly piggy-backing off other people and their resources and capabilities”* (A2RSKMGR01). An additional problem is his authority within the airline is minimal and describes the position of GRM as, *“I’m a pretty small fish in [name of airline deleted]”* (A2RSKMGR01). The GRM from Airline A2 believes he provides oversight and general advice on risk management issues to the risk owners at various levels of the airline, however he believes the implementation of a RMS is not something, *“...we could do it too quickly, you’re talking about long-term cultural change”* (A2RSKMGR01).

Airline A4 has a position referred to as the risk auditor whose role for the last five years has been *“working with the rollout of our risk management, the final one that we have adopted across all the various divisions”* (A4RSKMGR02). This is a junior position within the management team and the risk manager is at the next level within the management structure, whose equivalent position is the quality manager. Airline A4 train their staff in risk management processes by conducting workshops to *“provide some guidance, and that’s [name deleted] role in terms of facilitating some of that component and providing training and understanding”* (A4RSKMGR01). Airline A4 currently has two managers involved in risk management training and they believe more resources should be allocated to this function. A recipient of the training who claims that the training was very brief, with an example being ten minutes to discuss risk registers, reinforces this opinion of additional training resources being required.

#### 4.12 Concept C-11 RMS and Flight Operational Risk Owners

C11E1 Line managers want to adopt formal risk management processes but with some reluctance.

One negative aspect of having a RMS is that it could become too restrictive, such that if you have too many strict guidelines in place people may be hesitant to do anything. “...you have got to be careful; risk management is good but not to the point where you have got such strict guidelines in that everybody is scared to do anything” (A2FOPMGR06). This hesitancy is a concern for the DDFO of Airline A1 who claims risk is currently being managed on an informal level using the managerial skills and experience of the airline’s management team, although this is gradually changing to one where risk will be managed along formal lines. Whilst flight operations in Airline A1 discuss risk in an open manner, the airline is reluctant to adopt a RMS due to the belief that formalising risk management could lead to the reluctance of managers to put forward their ideas on how to identify and conduct risk assessments. “We just don’t push stuff through, but we don’t have a formalised process. Yes, a formalised process has its pros, but it definitely has its cons as well. You won’t get the same level of open ideas and thought with a formalised process” (A1FOPMGR02). One of the inadequacies of the RMS within Airline A1 proffered by a quality manager is that it is very much driven by regulatory requirements. Risk assessment is only done where it’s required by the SMS and, as a consequence, the airline does not do enough in the area of risk assessments. If there are safety outcomes, risk assessments have to be done, whereas if there are no safety outcomes, risk assessments are not being done. The airline should be more proactive in managing its variety of risks with multiple outcomes, rather than just safety. “The only thing what it really pushed them to do is the regulatory requirements. From my point of view, we don’t really do enough for the risk assessment, but we really want to do it. We know the importance of it. We want to be proactive” (A1QLYMGR02).

There was a noted reluctance by some risk owners in these airlines to avail themselves to formal risk management processes which were pre-existing within their airline. An example is the new CEO at Airline A4 who has placed an elevated level of importance on risk management, requiring operational managers to be more proactive in managing their risks. In addition, a line manager at Airline A4 stated that the framework and processes had been in place for a number of years but were, in the main, not used.

The format of the risk register, the way you calculate risk, any other criteria they use to assess risk, the little risk indicator and those little risk maps that they show us, they were all developed by in safety systems, probably before I even started (A4FOPMGR05).

This highlights the possibility that a RMS framework and processes may become 'shelf-ware' if managers are not motivated to utilise these facilities due to these managers believing they are inferior in managing risks when compared to the traditional informal methods. Risk management at Airline A4 has changed with the appointment of a new CEO whereas, previously, risk management was done through the SMG reports, with minimal emphasis on process, such as updating the risk register. The new CEO has placed a greater emphasis on systems and is changing the organisational culture from one of a 'can do' mentality to one of a more professional approach.

To make us more professional, nothing was ever not safe [unsafe], but there was always the "can do" attitude, the [name of airline deleted] attitude of "can do, get in and just do it (A4RSKCOR01).

This heightened level of risk management with Airline A4, bought about by the new CEO, is confirmed by the DFO who claims that the risk management processes were used sparingly in the past, with a reduced level of risk reporting. Using the metric of the SMS being 100% embedded within Airline A4, a safety manager believes the RMS is "*probably about 55, 60 [%] [embedded]*" (A4SAFMGR01). Line managers who have to deal with risks as part of their job functions do not share the belief in the RMS becoming embedded within the airline.

Knowledge of the processes used in risk management is limited and a possible reason is a lack of education in the risk management processes for line managers. *“The training was 10 minutes, when they first put it up on the screen and said, “We’re going to introduce a risk register, and this is the sort of thing you should be thinking about when you enter things” (A4FOPMGR05).*

C11E2 The reasons managers want to adopt formal risk management processes are numerous.

Notwithstanding the reluctance of some managers within flight operations regarding the implementation of a RMS, there were numerous reasons why other managers would like to see risk being managed on a formal basis. Some of the reasons put forward include better documentation, an improved retention rate of corporate knowledge, better compliance record, improved cost control, better identification of risks, enhanced reputation amongst customers, improved safety culture and improved decision making processes by risk owners. The CEO of Airline A1 absolutely believes the airline will obtain tangible benefits from a RMS, as he believes the airline industry is inherently risky and a RMS will improve the identification of risks. This process is extremely important in managing your risks because, if you do not know what your risks are, you cannot manage them.

I mean, as I say, the airline industry is subject to all kind of risk, whether it’s internal or external. First of all, in the identification of those risks, it’s already a very sort of big achievement. And you’re getting sort of developed. Even so, I think about those risks well beforehand and sort of come up with some mitigation plans. I mean, surely it will help this company’s survival (A1EXCCEO).

The DFO from Airline A1 believes the benefits in having a RMS are numerous. One benefit is that decision-making processes would be improved and another benefit is with regards to change management, whereby it doesn’t control the change management, but it certainly helps you in assessing the risks that are involved when you are changing a process or procedure. Another benefit of a RMS for senior management is protection for both management and the airline from litigation because the processes are embedded in the company and it is documented. Thus, if something does go wrong, you can defend yourself in court.

The DFO from Airline A1 commented that a RMS should prevent things from going wrong. *“I think a) it would allow you to sleep comfortably at night and b) looks good when you’re standing up there in court. Every company should probably have a risk management structure and airlines are no exception. I think airlines particularly should”* (A1FOPMGR01).

The MLO from Airline A2 believes a RMS is a valid management system because it provides a number of benefits to an airline. One area this manager believes will be improved if the airline implements a RMS is the decision-making processes. These processes will be improved as they become iterative, as it allows the management of the airline to keep going back and re-examining the risk and, as the environment changes, the risk level will change, hence the controls must also change. This manager believes documentation is a primary benefit of a RMS as, when documenting everything, the risk is actively managed. A RMS is a very clear process; legislation can be included so compliance risk can be better managed. *“I remember we did this, but it’s documented. We did this because of that, and there’s the legislation that told us to do that. It’s a very clear process for everyone to follow. I do think overall it’s a big cost benefit”* (A2FOPMGR08). The benefits of formalising documentation within a RMS was also noted by the risk auditor at Airline A4 who believes corporate knowledge is recorded and retained in the RMS and, therefore, management can say, *“Look, these are the things we have learnt,” it adds on our corporate knowledge where we’re training people... so you don’t lose that corporate knowledge”* (A4RSKMGR02). People within the airline can build on that knowledge when they do similar projects later, such as introducing a new aircraft type. Indeed, what was learnt from a previous introduction is documented and, when another type is introduced, a large number of associated risks have already been identified. A further benefit is visibility; if a risk is identified, that risk is documented in the risk register. To prevent the risk from eventuating, proactive and predictive strategies are required, largely based on accumulated corporate knowledge.

If we do nothing more now, where are we likely to end up?” and the best predictor of future performance is past performance. So you’re adding value by saying “If we do nothing more, this is where we’re going to end up and that visibility is provided up the chain (A4RSKMGR02).

The DDFO from Airline A1 also believes that a RMS forces you to adhere to documented processes, whereas a non-formalised risk management process is predicated on common sense and may be completed in a haphazard manner. You may not have thought of everything, where a RMS should cover most of the problems, and a RMS allows people to sit down and discuss all possible risks.

A line manager from Airline A1 agrees with formalising risk management processes, however, an issue is, people may not proffer an idea because they do not know the processes involved in identifying risk. With a RMS you will get more people speaking up, the RMS may improve the risk culture and, with an improved risk culture, you may obtain a greater participation rate amongst the staff by being more inclusive. *“You might include more people in the risk analysis, or the risk identification, because maybe at the moment, some people aren’t speaking up about risks, because they don’t really know the process”* (A1FOPMGR05). A line manager at Airline A2 also believes a RMS would be beneficial, as it would improve risk identification processes. One method to achieve this is by promoting brainstorming with an exchange of ideas, where *“...various departments could sit together and analyse the risk and determine as a group whether it was a significant risk and whether it needed further mitigation or whether it could be ignored”* (A2FOPMGR07).

A senior manager from Airline A2 believes an airline’s flight operations involves a large amount of complexity with serious incidents caused by the interaction of a large number of risk factors. This manager believes the current determination of likelihood is flawed because of this complexity and the current methodologies this airline uses.

So you’re attempting to predict the future on the basis of what’s happening now and in some cases the information you’ve got is very, very limited and you’re driven very much by the severity of the outcome rather than the likelihood of its occurrence, and likelihood is like throwing dice, it’s about probability which is a very imperfect science (A2QLYMGR01).

A lot of time in meetings is consumed by participants debating over the likelihood of the occurrence of an event as there are... *“big arguments about whether that was low, moderate, high, ultra. You know we thought it was high but a lot of other people said, “It’s never going to happen again”. It is a unique set of circumstances. It doesn’t quite suit this complex environment”* (A2QLYMGR01).

(The conflict arising from the determination of ‘likelihood’ may be the result of using traditional methods of managing FOR such as stakeholder knowledge and very limited formal risk management processes. This conflict may arise from simplistic risk assessment processes applied to a complex environment).

A key benefit proffered by the DDFO of Airline A2 is the continuity of the organisation’s management style and standards. An airline can be very well managed, however this can change with a change in senior management and a ‘maverick boss’ may be employed who desires to implement extreme cost cutting measures. If all the policies and procedures are documented, it would be difficult for a ‘maverick boss’ to implement risky changes if everything is documented, with ownership, responsibility and accountability already identified. *“I think it would be very sensible to have those policies written down and fully adhered to”* (A2FOPMGR02). One of the management pilots from the B747 fleet from Airline A2 believes one of the largest risks they must deal with is the recruitment and training of pilots with some of these pilots failing to achieve the company standard. This manager believes it is beneficial for the airline to mitigate that risk from the beginning by correlating pilots who did not meet the airline standard, with variables such as flying hours and aircraft flown. If there were correlations with sub-par pilots and common variables, the flight operations division could manage this risk by submitting a documented submission to the HR department in an endeavour not to employ these pilots. Currently, flight operations have trouble convincing the HR department not to employ pilots from certain backgrounds. A RMS would allow this risk to be better managed because *“...we can go along to recruiting and say “Don’t employ these guys”. At the moment they [HR] are saying “Well hang on; they meet all the requirements, what’s wrong with that?”* (A2FOPMGR08). The problem is, some of the pilots who are selected only have commuter jet experience and, as a result, have trouble meeting and maintaining the minimum company standard. Moreover, flight operations in Airline A2 do not want to accept this risk. Recruiting pilots with heavier jet experience will mitigate that risk as, *“you’re not going to get these RJ [Regional Jet] pilots and stick them on the 400 [Boeing 747-400] or the long haul operation. You’re going to have somebody, airline experience, 737 [Boeing 737] or bigger, with several thousand hours”* (A2FOPMGR08).

A number of managers from the flight operations within Airline A2 believe a RMS is not yet embedded and that it would take some time to embed it, with one of the managers claiming that it would probably require an event for the RMS to become embedded. These managers believe FOR is managed along traditional informal lines, whereas the DFO from Airline A2 has a different opinion. He maintains that Airline A2 has a RMS with risk assessment processes in place, and the airline's FORs are better managed today as a consequence of the formalising process.

Reputation was another benefit put forward by the ASM from Airline A2 and the DFO from Airline A3, both of whom believe that reputation is better protected because of a RMS. The ASM believes a RMS provides the airline with a commercial advantage in the marketplace by improving the safety culture, which is correlated to protecting and enhancing the airline's reputation. He insists that all the good airlines place a strong emphasis on the management of operational risk. *"...our safety culture gives us a reputation and our reputation gives us a commercial advantage if it's a good reputation...we've got a good reputation because of our safety culture"* (A2SAFMGR01). The DFO from Airline A3 also spoke about the safety culture of an airline improving with a RMS in place because of accountability and transparency within the airline being enhanced and this being recognised by the travelling public.

A line manager from Airline A3 believes improved cost control was an advantage obtained by an airline with a formal risk management program, as the efficiency of the operation is improved. It allows costs to be reduced and hopefully improves the productivity and profitability of the airline. *"...if you reduce the risk in an operation, you increase the efficiency of it. So, the bottom line is, it's more efficient and you're going to reduce costs and hopefully improve productivity and improve the bottom line"* (A3FOPMGR03).

The management team at Airline A3 believes a RMS will manage the assets of the airline better and save the company money, with one example being a reduction in litigation from the regulator for breaches of regulations. With a RMS in place “...we have highlighted so many systemic issues. If we have that covered, it will save the company so many dollars and also fines and other things from [the] Regulators” (A3QLYMGR01). The COO of Airline A3 believes there is a lot more commonality between the various departments and divisions in their approach to risk and safety. This is achieved because risk is managed across the organisation and the divisions that have experience in managing risk, such as engineering or flight operations, have the opportunity to pass on retained corporate risk management knowledge to other departments, such as cargo and airports. Managing risk is key to the business in the airline, and everything the airline does has risk attached to it. “...if you don't move forward and have an absolutely solid risk management process within your company, I don't think you're going to survive in this sort of environment” (A3EXCCOO). Compliance will become an even bigger issue, not just with the regulator, but within the industry itself in the form of the IOSA. In the future, the ISM will change many of the current standards that have the requirement ‘should’ to ‘shall’ and, consequently, increase the airline’s compliance requirements.

I mean, the latest ISM for the IOSA program, you know, it's creeping in. Like, a lot of the things that are “shoulds” now are going to be “shalls”, and you can see the direction that they're going as well, that they want to see, you know, well managed— Good management of risk, good management of safety, very strong safety management systems within the organisation (A3EXCCOO).

Risk is ubiquitous, the entire product line or service line has risk attached to it, and even damage to cargo is a problem, as is aircraft that has been damaged by loading systems. The airline faces multiple risks across the board; some are very small whilst others are comprehensive, however, there are risks everywhere in delivering the service to the customer. If you have an integrated, fully performing risk management program in place, the owners of the risk can identify and manage those risks.

If you've got good strong systems, you've got confidence in the organisation. So obviously, it's going to be economically better for the owners of the airline, but it's also going to be a lot more efficient. It's going to be a better organisation (A3EXCCOO).

An area that was considered to be of benefit to the implementation of a RMS was within change management. An example proffered by the safety manager from Airline A3 was in the area of changing a procedure or components, with the objective of reducing costs, which, if not done correctly can be a very expensive exercise. Change management, if it is done well, is the key to an airline with regards to introducing non-considered risks and *“even a simple thing of changing the escape lighting system...if you don’t do that right, it can cost you money”* (A3SAFMGR01). Managers from Airline A4 also agreed that the airline’s change management processes would be improved with a RMS, with an example provided by the MLO from Airline A4 who claims that the documentation processes would be improved which, in turn, would improve the change management processes. There are always compliance requirements because of amendments to current regulations or the issuance of new regulations; all of these require a risk assessment process regarding change management. Another area that this manager believes will be enhanced from a RMS is sustainability, as it will improve an airline’s longevity and mitigate the risk of litigation. Currently, once an airline suffers a negative event, the organisation very quickly loses control of communicating commentary about the event due to the emergence of social media. Once an airline has a serious event and the airline is in court being pursued by the regulators and, possibly, the coroner, it is in the airline’s interest to have a full RMS process in place which can demonstrate to the court that the airline is proactively managing its risks.

So you want to prevent the accident happening in the first place because aviation is such a public event. If it does happen and you get asked questions for whatever reason by regulators or coroners... the full verbal testimony about your full process is nowhere near as heavily weighted as tabling of a formal risk register and an application that you process (A4FOPMGR02).

The risk coordinator from Airline A4 and a line manager from Airline A2 both commented that a RMS helps in breaking the ‘silo mentality’ that exists within both of these airlines by providing greater visibility of the risks that are contained within each department to other stakeholders.

Previously, deliberately or otherwise, information was kept within the silo of the division and was not visible to other departments or divisions. Other divisions did not know what was happening; now, each of the divisions, or large departments, has a risk register and divisional heads also have access to the risk registers within all the divisions.

[Name of Airline A4 deleted] always talks about silos; all the silos aren't talking to each other. And I think that's getting better. GMs updating their risk registers, and that being published into the SMG reports; I think that all of the GMs have more of a visibility of what the major risks are in other divisions like ground ops and cabin crew or guest services (A4RSKCOR01).

The view regarding risks lacking visibility within the entire airline is an issue for a line manager in Airline A2. The divisional risk register is controlled by the DDFO and senior management within the division determines the risks that are inserted in the register. This manager believes there are a number of risks that are identified but are not inserted because of the control issues, as imposing controls to manage risk is a problem within the airline.

One of the things that I think that risk management structure overall in [name of airline deleted] doesn't allow us to put the controls in place very easily. I think you also have to look at the principle in which the airline is overall managed and there would be a system of silos where information changes hands at the top of the silo and doesn't cross through the bottom of the silo (A2FOPMGR09).

All of the interviewees who discussed the decision-making skills of the managers believe a RMS would contribute to an improvement in these processes.

#### C11E3 Decision-making processes at the organisational level.

One method put forward to improve an airline's decision-making skills at the organisational level was to implement a RMS because a system such as this would remove traditional forms of decision making such as 'shooting from the hip' and 'gut instinct.'

It would validate everything we're doing. There's no shooting from the hip, there's no gut feeling type stuff in it, which I think used to exist in Flight Operations. It takes all that out of it and makes it very clear cut. It gives you a pathway" (A2FOPMGR03).

A risk manager from Airline A2 believes that decision-making is so important in an organisation, that *“I think that’s [an] appropriate risk [decision making] to put on the register. So yes, that’s in there”* (A2RSKMGR01). At Airline A2, a line manager believes a RMS supports the organisation’s decision-making ability, as decisions regarding what option to choose will provide a cost benefit to the airline as, *“...you do save money. You don’t waste your time going off in directions unnecessarily”* (A2FOPMGR08). The quality manager from Airline A3 believes the decision-making skills of the management team has to be improved and they are continuously highlighting this in their management reviews. *“...we need much more improvement on that [decision making]. Because not all managers have the capability”* (A3QLYMGR01). In addition, the safety manager from Airline A3 asserts that even with very good decision-making processes, there will still be deficiencies in the management team’s decision-making skills. Consequently, what the airline requires, in addition to a RMS, is a robust crisis management plan, in the event that not all risks were identified through the RMS. Line managers from Airline A4 who believe *“...that the decision-making abilities of the management team would absolutely improve”* (A4FOPMGR05) support this view of implementing a RMS to improve the organisation’s decision-making skills. The risk auditor from Airline A4 believes the airline manages its risk well, so there may or may not be changes in the risk outcomes for Airline A4. This manager believes what would improve *“...are the decision-making processes to get to that outcome are better understood”* (A4RSKMGR01). Whilst Airline A4 is comfortable with the decision-making skills of its flight crew, an issue was raised regarding the erosion of the authority of the captain to make a decision because of the flat organisational structure of the airline. Another issue that was raised in relation to this topic in Airline A4 was there are inadequate reviews of decisions made by executive management and their impact on operational matters.

This concludes the section of the analysis utilising phenomenological inquiry using a ‘flat reporting’ technique. The second section of the analysis uses cognitive mapping as the method, and software known as Decision Explorer™ as the tool to manage the interviewee’s cognition.

## **4.13 Cognitive Mapping**

### **4.13.1 Key Terms**

The 11 complex concepts as discussed in sections 4.2-4.12 were cognitive mapped as a confirmation process to the integrity of the phenomenological method. The output from the cognitive mapping method were 15 key terms which mirror the output from the primary analytical method of phenomenology. The key terms described within this section reflect the interviewee's perspectives and, as such, relate to this study and not what may be interpreted by the wider community. This descriptive text applies to these key terms from the four airlines as generalisations. Where there are differences between these airlines with regards to these key terms, the body of text is noted accordingly. Whilst generalising is not an objective in qualitative research (Guba and Lincoln 1981), however, when dealing with different organisations as this study does, it improves the understanding and explanation (Miles and Huberman 1994) of the data. Hussey and Hussey believe it is acceptable to generalise concepts from one organisation to another if the researcher has "...a comprehensive understanding of the activities under study" (1997, 58-59). The objective of this study is to produce trustworthy findings which contribute to the body of knowledge of the phenomenon under study, with one of the criterion for assessing trustworthy findings being transferability. It is expected that readers of this study from similar airlines will relate to the descriptions of the key terms as written in this section. The 15 key terms that have emerged because of the cognitive mapping processes are contained in the following section.

#### **4.13.1.1 Audit**

Auditing is a key role for each of the airline's quality systems with audits by the regulator conducted on an ongoing basis. Two of the airlines, A2 and A3, have an 'elder statesman' conduct an external audit looking through the 'lens of wisdom' to review the operational aspects of the airline. Auditors add value to the airline through ensuring compliance and process improvement. Airline A2 was the only airline that stated that they conduct audits on aircraft after the aircraft had undergone a maintenance program, with aircraft selection based on a random basis involving flights where engines are shut down and re-started, as well as deploying emergency equipment, such as the Ram Air Turbine (RAT).

One of the most important audits conducted by these airlines is IOSA, with these airlines acknowledging the importance of this audit by conducting a substantial amount of pre-audit work prior to the audit.

#### **4.13.1.2 Change Management**

Managing change is a major issue for these airlines, with Airline A1 stating changes in the past were not conducted well, resulting in the occurrence of an adverse event. A major concern with poorly conducted changes is the negative impact to the airline's reputation, which has taken a long period to build but can be damaged very quickly, especially with social media. These airlines believe their change management processes are improving; one example proffered was through technology, specifically by electronically tagging operational manuals. Poor consultation and communication with stakeholders was noted as an area of concern within Airline A2. An example proffered by a line manager was, when changes to operational manuals were in the developmental phase, line managers were omitted and they only learnt about the change when they were inserted into the applicable operational manual(s), resulting in conflicts between stakeholders. One major area of concern was the amount of change occurring which is considered too much; this large amount of change causes stress to flight-crews and can cause this group of employees to become complacent. It was noted that the aircraft manufacturers do not always present their changes to procedures in a clearly understood manner, with the changes to Airbus landing distance calculations put forward as an example. Before this change, flight-crews understood how to calculate landing distance and, after the change, they were unsure how to perform the calculations. Risk assessment should be conducted on changes, as not all risks can be identified because of a change, however, Airline A2 believes this should only occur with large changes.

#### **4.13.1.3 Complacency**

Complacency is identified as a major emergent risk to the airlines and they believe it is insidious in nature. Airline A1 believes the two major events during the airline's previous ten years were caused by the flight-crew becoming complacent. This airline monitors complacency using various metrics, and during the flight-crew selection process attempts to identify applicants who may be prone to being complacent.

Complacency can be caused by the repetitive nature of the industry, including multiple sector days where flight-crews ‘go through the motions,’ industrial issues, excessive levels of change as well as fatigue resulting in a lowered level of focus by flight crews. Complacency results in an elevated level of operational risk with an associated reduction in safety.

#### **4.13.1.4 Compliance**

The safety manager from Airline A3 was dismayed at the high level of non-compliance findings observed on a LOSA. This large amount of non-compliance of SOPs by the flight-crew resulted in a substantial change to the airline’s SOPs. It was noted that pilots from the USA were largely responsible for these non-compliances; the propensity of this pilot group to have non-compliance issues was supported by managers from Airline A2. Airline A2 has 55 nationalities within its pilot group and, to manage this diversity, it demands a mindset of strict compliance to SOPs. Non-compliance to SOPs causes conflict on the flight deck as it is considered unprofessional and disrespectful by, and to, the other flight-crew members. FDA monitors SOP compliance and, subsequently, FDA improves SOP compliance. Flight-crews want to know when FDA will trigger an event, with the airline responding by stating ‘comply with the SOPs and no FDA event will occur.’

#### **4.13.1.5 Costs**

The airlines stated that they were happy with the budgets allocated to them to manage flight operations, however they also stated that they are under pressure to reduce costs. Airline A2, which is domiciled in Asia, claimed that they were not under pressure to reduce their costs because of the emergence of LCCs. This airline will increase its flight operational budget if required, with an example proffered as the use of additional simulator sessions for their long haul pilots. The airline was concerned that the pilot’s manipulative skills were atrophying as a result of minimal recent manual flying exposure, as some pilots only conduct one manual landing per month. A number of cost reduction possibilities were suggested, such as through the adoption of technology including Electronic Flight Bags (EFBs), however this can introduce new risks to the airline, which have to be assessed. Having a quality system can also reduce costs by having well-written and efficient procedures.

It was pointed out that there is a very fine line between reducing costs with no adverse events, and cost-cutting contributing to an adverse event. Airlines observe other airline's changes to SOPs to reduce costs, and may change their SOPs to obtain the same cost advantage without conducting a risk assessment on the change, which exposes the airline to an elevated level of operational risk.

Flight-crews from Airline A2 and A4 pointed out that if the pilot group believed the airline was excessively cost-cutting, resulting in lowering of the operational standard of the airline, the pilot group would 'pushback' against the cost-cutting.

#### **4.13.1.6 Integrated Management System (IMS)**

The airlines believe the SMS, QMS, and RMS can be integrated into a single management system, referred to as an IMS. The view from these airlines is that the SMS is reactive, the QMS is proactive, and the RMS is predictive. Each of these systems has their individual skill sets possessing their own toolboxes, and with some overlapping of resources. Airlines A1, A3, and A4 have each of the systems housed within the safety department and, in the case of Airline A3, the safety department resides within the flight operations division. It is the intention of Airline A3 to set up an autonomous safety and risk department along the lines of an IMS. Airline A3 intends to maintain a QA function, even though it is not required by legislation, as this airline believes the PDCA cycle improves the airline's processes and, consequently, the product. The QMS from Airline A2 is housed separately from the safety department, with the safety department in Airline A2 overseeing operational risk management. It is believed that there is a better use of resources due to the overlapping of the three systems; RMS and QMS using common software, as well as the same employees conducting risk assessments and QA. It is believed that emergency response planning, and the organisation themselves being resilient, should underpin the IMS.

#### **4.13.1.7 IATA Operational Safety Audit (IOSA)**

IOSA is the industry audit, with the airlines taking IOSA very seriously. As an indicator for this level of seriousness, each of the airlines conducts a pre-audit in preparation for the IOSA. These airlines claim IOSA is value adding in areas such as safety by enforcing safety principles as a catalyst for internal change, and by transforming an airline from an acceptable standard to world standard. This was noted by Airline A1, where the airline benefited from the prescriptive nature of the standards contained in the audit, whereas the regulator's audit is not prescriptive but, rather, compliance-focused on national legislation. Whilst the airlines point out that they have two regulators, one is a national law enforcer and the other being industry compliant centric, it was noted that there is a lack of standardisation between the audit checklists. It is believed IOSA is a greater motivator for change, with Airline A1 claiming IOSA professionalised their operational manuals by ensuring these manuals complied with sound operating principles. Most of the airline's findings from IOSA relate to documentation issues rather than implementation issues, with senior management accepting the findings. Furthermore, there were no credibility issues raised with IOSA. The only dissenting view of IOSA was from Airline A1, who believed that, to be fully compliant with IOSA standards, it required some entries into their operational manuals that these managers were not entirely happy with, and they also held the opinion that the 'tail was wagging the dog'.

#### **4.13.1.8 Non-Technical Skills (NTS)**

These airlines consider NTSs very important, with the possibility that flight-crews could fail a check flight by demonstrating an unacceptable level of performance with regard to these skills. NTSs are used to manage the flight, including managing threats and mitigating errors. Check and training captains in Airline A1 stated that they aggressively push these skills, as they believe they are part of the foundation that underpins a flight achieving a high level of safety. Airline A4 believes an additional benefit of flight-crews possessing a high level of NTSs is an enhanced reporting culture. It is believed that NTSs were previously common-sense based, whereas today they are structured, professional and conform to published procedures.

FDA monitors the flight-crews NTSs and management of the airlines use FDA as a tool to monitor these skills and provide feedback to the pilot group where it has been observed that flights were not conducted in accordance with SOPs due to a failure of the flight-crews NTSs.

#### **4.13.1.9 Organisation**

These airlines believe costs are always under pressure to be reduced, with no reduction in safety, as they believe being too cost conscious can deliver unexpected adverse outcomes. Reputation is very important to them and they believe reputation takes a long time to build, but can be tarnished with a single event. Management within flight operations at Airline A2 claim they have two objectives: manage the operation within the budget, and preserve the level of safety the airline enjoys as they believe safety is the ‘crown jewels’ of the airline. Airline A1 states that they use their reputation for safety as a competitive advantage in their marketing campaign. This airline’s main market is the PRC and they acknowledge this advantage is reducing as the airlines from the PRC improve their level of safety. Each of the pilot interviewees from these airlines stated that they are never pressured to depart with unresolved maintenance issues, with the exception of Airline A1, with these pilots claiming that, at times, station managers within the PRC pressure crews to depart with unresolved defects due to insufficient maintenance support at these airports. However, the pilots claim that this pressure is rejected. Yesteryear at Airline A1, an operational manager pressured the flight-crew to return with an unresolved maintenance issue, which was rejected, and this manager is no longer employed by the airline. As the airlines are always under pressure to reduce costs, one method that was implemented by Airline A2 is to base their flight crews at various bases around the world. The problem with this, according to operational managers from Airline A2, is a lowering of the absorption of the organisational culture of the airline by newly employed flight crew. In addition to this concern is a possible reduction in the operational standard of these pilots as they are away from the constant scrutiny of the check and management pilots at the airline’s major base. Global bases are not an issue for the other three airlines as they base their pilots within the country the airline is domiciled.

#### **4.13.1.10 Protection-Production**

The safety manager from Airline A1 previously believed that the concepts of protection and production were conflicting, whereas he now believes that they are complementary. Previously, production was the focus, whereas today production is still preeminent as the primary objective of the airlines is to be commercial, even though attention to safety is very much at the forefront. Getting the production-protection balance correct is an issue with the airlines and, in some cases such as with Kathmandu, some of the flight crew from Airline A1 believes the balance is too much in favour of production and not enough protection. Airline A1 operates into this airport at night, with these pilots claiming it should be an operation limited to daylight hours only. Airline A1 and Airline A2 operate in Asia, which the flight-crews from these airlines claim to be a high threat area, however they believe the airline provides the necessary resources to safely manage these threats. Flight-crews from these airlines have stated that if they believe the airline is reducing the level of protection below what they as an individual, or as a group, believe is unsafe, they will push back against this reduction. Examples proffered were operating to an airport that was considered a high threat airport without adequate controls being put in place, and employing pilots the existing pilot group believed were sub-standard. It is not unusual to hear ‘talk’ within the airline industry of an airline being able to suffer a hull-loss and recover and this was raised with the pilot group from the airlines. Still, interviewees from Airlines A1, A2 and A3 claimed that this was not the case with their airlines. In the case of Airline A2, one of the interviewees stated that a previously employed manager proposed a concept that the airline could lower its level of protection and, in the event of it suffering an aircraft accident, it could recover. Other interviewees from this airline refuted this claim, indicating that this was pure rumour and was never considered credible.

#### **4.13.1.11 Quality Management**

Whilst these airlines do not legally require QA with regard to flight operations, they all still possess a QMS, or at the very least a QA section. Airline A2 has a stand-alone QMS, separate to any other department, as this airline believes a QMS delivers integrity to the airline. These airlines pointed out that, at the very least, a quality section provides value to the airline through its various roles, such as conducting audits, improving service delivery, reducing waste and contributing to safety issues, as well as being proactive. Airline A3 believes one of the advantages of a QA system is, it is an integral part of the SMS because of the PDCA cycle and, for this reason, this system will be retained.

#### **4.13.1.12 Regulator**

The primary role of the regulator is to ensure the airlines comply with national legislation. With the airlines based in Asia, some of these regulations are considered outdated, such as airlines requiring their pilot trainees undergo base training after they have completed their simulator training, and the law requiring a pilot to conduct at least one landing every 35 days, which is considered unsafe. The Regulators for Airlines A1 and A2 are considered old fashioned and possess a 1980's British mindset. All of the airlines claim that they have a professional relationship with the regulator, however management at Airline A3 claims the relationship with their FOI can, at times, be strained. All of the airlines believe the relationship is at arm's length and is not cosy. Airline A2 is the largest airline in the country and they remarked that they do not enjoy, nor do they seek, special privileges. In addition, Airline A3 is one of the largest organisations in the country and they claim that they do not enjoy any special treatment. At times, the FOI for this airline can be aggressive and he will rebuke the airline for any shortcomings. Moreover, the airline has stated that they would like to resolve problems without advising the FOI, however this has never happened. Each of the airlines assert that their regulator is very rigid with regard to documentation issues, they cannot be corrupted, and there is no reduction in oversight by the regulators.

Furthermore, IOSA is prescriptive, whereas the regulator is not. However, Airline A1 states that, at times, their FOI wants to exceed the legal authority by requiring that the airline insert a non-legally required procedure into an operational manual. The airline rejects this requirement, which the FOI accepts. The regulator requires Airline A4 to increase their level of risk assessment, as it was noted on an audit that the airline manuals for risk assessment on changes had become shelf-ware.

#### **4.13.1.13 Reports**

Airline employees believe that the airlines have a strong reporting culture, which is a mistaken belief according to managers who claim that the reporting culture is not as strong as employees believe. In the Australian domiciled airline, managers believe that flight-crews are more inclined to complain rather than submit a report, as they maintain that someone else will submit the report. It was noted that Australian flight-crews would not submit a report if they believe it could harm a colleague as it goes against the national cultural aspect of ‘not dobbing,’ whereas they will submit a report that may harm a person external to the airline. It was reported that pilots have a reluctance to submit reports even though the airlines have established multiple reporting methods, such as electronic or paper, and stress the importance of submitting reports, as it improves the airlines defences. Pilots have a tendency to submit high and medium-level reports, but not low-level reports. Flight operation managers from Airline A1 consider some of these reports to be complaints, whereas the airline’s safety managers view them as credible reports, which can lead to the discovery of underlying safety issues. An example proffered by Airline A1 was that flight-crews were submitting reports about the poor quality of the hotel accommodation in the PRC. Flight operations managers believed these reports were complaints and that the flight-crews should accept the accommodation, whereas the safety managers believed that it was a poor quality of sleep issue, resulting in fatigued flight-crews, which was a significant safety issue for the airline. Due to a lack of action by flight operations managers to these reports, industrial action was enacted, with a reduction in the level of reporting by the flight-crew. To rebuild the reporting culture, the airline offered financial incentives to the flight-crew.

Flight-crews have stated that it is very easy for a reporting culture to dissipate due to a number of reasons, such as a change in the organisational culture, new management team, punishment culture and the dismissive attitude of operational management. However, once a reporting culture fades, it takes resources to rebuild the willingness of employees to submit reports.

#### **4.13.1.14 Risk Management**

Apart from risk management requirements that are contained within the airline's SMS, the four airlines manage their FOR along informal lines as they have always done, by relying on regulations, corporate knowledge and the experience and abilities of the airline's management team. One manager who remarked that a previous senior manager would not reach for what was described as the 'poison dollar' volunteered an example of this knowledge at Airline A2. That is, those flights that were considered too hazardous, or exceeded his personal risk level, would either be rejected, or he would insert controls that he believed reduced the level of risk of the flight to his acceptable level. All four airlines indicated that they were moving towards a more formalised method of managing FOR. The CEO from Airline A1 claimed that he will provide the required resources that will allow the airline to create a RMS. Indeed, the DFO from Airline A2 believes that the airline already manages its risk along formal lines, whereas the COO from Airline A3 intends to expand the role of the safety department to include risk, and then rename the department, the Safety and Risk Department. Moreover, Airline A4 has put in place a number of formal processes, such as an organisational-wide risk management framework, including risk registers, however these processes are not used on a daily basis by the risk owners of this airline. This lack of uptake by the risk owners of the formal risk management processes in Airline A4 may be because of a lack of training in how these processes work. Not all of the senior flight operational managers from these airlines are convinced a RMS would be beneficial to the airline for a number of reasons. Some managers believe that the informal system that has been in place for many years works well and are reluctant to change, fearing that it may produce inferior outcomes.

Some of the concerns of these managers are that a formal system may inhibit the free flow of thinking regarding risk, as it may impede individual thinking to the point of producing 'gobble-de-gook.'

Unlike a SMS, a RMS is not required by legislation, which is a major factor in why these airlines do not possess a RMS. Indeed, some of the junior managers complain that the only risk assessment the airlines undertake is what is required by legislation. Airline A4, as previously stated, has developed an ERM framework with associated processes and manuals, however these manuals have become shelf-ware as they are not utilised by the airline managers. Indeed, the non-use of these manuals was reported as a finding by the regulator during an audit.

At Airline A2 and Airline A4, there appears to be a horizontal line at the DFO level. At this level and above, risk is managed formally and, below the DFO level, it is managed informally. A problem, which was highlighted with the management of risk on an informal basis, is the risk assessment processes are not defined regarding analysis and evaluation, which gives rise to conflict between risk owners and their superiors. Some of these junior managers are not sure what benefits a RMS would deliver, as they have had no experience with such a system. However, a number of these managers believe a RMS could improve the identification of risks and the documenting of such risks, as well as improve the retention of knowledge about risks. The management of FOR within these airlines is slowly evolving towards a formal management system, however the impediment is the reluctance by senior management to commit to the establishment of a RMS. It is believed that it will take a serious event for this to occur. The risk managers within these airlines claim that the amount of resources that are currently allocated in this area is limited, and it requires resourcefulness on behalf of the managers to obtain the required level of resources. Using Airline A4 as an example of the level of authority a risk manager has within these airlines, the safety manager is at level five, the quality manager is at level four, and the risk manager is at level three; with three being the most junior.

#### **4.13.1.15 Safety Management**

Safety within these airlines is managed along formal lines through the use of a SMS. When it comes to safety, culture is most important, processes are secondary, and safety culture can always be improved, as there is no endpoint in safety. At Airline A1, the pilot group believes that the attainment of their safety performance is due to the pilot selection, and the airline focusing on safety as a key component of its flight deck culture, with safety as the basis of the airlines NTSs.

Whilst all of the interviewees believe their airline is safe and all airlines have a written safety policy, there was some concern raised in relation to the limited number of pilots who have actually read the safety policy, as well as the limited amount of safety artefacts on display. Airline A2 has a large number of safety artefacts on display, whereas the other three do not. Non-compliance of SOPs was an issue at Airline A2 and Airline A3, but was not a stated concern with the other two. Commercial success was the primary objective of the airlines, however safety was an integral part of the overall management of the airlines, with Airline A2 stating that safety is the ‘crown jewels’ of the airline and Airline A1 claiming that safety gave the airline a competitive advantage in the market. Airline A1 also remarked that their competitors’ level of safety was improving.

This completes mapping the cognition of the interviewees with regards to describing the 15 key terms from this study with the chapter’s summary presented in the following section.

#### **4.14 Chapter Summary**

This chapter contained the study’s analysis of the data collected by the way of semi-structured interviews. The output of these processes was the creation of 11 complex concepts, with their associated elements presented in a ‘flat reporting’ style. This style was selected so as to ensure the ‘voices’ of the interviewees were heard and that their narratives were preminent, with the views of the writer being secondary and bracketed in line with the principles of phenomenology. These 11 complex concepts were cognitive mapped using Decision Explorer™ software as the tool in the mapping process. The rationale behind these 11 concepts being cognitive mapped was to confirm the phenomenological processes used in the flat reporting section were valid. The output from this mapping process was the emergence of the study’s 15 key terms. These key terms are applicable to this study and confirmed the phenomenological analysis was valid, as the knowledge obtained in both sections is the same.

## **5 Chapter Five Results**

### **5.1 Introduction**

This chapter answers the RQ as well as SQ-2 and SQ-3 with the answers to these questions sourced from the 11 concepts and their associated elements as well as the 15 key terms all of which are contained in Chapter Four Analysis. These three questions are linked, namely the importance and approach to managing FOR and the drivers to create a RMS.

These airlines are legally required to manage their safety requirements via a SMS. However, apart from the management of safety risk and those risks associated with the management of change, these airlines are not required to manage their FORs via a RMS. Apart from the two nominated risks covered by the SMS these airlines manage this risk using non-systemic traditional methods. This requires a large number of departments, systems, processes, to integrate and communicate both internally and externally to ensure the airline's FOR is contained to an acceptable risk level. The generic view of FOR includes diverse categories such as, people, processes, systems, external events with this study including aspects of organisational culture.

### **5.2 Findings**

This study produced nine findings all of which are used to answer the RQ and the four sub-questions. Airlines are required to manage a large number of FORs involving a multitude of diverse risk factors, a number of which were reviewed in length within the analysis chapter. Findings F-1 to F-6 highlight the non-systemic use of strategies and tools that are used to manage FOR and its drift with Findings F-7 to F-9 dealing with the emergence of a systemic based risk management strategy. The first six findings deal with issues such as non-compliance to SOPs which involves aspects of 'practical drift' and 'normalisation of deviance' both of which contribute to an organisation's risk drift. An airline's reporting culture is a key issue in the success or otherwise in managing FOR which requires a just culture, and not one of blame and punishment if the airline wants to have a robust safety system instead of a vulnerable one along the lines of VSS.

An airline's quality system contributes control and confirmation to an airlines operational systems, thereby reducing and possibly reversing FOR drift. Another finding deals with the issue of providing adequate safety resources whilst still allowing the airline freedom to be commercial viable. Compliance to national regulations is a major strategy in managing FOR with the role of the regulator being a finding. Operational changes within an airline are a normal part of their existence, subsequently, managing these changes requires robust procedures which is the last finding dealing with these airlines non-systemic management of FOR. The final three findings deal with the maturity of, the level of resourcing provided to, and the acceptance by line managers of their airlines RMS.

All of these findings are sourced from the analysed data with their linkages to the data contained in Table 5-1. Whilst it is imperative to source and discuss the findings from the analysed data, it is also important to compare the findings with the literature (Eisenhardt 1989). Table 5-2 contains the linkages between this study's findings and the literature contained Chapter Two Literature Review and the report's appendices.

**Table 5-1 List of Findings and Linkages to the Analysed Data**

<b>Number</b>	<b>Description</b>	<b>Linkage to analysed data</b>
Finding-F1	Flight-crew's compliance to an airline's SOPs is a key issue.	Concepts C-1, C-3, Key Terms, complacency, NTS, Compliance.
Finding-F2	Achieving and maintaining a 'just culture' is an objective of these airlines.	Concepts C-2, C-3.
Finding-F3	These airlines want to maintain a quality function associated with flight operations.	Concept C-7, Key Terms, Quality Management, IMS, IOSA.
Finding-F4	These airlines believe the balance between production and protection is acceptable.	Concept C-5, Key Term, Protection-Production.
Finding-F5	The relationship between the airlines and the regulators are aligned with ICAO philosophy.	Concept C-8, Key Term, Regulator.
Finding-F6	The change management processes within these airlines are improving.	Concept C-6, Key Term, Change Management.
Finding-F7	Excluding the risk management elements from ICAO Annex 19, the formal management of FOR within these airlines is in its infancy.	Concept C-9, Key Term, RMS.
Finding-F8	Excluding the risk management elements from ICAO Annex 19, the resources to establish a flight operational RMS within this airline are deficient.	Concept C-10, Key Term, RMS.
Finding-F9	The majority of managers from flight operations want their airline to establish a flight operational RMS.	Concept C-11.

**Table 5-2 List of Findings and Linkages to the Literature**

<b>Number</b>	<b>Description</b>	<b>Linkage to the Literature</b>
Finding-F1	Flight-crew's compliance to an airline's SOPs is a key issue.	Section 2.6
Finding-F2	Achieving and maintaining a 'just culture' is an objective of these airlines.	Sections 2.4.2-2.4.5
Finding-F3	These airlines want to maintain a quality function associated with flight operations.	Section 2.7.1
Finding-F4	These airlines believe the balance between production and protection is acceptable.	Sections 2.7.5-2.7.6
Finding-F5	The relationship between the airlines and the regulators are aligned with ICAO philosophy.	Sections 2.5.3-2.5.4
Finding-F6	The change management processes within these airlines are improving.	Section 2.7.2.1 Appendix 2-3
Finding-F7	Excluding the risk management elements from ICAO Annex 19, the formal management of FOR within these airlines is in its infancy.	Sections 2.7.3-2.7.4 Appendix 2-6
Finding-F8	Excluding the risk management elements from ICAO Annex 19, the resources to establish a flight operational RMS within this airline are deficient.	Sections 2.7.3-2.7.4 Appendix 2-6
Finding-F9	The majority of managers from flight operations want their airline to establish a flight operational RMS.	Sections 2.7.3-2.7.4 Appendix 2-6

### 5.3 Research Question

The Research Question is:

*What is the perceived importance and approach to the management of flight operational risk by selected airlines within the Asia Pacific Region?*

The two key words in the RQ are ‘importance’ and ‘approach’. What level of importance do these airlines apply to the management of FOR and what processes, systems and strategies are used to manage this risk?

#### 5.3.1 Importance

The failure of people is a key category in FOR, consequently an airline that places a high level of importance on managing this risk would endeavour to ensure their selection and training, checking and monitoring processes of their flight-crew are of a high standard.

The management of these airlines in the main believe the selection processes are robust enough to ensure the successful flight-crew applicants satisfy the requirements of achieving and maintaining the required standards in both technical and non-technical skills, as well as adapting to the airline’s organisational culture. The exception are a few junior line managers in Airline A2 who believe some of the pilot applicants lack the command ability and in all probability will fail their command course as well as some lack the necessary heavy jet experience which they deem is necessary. This view is in conflict with the airline’s HR department who today believes heavy jet experience is not mandatory and if an applicant in the future were to fail their command course, they will still perform their duties as a first officer to a satisfactory standard. The management of these airlines consider the management of FOR very important and allocate substantial resources in the training checking and monitoring of this employee group.

The remainder of the discussion on the level of importance these airlines place on the management of FOR is contained in the answer to SQ-2.

### 5.3.2 Approach

The four airlines involved in this study do not manage their FOR utilising a systemic approach such as a RMS, but rather by addressing each risk individually utilising corporate knowledge, decision-making skills of the management team, stakeholder requirements, organisational culture and regulations. They do however, utilise some systems, such as the SMS, QMS and FRMS.

FOR is not clearly defined, however, for the purpose of the study, this risk is the risk of a loss that emanates from activities and functions associated with flight operations involving the airline's organisational culture, people, systems, internal processes or from an external event(s). Risk factors associated with FOR are ubiquitous; as such, this risk has a large number of risk factors both within and external to the flight operation's division of an airline, with these ubiquitous risk factors being owned by a multitude of stakeholders. It is how these stakeholders, both as individuals and as a group, assess the level of importance and the type of controls that are installed in managing these risk factors.

If a number of these risk factors were to occur at the same time, an airline could suffer a loss up to and including a catastrophic event such as a fatal accident and/or a hull loss. To minimise the eventuality of a loss of this magnitude, these airlines lower both aleatory and epistemic uncertainty by managing these risk factors utilising multiple methods. A key category in FOR is the failure of people and the key personnel group are the flight-crew. Airlines A1, A3 and A4 predominately operate domestic and regional flights where their flight-crews obtain an acceptable amount of manual flying exposure, consequently maintaining their technical skills. Conversely, Airline A2 is a long haul international airline and the DFO of this airline was concerned at the lack of manual flying the flight-crews were doing, this was especially true for the B777 fleet. A risk control was implemented requiring these flight-crews to do two additional simulator session focusing on manual flying every twelve months. This is a very good example how these airlines manage their FOR. An issue is identified via the reporting system, for example, un-stabilised approaches, the DFO discusses the issue with departmental managers and if the risk is considered by this group to be excessive, resources are allocated and a control is inserted, in this instance additional simulator sessions.

These airlines do not have an organisation wide established risk criteria, subsequently it is up to the responsible manager to decide whether the risk under discussion requires the insertion of a control or not. This leads to frustration on the part of junior line managers who believe the risk does require a control mechanism, however, they have to manage the risk without the desired control.

These airlines are comfortable with the technical skill standards of their flight-crews; however, what was discussed at length with the interviewees were the flight-crews NTS. These airlines place a high level of importance on this skill set as the mismanagement of a flight can result in an UAS with the possibility of the occurrence of an ES, which will result in a loss to the airline. The airlines provide the required level of funding to ensure this skill set is maintained and apart from the issue of SOP non-compliance in Airline A3, the management of these airlines are comfortable with their flight-crew's management abilities.

### **5.3.3 Flight-Crew Failures and Practical Drift**

If human failures were to occur within the flight-crew group, the likelihood of a loss within flight operations increases. A major cause of flight-crew failure is 'practical drift' where flight-crews for a variety of reasons do not comply with an airline's SOPs resulting in possible non-compliance to national and company regulations as well as an increased likelihood of a flight operational event. It is for this reason the first finding of this study involves SOP compliance.

#### Finding-F1. Flight-crew's compliance to an airline's SOPs is a key issue.

The level of SOP compliance by flight crews is culturally based, both at a national and organisational level. The pilot group from Airline A2 is very diverse and comprises pilots from a large number of nationalities. Strict adherence to the airline's SOPs is mandatory, and pilots can fail check flights for minor SOP errors. Indeed, pilots from the USA were noted as having difficulty complying with this requirement. This observation was also noted with Airline A3 who also employs pilots from the USA. However, whilst the check captains from Airline A2 would fail a pilot for a minor SOP error, the same was not the case with Airline A3, highlighting the organisational cultural aspect to SOP compliance. It was not until Airline A3 conducted a LOSA, which highlighted this deficiency as a finding in the audit report to the airline's management.

A culpability model<sup>9</sup> determined that this non-compliance problem within Airline A3 was due to two reasons:

1. the intentional non-compliance by the flight crew.
2. the SOPs themselves were at fault, necessitating a complete rewrite of the airline's SOPs.

The organisational culture within Airline A2 reduced the likelihood of this airline drifting away from its baseline performance, whereas the organisational culture within Airline A3 allowed this drift to occur. Additional factors such as the risk appetite of flight crews, complacency, fatigue, and lack of engagement with the airline can also cause SOP non-compliance to occur.

These issues were raised with the interviewees, with three of the airlines believing that whilst these issues do arise, the flight crews are disciplined enough to maintain a SOP compliance mindset. The fourth airline, Airline A3, implemented a strategy to correct this shortcoming in its flight crews after the LOSA identified the SOP non-compliance problem. This was achieved by rewriting those SOPs that were found to be problematic and re-training the pilot group on the new SOPs, with the requirement that a compliance mindset be adopted. Failure to do so for a serious breach could result in dismissal from the airline. These airlines, apart from Airline A1 who, at the time of data collection had not conducted a LOSA, use this audit to determine (amongst other information) the level of their flight crew's SOP compliance. These airlines also use FDA to identify SOP non-compliance. Two of these airlines claimed that since they have been recording the aircraft's flight parameters using FDA, they have not observed their flight crews committing a wilful violation. It was indeterminable whether this was a result of disciplined flight crews, or concern about being identified by the event being recorded by FDA.

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<sup>9</sup> An example of this model is contained in Appendix 5-1.

Flight crews want to know what the trigger points are for an event to be recorded, with the airline responding by stating that if the SOPs are complied with no event will be triggered. Non-compliance to SOPs may or may not be a wilful violation.

#### **5.3.4 Information Flow Reporting Culture and Just Culture**

Of all the various sub-cultures discussed by the interviewees, the reporting culture was the most widely talked about culture. One reason for this is that the pilot group are encouraged to report, especially if an event has occurred, as non-reporting of the event may lead to negative outcomes for the concerned flight-crew, and the airlines need to know safety critical information. Without this knowledge, the risk factor is unknown and therefore the risk is unmanaged creating an ‘unknown unknown’.

Three of the four airlines believe they have established, or are establishing, a ‘just culture’ as part of the overall culture of their respective airline. A punishment culture previously existed within Airline A3, where all errors, wilful or honest, were penalised. The cultural change at this Airline to a just culture was brought about internally by a generational change in management, and externally by the influence from IOSA. IOSA was an agent of change by improving the management of safety and operational risk within this airline. Airline A3 is endeavouring to promote a culture where honest errors will not be punished. However, some members of the pilot group remain unconvinced with regard to a just culture becoming established and, due to a fear of self-incrimination, they will not submit reports unless they believe they have to, as a means to mitigate any penalties that may be imposed upon them. Indeed, this reluctance by the flight crew to submit flight operational reports was a motivator in changing the airline’s organisational and safety cultures. These airlines are all at various stages of establishing a just culture. Airline A2 has a well-established just culture with a written policy signed by the CEO. The pilots from this airline are cognitive of the requirement to report all errors, honest or otherwise, as any unreported error brought to the attention of management by other reporting methods will result in disciplinary actions. Airlines A1 and A4 have an emergent just culture, with some confusion at Airline A4 between a culture which is just and one where there is no blame attached to errors, honest or otherwise.

Finding-F2. Achieving and maintaining a ‘Just Culture’ is an objective of these airlines.

A lack of a definitive term for a just culture may lead to some confusion amongst line managers and line pilots as to what is acceptable and unacceptable behaviour as, during the data collection phase, there was some confusion observed at Airline A4 regarding what constitutes a just culture and a ‘no blame’ culture. This confusion was noted during interviews where a line manager claimed the airline has a ‘no blame’ culture. This belief that the airline has a ‘no blame’ culture was refuted by a more senior manager who stated in a response to a question regarding the airline’s ‘no blame’ culture; the airline does not have a ‘no blame’ culture, although they do have a just culture. This confusion within the management ranks was the result of the airline previously having a ‘no blame’ policy which was interpreted by the flight-crews as meaning that as long as they self-reported the event nothing would happen to them. Because of this mistaken belief, the ‘no blame’ policy was withdrawn.

Whilst Airline A4 has changed an aspect of its culture from a ‘no blame’ policy to a just culture, Airline A3 has moved from a punishment culture towards a just culture in an attempt to improve the level of safety within the airline. Airline A3 has operational management commitment to develop, implement and embed a just culture, however not everybody is convinced the goal has been achieved. Whilst first officers can see changes for the better, they do not believe the transition to a just culture is complete as they are observed after landing to check if any reportable events occurred during the flight.

A just culture is not a ‘no blame’ culture and when events occur, and the flight-crew have committed a wilful violation, disciplinary actions are required. However, other events were the result of systemic problems, or simply human error, and the substitution test was passed. In a just culture, no disciplinary action against the crew would normally be taken. This substitution test is used in Airlines A2 and A3 where, during an investigation of an event, the question is asked: “would a good pilot commit the same error given the same circumstances?” In the case of Airline A3, when they were investigating the large number of intentional non-compliances to the airline’s SOPs, it was discovered that two issues were involved, poorly written SOPs as well as wilful violations.

These wilful violations are on the side of the line delineating unacceptable behaviour as opposed to acceptable behaviour. These airlines believe the decision-making processes should be open and transparent, ensuring that the outcome is just, and favouritism has not occurred. This is a problem with the emerging just culture at Airline A3 where the perception of some of the pilots is that the punitive behaviour of management still prevails and some of the flight-crew believe at least one pilot was unfairly punished. Non-compliance to SOPs contributes to risk drift increasing FOR. Flawed change management and decision-making processes can contain latent conditions and by stealth increases the level of FOR. One method to monitor flight operations and identify latent conditions before they appear post event is by having a QMS or at least a QA section associated with flight operations within the airline.

Finding-F3. These airlines want to maintain a quality function within flight operations.

The operational management of these airlines want their respective airlines to maintain at a minimum a QA function. This is the case with three of the airlines whose QA section is associated with the airline's safety department and the fourth airline has a stand-alone QMS. The role of these QA departments is to provide organisational control over the airlines operational areas. By doing this, FOR is reduced as variances in process outcomes are reduced by reviewing process integrity, which in turn produces system integrity. The primary methods utilised in achieving this is by reviewing policies, ensuring documentation control and via the audit process, both by conducting internal audits and hosting external audits. A manager from Airline A3 believes a key attribute of QA is monitoring via the PDCA cycle where a procedure or a process after it has been implemented is reviewed and any defective parts of the process or procedure such as a latent threat is removed, with the process being corrected as required. Whilst the QA section from these airlines conducts internal audits and reviews to ensure system integrity, an external audit QA hosts is the IOSA. All of the airlines view this audit in a positive light, as this audit's standards are comprehensive; and as a consequence an airline's safety and risk outcomes are improved. The ICAO mandated SMS does not require an airline's flight operations to have a QMS or a QA section. However, a number of managers from these airlines discussed the possibility of merging the function of safety, risk and quality into a single department.

The rationale behind this concept was each of these functions has their own strengths, tools and techniques, with safety being reactive, quality being proactive as outlined above and risk being predictive. For an airline to manage its FORs, it first must generate the income that funds the resources, for example, the systems discussed above, which assists in the mitigation of the large number of risk factors associated with flight operations.

### **5.3.5 Flight Operational Risk and Business Risk**

Finding-F4. These airlines believe the balance between production and protection is acceptable.

This finding relates to the management dilemma of providing the correct level of safety whilst still allowing the airline sufficient freedom to produce enough revenue to allow the airline to remain commercially viable. If this balance is not achieved and preference is given to an elevated level of safety, that is, a ‘brake’ is applied, profitability declines and the likelihood of business risk materialising increases. However, too much production results in the airline’s assets being excessively utilised without sufficient safety measures being installed, where the ‘brake’ is removed and the ‘accelerator’ is applied, which increases operational risk and also the likelihood of an accident occurring.

The four airlines in this study are owned in total, or in part, by the private sector and are therefore required to be profitable. The safety component of these airline’s organisational culture is at the forefront of both the flight crews and management’s mindset, with Airline A1 and A2 being very cognitive of this aspect of the operation. The route network these two airlines operate is considered to contain a high number of threats, with Airline A1 operating into the PRC for many years. This strong safety mindset displayed by the flight crew from Airline A1 is a result of this airline’s experience gained through the exposure to a large number of threats that needed to be managed, especially in the earlier years. However, notwithstanding the high threat environment this airline operates within, the overriding requirement of this airline is to be commercially successful. This view is fully supported by the safety manager who previously believed production and protection were conflicting forces, but who now believes they are complementary and should be balanced.

Airline A2 believes the airline's safety management is extremely important however, at the same time, the airline has to operate within the financial constraints of the budget. All of the flight operations divisions from these airlines are satisfied with the budgets they are allocated; however, they are also under pressure to reduce costs. Resources for functions such as flight crew training were considered satisfactory and maintenance of the aircraft within these airlines was not an issue. Fatigue was an issue within Airline A1 for some time, but had been resolved and was not raised as an issue within the other three airlines.

Flight-crews from these airlines are satisfied with the level of resourcing for flight operations and if the level of safety were to be reduced they have the opportunity to 'pushback' against the reduction. The key issue here is what is the acceptable level of resourcing before conflict occurs? An issue that is heard within the industry is the ability of an airline to suffer a hull loss and then continue as a viable organisation. What the concern is, airline management reduces the level of safety resourcing below a critical point of insufficient protection resulting in a hull loss. This concept was raised with the flight-crews from these airlines. Interviewees from Airlines A1, A3 and A4 claimed this concept is not an issue as safety is well resourced. However, in Airline A2 there were dissenting views on this topic. A senior check captain claimed in the past, because of cost savings management considered the concept of reducing safety protection to the point of a possible hull loss; however, other members of the flight-crew group refuted this view. This philosophy, if implemented could cause the airline to breach a number of national regulations. Complying with regulations is one strategy airlines use to manage their FOR; these regulations are substantial in number, consequently a large amount of resources is required to ensure these laws are complied with.

### **5.3.6 Compliance to Regulations**

An issue that was noted when reviewing the literature for this study was the '*the bureaucratisation of safety*'. This was raised during the data-gathering phase by asking interviewees the impost of the SMS and IOSA on their respective airlines as these two requirements are the largest administrative tasks imposed on airlines of a bureaucratic nature in recent times.

Apart from a single issue where an airline had to comply with all IOSA standards to pass the audit, the overall assessment of IOSA was positive with the belief the audit was sharing knowledge with regard to the world's best practise. With regard to the imposition of the ICAO mandated SMS, it was regarded in a positive light, apart from a quality manager who believes the function of quality within the airline industry is being downgraded when compared to the functional areas of safety and risk.

All four airlines are domiciled in countries that are member states of ICAO and are therefore required to abide by the ICAO safety management SARPs. Each of these member states has a regulator whose primary role is to provide oversight in ensuring the countries aviation safety regulations are complied with. Compliance to a nation's aviation laws is an absolute requirement. However, focusing solely on compliance issues may inhibit the identification of serious underlying safety issues. What is required is for the regulator and the airlines to cooperate and create a relationship of openness and trust rather than obscure safety issues.

Finding F5. The relationship between the airlines and the regulators are aligned with ICAO philosophy.

The requirement for an open relationship between the regulator and an airline with professional courtesy, but with some distance between the two parties was observed to be the case with Airlines A1, A2 and A4. However, the same cannot be said for Airline A3; previously managers at Airline A3 considered concealing safety issues because of the then poor relationship between both parties.

The operational management team from Airline A1 describes their relationship with the regulator as professional and personable, with their FOI being approachable. The issue that the airline has with their FOI is, at times, the FOI will try to micromanage the airline by requesting non-regulatory requirements be inserted into the airline's operating manuals. (This could be because of the FOI attempting to contribute to the creation of a generative safety culture with a constructive dialogue). The relationship between the operational management team at Airline A2 and the regulator is described as arm's length, although it is also described as being on a first name basis. In addition, the relationship between the operational management team at Airline A3 and the regulator is described as a good working relationship which can, at times, be fractious.

Still, the relationship between both parties is improving which may be in conjunction with the airline moving from a punitive culture to a just culture, and possibly the FOI moving from a pure compliance mindset to embracing a more open and collegial relationship. During Airline A4's formative years, there were issues with the regulator because of limited resources, and internal auditing being conducted on a snapshot basis. The regulator now requires the airline to increase the level of risk assessment and to conduct risk assessment on a wide range of operational areas. As Airline A4 has matured, so has its relationship with the regulator, and now the regulator looks to the airline for guidance on various issues facing the industry. An issue the regulator has with Airline A4 is its change management manuals have become shelf-ware, which was cited as a finding against the airline during an audit, which is discussed in the following section. Another element in FOR which may increase the likelihood of an event occurring are flawed changes to systems and processes creating latent conditions.

### **5.3.7 Latent Conditions in Systems and Processes**

An issue identified in this study was risk drift, where the likelihood of a flight operational loss increases because of a lack of corrective action being applied to a rising level of aleatory uncertainty due to practical drift, as was the case with Airline A3. Another area within flight operations that can cause an increase in the level of randomness of an event occurring are the creation of latent conditions. Whilst these conditions are not risk drift factors, they do however reside within the system undetected until triggering factors occur which become contributory factors in an event. Two common causes in the creation of these latent conditions are flawed decision-making processes and changes made to procedures, processes and systems contributing to unexpected outcomes. These airlines acknowledge their decision-making processes within change management are improving but still have issues, which leads to the following finding.

Finding-F6. The change management processes within these airlines are improving.

Inadequate change management processes can increase both aleatory and epistemic uncertainty, which causes human errors and procedures and processes to fail. Interviewees from the four airlines claimed that, in the past, their airline did not manage change all that well but are now improving in this area. One change management process that has been improved was the change from an informal to a formal process, which included the requirement for documentation, whereas managers previously conducted changes on an intuitive basis. At Airline A1, the prevailing belief is that the airline has learnt from previous mistakes where implemented changes did not always proceed as expected. On one occasion poorly conducted changes to a procedure resulted in this airline suffering from an adverse event due to the creation of a latent condition. This resulted in an incident, which could have had serious consequences. By producing a flawed procedure, the level of randomness within the system increased, and when a trigger factor appeared, in this case, error(s) made by the flight crew, the resultant outcome was a serious incident. Providing employees with additional knowledge should lower the level of risk within an airline, however, flight-crews believe the large amount of changes they are required to learn and apply is too much, and claim that it increases the level of uncertainty within the airline. Indeed, when many changes are occurring, flight-crews claim they experience stress which can cause this group of employees to become confused and complacent.

An issue that was raised within Airline A2 that has not been addressed when changing processes or procedures is ensuring relevant stakeholders are engaged. Poor consultation and communication with stakeholders was noted as an area of concern within the airline, which can result in conflicts occurring between these stakeholders. As a strategy to assist with the engagement of stakeholders regarding changes in procedures, Airline A2 has adopted electronic tagging of operational manuals, which should ensure stakeholders of an operational manual being informed of any change. In addition, Airline A3 acknowledges the change management processes have to be improved and the airline is actively working on improving these processes. At Airline A4 change management processes are documented, however these documented processes appear to have become 'shelf-ware,' as junior line managers are not aware of their existence.

Consequently, these procedures are not followed, through either ignorance or intent. A finding by the regulator on a recent audit of Airline A4 was that there is an inadequate level of risk assessment being conducted on operational changes.

Indeed, it is not only the airlines that are causing problems with change, the aircraft manufactures also contribute to elevating the level of FOR of the airlines, as the airline has had to absorb a large number of changes on an ongoing basis. Some of the knowledge presented with these changes are lacking in clarity resulting in flight-crew members being unsure of how the new procedure is to be implemented, leading to an unexpected increase in epistemic uncertainty.

As noted at the beginning of this answer, the four airlines involved in this study do not manage their FOR utilising a systemic approach such a RMS, but rather by addressing each risk individually utilising corporate knowledge, decision-making skills of the management team, stakeholder requirements, organisational culture and regulations. The last part of the answer to the RQ discusses the formal management of FOR including three findings from these airlines.

### **5.3.8 Systemic Management of Flight Operational Risk**

Finding-F7. Excluding the risk management elements from ICAO Annex 19, the formal management of FOR within this airline is in its infancy.

Only one of the four airlines has an established organisation-wide risk management framework that covers both operational and non-operational areas, with this framework being integrated into the airline's SMS. There are multiple reasons why these other airlines have not adopted a formal RMS. The main reason, apart from safety and change management issues that are an integral component of an airline's SMS, is FOR is not required by law to be formally managed. Nonetheless, the airline industry manages its operational risks extremely well, as the safety statistics of the industry demonstrate. Previous generations of managers within flight operations would use 'gut instinct' to determine what an acceptable level of risk was and make their decisions accordingly. This style of management has since matured and improved, but still remains non-systemic based. The airline industry, with its multiple stakeholders, are closely connected through organisations such ICAO, with each country's regulations being based on this organisations' standard and recommended practises.

Airlines domiciled within these countries are required to comply with these regulations. As a result, airlines tend to manage their operational risk through legislation, rather than via an internal system. Where there is no legislation, or it is inadequate to manage a risk, these airlines manage it through traditional methods, such as retained corporate knowledge, reporting systems, operational systems such as SMS, QMS, FRMS, and the managerial skill sets of the risk owners. The concerns against using a systemic-based approach, therefore, is that the informal method works well, so why risk adopting an unknown, and therefore risky, formal method?

There appears to be an invisible horizontal line through the flight operations division placed at, or near, the DFO level. At this level and above, formal risk management processes exist, such as the use of risk registers. However, below this level and excluding individual manager(s) who have acquainted themselves(s) with formal risk management knowledge, these processes are unknown. It appears that the formalising of risk management processes is not for operational risk owners to improve their risks assessments skills but for corporate governance requirements, allowing executive management and board members visibility to the airline's operational risks on a formal basis.

The majority of these airline's flight operations management team have had little, or no contact with the limited number of risk management professionals employed by their airline. The safety departments from these airlines are moving towards formalising risk management, however, this is occurring at an incremental rate as there is no legislation requiring a RMS and resources are limited.

Finding F8. Excluding the risk management elements from ICAO Annex 19, the resources to establish a flight operational RMS within this airline are deficient.

These airlines are required to produce a safety policy as part of their SMS, whereas they are not required to produce a risk policy. The risk policies from these airlines are vague and, in some cases, not signed by executive management. These policies are then forwarded for approval and, if there has been no response after some time has elapsed, the non-response is considered, by at least one of these airlines, as being approved, as no definite rejection was received.

This lack of formal acceptance of a risk policy is indicative of the airline's unwillingness to commit resources to a RMS. What is required to create a RMS is capability, and this lack of funding to obtain the necessary resources for a RMS impedes this ability. Resources, which have been allocated to a parallel function such as safety, are leveraged to include risk management. Still, there is a desire to provide the resources as the executive managers from two of the airlines who were interviewed stated that they would provide the resources that are required to manage their airline's FORs.

The resources that must be increased first, which, at the time of data collection was limited, are human resources. Indeed, available risk management employees are in short supply, with the GRM from Airline A2 mainly providing business risk advice to the CFO, with the complaint from FOR owners who want to become better acquainted with formal risk management processes that the GRM is never available. The GRM admits his authority within the airline is limited and is obliged to obtain the required resources as best as he can.

Excluding Airline A3, which is undergoing a management structural change, the authority of the person responsible for safety management within these airlines is a senior employee answering to the CEO. The manager responsible for quality management is a mid-level manager, whereas the manager responsible for risk management is a junior manager, or is non-existent. The risk function has been attached to a safety manager and, using Airline A4 as a proxy, the manager responsible for safety is classified as a level five<sup>10</sup> manager, the manager responsible for quality is a level four,<sup>11</sup> and the manager responsible for risk management is a level three<sup>12</sup> manager.

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<sup>10</sup> Higher level

<sup>11</sup> Middle level

<sup>12</sup> Lower level

The safety departments from these airlines are expanding their functions to include a risk assessment capability in line with their obligations to manage safety risk. Another reason why these airlines have limited resources with regards to the formal management of operational risk is they have reviewed processes from this type of risk and believe some of these processes to be unsuitable for their industry. As an example the safety manager from Airline A1 claims the 'bowtie risk assessment' method is unsuitable for airline industry, and the GRM from Airline A2 claims all of his risk management processes are created in-house, primarily using a spreadsheet, as he has not observed any risk management products that are suitable.

These airlines all use the same quality management software, and the majority of the users of this product have a negative view of it regarding its risk management capabilities.

Funding for staff training of risk management processes is very limited. Consequently, the risk assessment processes such as risk identification, and excluding safety risks, is conducted on an informal basis. The risk analysis is conducted primarily on management experience rather than on a qualitative, or quantitative basis, and risk evaluation is also conducted based on a senior manager's belief, rather than on the risk criteria that has been established by the airline. Therefore, risk-owners who desire to implement a strategy to manage an identified risk have to accept their supervisor's decision.

Finding F9. The majority of managers from flight operations want their airline to establish a flight operational RMS.

Senior managers within these airlines indicated that they want the operational risks of their airline to be well managed, however the funds that have been allocated to resource a RMS are minimal. Some of these resources have become shelf-ware as risk owners are unaware of how risk assessment processes work. Furthermore, some of the managers are not interested in acquiring these skills unless training courses are arranged, whereas other managers are interested in obtaining these skills, although the airline's allocation of funds for these training purposes are limited.

Apart from senior managers and the individual manager(s) who have acquired risk assessment knowledge themselves, managers from these airlines are unaware of how a RMS functions. However, they are interested in obtaining this knowledge, as they believe the airline's management outcomes would improve as a consequence of:

1. improved decision-making processes
2. improved change management processes
3. better control of documentation
4. improved retention of corporate knowledge
5. improved compliance record
6. better cost control
7. enhanced risk assessment abilities through improved risk identification, risk analysis and risk evaluation
8. better outcomes for the airline's CSFs such as safety, legal and reputation
9. improved corporate governance
10. better litigation outcomes
11. an expectation of lowered insurance premiums
12. improved sustainability.

These reasons for an airline adopting a RMS are explained in the answer to SQ-3.

It was noted during the data-gathering phase that some junior managers were frustrated because their supervisor denied their requests for resources to manage an identified risk. This was not the case with Airline A4, as this airline has an organisation-wide risk management framework in place. As a consequence, the airline's risk criteria are firmly established, with risks being analysed and evaluated in a uniform manner. With this RMS in place, the risk becomes visible to the airline's senior managers, effectively reducing the 'silo effect' and, if the risk assessment is considered correct, resources are then required to treat the risk, so as to reduce the risk to an acceptable level.

This completes the answer to the RQ; the following section contains the answer to SQ-2.

## 5.4 Sub Question SQ-2

### 5.4.1 Introduction

*Do Airlines in the Asia Pacific Region consider the management of flight operational risk important?*

This question and the study's research question deal with the same topic, which is the importance of managing FOR. As these questions share a common linkage, they are answered in association with each other.

The answer to this question in a word is yes! Business risk was considered the number one risk an airline must manage; the second most important risk was operational risk. If the management of FOR was not considered important, the level of incidents and accidents within the Asia Pacific Region would be substantially higher with catastrophic consequences to CSFs such as safety, legal, reputation as well as economic disruptions. The reality of airlines not placing a high level of importance on this risk is unthinkable, this is why these airlines provide substantial resources to manage this risk acceptable to all major stakeholders such as the, regulator, shareholders, employees, passengers, and management.

A prime indicator to determine the level importance these airlines place on the importance of the management of FOR is the level of resources they allocate in the management of this risk. As this answer conveys, these airlines expend a large amount of funds in the management of FOR, albeit not on a formal systemic basis. Interviewees were asked, what they believe the budget to manage this risk within their airline was, with none of the interviewees being able to provide an answer. A good indicator of an airlines attitude towards the management of FOR is its risk culture.

### 5.4.2 Risk Culture

These airlines are risk averse and the flight-crews from these airlines are also risk averse, the culture on the flight deck is considered to possess a low tolerance for risky behaviour and apart from Airline A3 and its earlier SOP non-compliance issue, comply with their airline's SOPs. For this reason, practical drift after Airline A3 resolved its non-compliance issue would appear not to be an issue.

The flight-crews from these airlines claim to respect hazardous weather, which is supported by these airlines managers who state flight-crews are not pressured to arrive and depart with weather that is below published minimums. The route network of Airline A1 and A2 is assessed as a high threat network by the interviewees from these airlines. They however, are satisfied with their and their airline's ability to deal with the threats they encounter. The interviewees from Airlines A3 and A4 consider their respective airline's route network to be low level of threats and the threats are comfortably managed. The flight-crews and these airlines consider themselves to be risk conservative and not risk seekers. One area of concern, which could cause risk to drift towards failure, is a human factor, which is complacency.

#### **5.4.3 Human Factors**

The management teams from the four airlines indicated they were generally satisfied with the ability of the pilot group to carry out their duties to the required standard. These airlines claimed they were happy to fund pilot training to ensure pilots obtained the required standard. These airlines require their pilots to possess the required technical skills and where there is an observed shortfall, additional resources are allocated to correct this issue as was the case with Airline A2 providing its B777 flight-crews with two additional simulator sessions per year. The complementary skill set to technical skills are non-technical skills which are the management skills rather than manipulative skills, examples of these skills are, situation awareness, decision making and team building. These airlines require their flight-crews to possess a high standard of non-technical skills, and for this high standard to occur and to be maintained, it requires a substantial level of funding.

Pilots are required to undergo check flights both in the aircraft and in the simulator throughout the year to ensure they remain proficient. Managers from Airline A2 monitor these check reports very closely looking for marginal performers. This close monitoring was not raised at the other airlines. A possibility for this is Airline A2 bases their flight-crews around the world, whereas the other airlines base their flight-crews in the airline's country of domicile. Airline A2 is concerned that a pilot joins the airline, undergoes the required training and relocates to an offshore base away from the scrutiny of check and management pilots.

The problem this airline is concerned with is ‘performance drift’; a new pilot has not spent enough time absorbing the airline’s culture, and without scrutiny can drift to an unacceptable level of performance. Similar to ‘performance drift’ is complacency where pilots are self-satisfied with their performance, but have ‘tuned-out’ lowering their level of situation awareness and therefore no longer ‘mindful of danger’. A number of reasons why complacency occur were suggested such as, personal attributes, which at least one of the airlines attempts to identify this trait and reject the candidate during the selection process. Others are fatigue, modern technology aircraft (highly automated) and multiple sector days over the same routes. These airlines monitor these and other behaviours.

#### **5.4.4 Monitoring**

These airlines provide substantial amount resources to monitor human performance by both electronic surveillances in the form of FDA and human observation via the auditing and checking processes. The objective of this surveillance is to ensure the aircraft are being operated in a manner to the satisfaction of the airline and the regulator. The concern is flight-crews both individually and as a group as was the case with Airline A3 can drift away from the required norm exposing the airline to an elevated level of aleatory uncertainty, that is, the system itself has an increased level of randomness increasing the likelihood of a serious incident or accident. These airlines have multiple monitoring systems, each with their specific functions due to their respective strengths. All of these systems require substantial funding which is indicative of these airlines placing a high level of importance on the management of FOR. Some airlines conduct line audits on a routine basis on their flight-crews, however, none of the four airlines involved in this study conduct these audits, relying on the checking system as an ongoing human based observation. The problem is if this system were to fail, that is, the system fails to achieve its objective of ensuring the flight-crews operate the aircraft to the required standard, practical drift by the flight-crew would go unnoticed with the airline falsely believing the airline is operating to or close to baseline performance as was the case with Airline A3. The monitoring systems or processes these airlines use are the checking system, LOSA and FDA.

The majority of the management team from these four airlines, ranging from junior line managers to executive managers believed the management of FOR should become systemic based.

#### **5.4.5 Creating a Risk Management System**

Apart from Airline A4 creating a risk management framework and subsequently merging this framework into the SMS, these airlines do not possess a systemic based FOR management system. This is the rationale for the following finding.

Finding F7. Excluding the risk management elements from ICAO Annex 19, the formal management of flight operational risk within this airline is in its infancy.

Executive managers from these airlines stated they would provide the resources to manage FOR on a formal basis as they believed all organisations contain risks, with airlines especially so. One of the chief concerns was the lack of a formal risk identification program with an overall concern being managing risk was a key function with any business and mismanaging risk is problematic, with this view being embedded within executive management. This concern was observed during the data gathering phase where there appeared to be a horizontal line situated at the DFO level, where executive management had visibility into the risk factors for corporate governance requirements. Executive management consider the management of FOR very important and the motivation by executive management to provide the resources for the establishment of a RMS was considered to be genuine, however at the time of data collection, it was noted this was not the case as per the following finding.

Finding F8. Excluding the risk management elements from ICAO Annex 19, the resources to establish a flight operational RMS within this airline are deficient.

This completes the answer to SQ-2. There is a close association between SQ-2 and SQ-3 where SQ-2 deals with the importance of managing FOR and SQ-3 discusses the motivators behind formalising the management of this risk.

## 5.5 Sub Question SQ-3

### 5.5.1 Introduction

The RQ and SQ-2 discussed the importance of managing FOR, with this question, SQ-3 asking, what are the motivators in creating a RMS as outlined in the following question?

*What are the key drivers for establishing a flight operational risk management system?*

A major motivator in the establishment of a RMS is reflected in Finding-F9 where the majority of managers want their airline to create and implement such a system as they assume they would better manage their risks and in doing so improve the output of processes they are responsible for as per the following finding.

Finding-F9. The majority of managers from flight operations want their airline to establish a flight operational RMS.

These airlines are required to manage their safety obligations via a SMS as per the ICAO SMS framework contained in Appendix 2-7. This SMS requires these airlines to manage safety risk and the management of change, so why would these airlines spend additional resources to develop and implement a RMS? The answer to this question is presented in the following section and explains the rationale of Finding-F9. As outlined in Concept C-11, there are many reasons why a number of managers from these four airlines would like their airline to implement a RMS, with some of these reasons presented here.

Improved decision-making processes, improved change management processes, better control of documentation, improved retention of corporate knowledge, improved compliance record, better cost control, and enhanced risk assessment abilities through improved risk identification. As well as better risk analysis and risk evaluation, better outcomes for the airline's CSFs such as safety and legal, improved reputation and corporate governance issues, better litigation outcomes, an expectation of lowered insurance premiums, and improved sustainability. These processes/outcomes already exist within these airlines, what a RMS would do is to improve these processes/outcomes. Consequently, reducing the likelihood of an event occurring by assessing the risks and risk factors associated with FOR with the overall objective of preventing risk drift.

A discussion of some of these reasons are in the following section.

### **5.5.2 Improved Decision-Making**

Interviewees from all of the four airlines believe the decision-making skills of their management team would improve with the introduction of a RMS because the ‘gut instinct’ and ‘shooting from the hip’ style of decision-making processes would be replaced with a fully documented and risk assessed pathway. Managers from Airline A4, who believe the decision-making capabilities of these managers would improve, support the view of implementing RMS to improve the organisation’s decision-making skills. The risk auditor from this airline is more positive with regards to the decision-making capabilities of the managers and believes there may or may not be changes in the risk outcomes for the airline. The risk auditor also maintains that improvement would be enhanced through managers having a better understanding of the decision-making processes.

At Airlines A1 and A2, operational decisions, such as suspending operations due to a substantial hazard such as a typhoon, are made by the airline, whereas flight specific decisions are left to the captain. A major reason for this is both airlines do not operate a dispatch system. A dispatch system for flight operations is an integral part of the USA airline model where the airline has operational oversight on its flights and the decision-making processes are a shared responsibility between the flight crew and the dispatcher, with the captain having the ultimate decision-making authority.

Another issue that was raised in relation to organisational decision-making was at Airline A4, where there is an inadequate review of multi-level decisions made by senior management and how these decisions affected the operational part of the airline. This lack of review of decisions made by senior management, leading to what is considered by one operational manager to be a poor risk management practice as these management decisions may lead to the creation of latent conditions as well as the possible introduction of additional risk factors. An example of what this operational manager is referring to is contained in Appendix 5-3.

### **5.5.3 Improved Risk Documentation**

When risks are managed on a systemic basis, documentation is an integral component of the process. This requires a disciplined approach to the storage and dissemination of knowledge rather than a haphazard approach, which can occur within an informal method. The risk register is an essential document allowing corporate knowledge to be absorbed and retained. Documentation also allows previous decisions to be reviewed and adjusted as required when new information, which has an influence on the risk, is obtained. Improved litigation outcomes because of the ability to demonstrate to the court the airline's risk management system in the event of an incident or accident. Depending on the capability of the RMS, it is possible for an airline's policies including its risk policy to be documented within this system preventing a new management team coming in and changing the airline's risk appetite to an unacceptable level. Documentation also allows the risk to be viewed by relevant stakeholders increasing the visibility of risk.

### **5.5.4 Airline Wide Risk Criteria**

By establishing the airline's risk criteria, assessed risks that exceed the airline's risk tolerance are required to be treated. This removes the ability of the responsible manager from intercepting the request for mitigating resources as the risk criteria reflects the airline's risk policy. Risk owners can become frustrated where in their opinion; resources to treat a risk are not forthcoming, with no recourse for appeal. This frustration was observed in two of the airlines where the responsible manager overruled risk owners in denying resources to treat an identified risk, in one instance the risk was realised which could have resulted in a serious incident. By having established airline risk criteria, authority to overrule risk owners is reduced, however, the assessment processes have to be acceptable to both risk owners and management. Whilst having an airline wide risk criteria was identified as a motivating reason to implement a system based risk management system, a point of conflict to this motivator was the assessing processes. In one of the airlines where treatment resources were declined to risk owners, the underlying issue was calculating the likelihood of an event occurring. This airline based their likelihood calculations using a qualitative methodology, which is judgement, and experience based creating differing levels of likelihood, which could result in the assessed risk being acceptable to one person and to another person, exceed the airline's risk tolerance.

To resolve these disputes, an agreed methodology in calculating likelihood has to be established as part of a systemic based risk management program, once this is achieved, and the risk criteria is acceptable to all stakeholders; increased authority is transferred to the risk owners.

### **5.5.5 Increasing Level of Compliance Requirements**

The bureaucratisation of safety has been addressed in academic journals acknowledging its benefits and limitations. Interviewees did not explicitly raise the concept of the bureaucratisation of safety; however, it was discussed with regard to the increasing level of compliance requirements. On a generalised basis, the operational managers from this study were accepting of the regulatory requirements that was imposed on their airline. A notable exception was in Airline A1 where the FOI would endeavour to impose a personal requirement, not required by regulations to be inserted into this airline's operational manuals. However, when this request was denied, the FOI was accepting of the rejection. With regard to industry compliance requirements, the situation was slightly different, the regulator is the sovereign representative and IATA is the industry representative. Compliance to both sets of regulations is mandatory, non-compliance to sovereign regulations will result in the eventual cancellation of the airline's AOC and non-compliance to IATA regulations will result in the eventual loss of membership from IATA. Compliance to IATA regulations is confirmed by an audit conducted every two years on IATA member airlines and is referred to as IOSA. This is a comprehensive safety audit with a substantial number of standards. The concern from airlines involved in this study is twofold, firstly, they feel aggrieved inserting some of the IOSA standards into operational manuals as they have some concern about the applicability of the standard and to pass the audit, the standard has to be documented. Secondly, at the time of data collection, IOSA contained two types of standards, one included the word, 'shall' requiring mandatory compliance and 'should' whilst not mandatory was recommended. The view at this time, was IOSA was moving towards a 'shall' mindset reducing or phasing out the 'should' standard resulting an increase in industry compliance requirements not covered by the SMS. Consequently, it was considered prudent to allocate resources to ensure these ever increasing industry regulations were complied with.

### **5.5.6 Dissemination of Risk Knowledge**

Operational divisions within the airline who have been managing their risks albeit on an informal manner have acquired a substantial amount of risk management knowledge. Once risk management within an operational division such as flight operations is systemic based, the system can be expanded to include other operational divisions such as engineering and later to non-operational areas such as administration enclosing the entire airline in an enterprise wide risk management system. The risk management knowledge that is contained within the operational areas will increase with the introduction of a systemic approach, with this knowledge being disseminated to other parts of the airline improving their risk management capability.

### **5.5.7 Improved Risk Visibility**

Departments within these airlines in part, are managed with a 'silo mentality' where risk owners who are departmental employees can identify a risk and bring it to the attention of the responsible manager. It is up to this manager to determine whether resources will be allocated to manage this risk or to remain unmanaged and consequently invisible to the airline as a whole as a consequence of the 'silo mentality'. Apart from risks, which must be managed because of a regulatory requirement, an airline whose risk management processes are not systemic based, risks can remain hidden as it is dependent upon the judgement of the responsible manager(s) to determine whether or not resources will be allocated to implement control(s) to manage this risk. Systemic based risk management will allow a risk, which is referred to as a 'known unknown' to become a 'known known' as the risk is entered into the risk register by the risk owner and not intercepted by the responsible manager. This allows the risk to become visible to other stakeholders within the airline allowing senior management to query the responsible manager on the on-going management of the risk. An important requirement for this process to function is for the airline to have established risk criteria that requires a risk that has been assessed as exceeding the airline's risk tolerance to be treated.

### **5.5.8 Greater Understanding of Risk**

The risk owners currently manage their risks utilising traditional methods such as regulatory compliance, conformance to company policies and procedures, and following company instructions. Their actual understanding of the formal processes of managing risk is very limited because of minimal or in some cases; no training courses on the subject of risk are provided. One example proffered by an interviewee was a ten-minute demonstration regarding risk registers. An area where training is provided is safety as per the SMS's regulatory requirements. Managers responsible for risk within an airline, where possible, use these safety-training courses to impart some risk management knowledge without compromising the integrity of the safety courses. The vast majority of interviewees involved in this study claimed they have had no dealings with a RMS or a Risk Assessment Program (RAP). However, they believe if the airline were to introduce such a system or program and they were given training courses on the various formal risk management processes, they believe this greater understanding of risk would be of benefit to them.

A few of the older managers believe the traditional methods work well and they do not see the need to adopt formal methods, with one area of concern being the reduction in the identification of risks. A risk manager who believes risk identification is enhanced with a formal system as workshops utilising methods such as brainstorming are conducted refuted this concern. A common theme from interviewees was the management of risk on the flight deck is well advanced of that from the airline's operational offices. This is the result of flight-crews being subject to risk management training courses over many years such as TEM and the belief in the office is, the 'time has come' to formalise risk management at an organisational level as the functional areas of safety and quality have done.

This concludes the answer to SQ-3, a summary of the chapter is presented next.

## **5.6 Chapter Summary**

This chapter presented the study's nine findings which were distilled from Chapter Four Analysis. In conjunction with these nine findings, the RQ, SQ-2 and SQ-3 were answered. The findings were presented in tabular form with linkages to the relevant section(s) in the analysis chapter as well as linkages to the literature in the literature review chapter and the appendices. All nine findings are discussed in the study's RQ, with the RQ, and SQ-2 sharing a linkage with regard to the importance these airlines place on the management of FOR; consequently, they are answered separately but in tandem. The study's findings are centric in the answer to the RQ; and the human element is the focus in the answer to SQ-2. The answer to SQ-3 contains a single finding which is the main focus of the answer which discusses what are the main drivers in establishing a RMS?

This concludes Chapter Five Results; the answers to SQ-1 and SQ-4 are presented in the following chapter as well as this study's theoretical contribution to the topic's body of knowledge.

## 6 Chapter Six Discussion from a Theoretical Perspective

### 6.1 Introduction

This chapter is a theoretical discussion answering SQ-1, SQ-4 as well as supplying the study's theoretical contribution to the topic's body of knowledge. It is normal to answer questions in a study such as this from the analysed data; however, in this instance this is not possible as the data that was forthcoming from the interviews was of insufficient quality to provide acceptable empirical findings. The reason for this is, only three of the 71 interviewee's job function was in the area of risk management, subsequently the overall data forthcoming was lacking in both quantity and quality with regard to the systemic management of FOR. Because of this shortcoming, the answers to SQ-1 and SQ-4 are sourced from the literature and referenced accordingly hence, they are theoretical answers.

As a method to improve the interview guide, interviews were conducted with three experienced airline captains from the Asia Pacific Region before the commencement of data collection. However, no pilot study was conducted with the airlines, as it was the researcher's opinion, obtaining access to the airlines would be problematic and visitation times would be limited. The researcher believed visiting these airlines to conduct a pilot study and later return to conduct the main study would not be acceptable to the management of these airlines. This concern of limited operational access to these airlines is supported by the literature as empirical literature on operational risk is somewhat minimal due to limited access to corporate data, (Li and Moosa 2015). This view is supported by Chernobai et al. (2011) who claims academic research on the causes of operational risk losses is currently very limited.

The two questions that are answered in this chapter are:

*SQ-1. What is the definition of flight operational risk?*

*SQ-4. What are the key factors inherent in a flight operational risk management program?*

## 6.2 Sub Question SQ-1

### What is the definition of Flight Operational Risk?

There is no universally accepted definition of operational risk; each industry has their own definition (Hoffman 2002) consequently the answer to SQ-1 is this study's definition of FOR for the airline industry.

As a commencement point to answer SQ-1, an existing definition is used as a base with the most appropriate definition being sourced from the finance industry. The reason for this is, the finance industry was the catalyst for operational risk, has expended substantial amount of resources researching this risk and the definition is concise and clear. The Bank for International Settlements (BIS) through its Basel Committee on Banking Supervision (2011) defines operational risk as;

The risk of loss resulting from inadequate or failed internal processes, people and systems or from external events; this definition includes legal risk, but excludes strategic and reputational risk (BIS 2011, 3).

This definition can be separated into its key categories, which are, 'inadequate or failed', 'internal processes', 'people', 'systems' and 'external events'.

To answer SQ-1 it requires the term 'FOR' to be separated into its key elements, namely flight, operational and risk.

The first element 'flight' is a specific functional area of an airline referred to as flight operations separate to other functional areas such as cabin services, maintenances, and ground operations. However, operations is different to operational (Hettinger et al. 2008). Operations risks are risks that reside within the domain of flight operations, and FORs are those risks that have an impact on flight operations and are owned by the process owners from the flight operations division, although they may reside within, or outside, of this division. The term 'flight' in this context refers to any risk that can have an effect on the objectives of the airline's flight operations division. Consequently, the first term, 'flight' is defined as:

- *that has an association with flight operations.*

The second element ‘operational’ is defined next.

The Oxford Dictionary of English’s Oxford University Press (2010, 1245) definition of ‘operational’ is “relating to the routine functioning and activities of an organisation”, with the key words being routine, functioning and activities. Risk management involves identifying all possible risks that could materialise and have an effect on the airline’s objectives (AS/NZS 2009). This involves considering risks that are both routine in the normal course of business activities, as well as risks that are non-routine. With this belief, the term ‘routine’ should be omitted from the definition of ‘operational’. The term ‘functioning’ is a verb meaning to “work or operate in a proper or particular way” (Oxford University Press 2010, 708) and should be changed to the noun ‘function’ which means “an activity that is natural to or the purpose of a person or thing” (Oxford University Press 2010, 708).

Because of these changes, the definition of operational in this context is amended from ‘relating to the routine functioning and activities of an organisation’ and becomes:

- *as a result of functions and activities.*

The third element, ‘risk’ as a concept is not easily defined and, subsequently, there is no agreed definition of risk (Aven and Renn 2009, 1). Nonetheless, there are a number of definitions containing certain terms proffered by individuals and organisations on the various definitions of risk. Some of these terms appear in a number of the definitions and include value, probability, uncertainty and event. The terms probability and uncertainty are related, as probability is used to quantify uncertainty and this creates a problem, as to express uncertainty as a probability which is based on a value judgement requires a subjective assessment which is underpinned by assumption and suppositions (Aven and Renn 2009). In this instance, the risk is subjective risk, or perceived risk, and proponents of subjective risk believe that risk is socially created. Therefore, it is not possible to have objective risk. Conversely, supporters of the belief of objective risk refute the social science viewpoint and believe that risk is solely based on facts of the world, such as the physical sciences, and do not acknowledge non-epistemic values (Hansson 2010, 235). Still, assessing risk in the airline industry requires the use of both views. Subsequently, an amalgam of both of these theories is required, where risk contains both facts and values (Hansson 2010).

However, as the risk in this study is operational risk, which involves a substantial input of the human element which is a large contributor to uncertainty, subjective risk, or risk perception, has to be the dominant partner.

A theory of risk viewed through the subjective lens is the ‘relational theory of risk’ which is an interpretive theory involving three elements, risk objects, objects at risk, and relationship of risk (Boholm and Corvellec 2011), with key points from this theory outlined in Table 9-18 in Appendix 5-2.

Schematically, the relational theory of risk is defined as:

[Risk object] «« (Relationship of risk) »» [Object at risk] (Boholm and Corvellec 2011, 179).

Distilling Table 9-18 into a simple statement, the relational theory of risk is defined as:

- *the chance (uncertainty) of harm (risk object) impacting upon (relationship) something of value (object at risk).*

ISO defines ‘risk’ as the “effect of uncertainty on objectives” (2009, 1). Uncertainty is in both definitions, as is relationship, namely ‘impacting upon.’ Moreover, ‘effect’ and ‘object at risk’ are also in both definitions, specifically ‘something of value’ and ‘objectives’. What is missing from the ISO definition is the risk object, as this infers harm and, in the ISO definition, the ‘effect’ can be either positive (help) or negative (harm), whereas, in the relational theory definition, it is negative (harm). As risk is managed to obtain positive benefits for the risk owner, or at least minimise the harm, both positive and negative outcomes that can provide opportunities and losses should be assessed. Subsequently, the ISO definition should be adopted.

Consequently, the third term of flight operational risk, namely ‘risk,’ is defined as:

- *effect of uncertainty on objectives.*

Combining all three sections of the definition allows the complete definition to emerge:

- *the effect uncertainty has on an airline’s objectives as a result of functions and activities that have an association with flight operations.*

Using fuel as an example, there are a number of risks that fuel presents to an airline which may affect its objectives. Fuel has a quality or contamination risk that can have consequences for the CSFs of safety and reputation. Another risk is availability, due to a logistics failure which would not have an impact on the critical success factor of safety, but may impact reputation and finances. Fuel price is a risk, although it would be considered a financial risk rather than an operational risk.

We can now compare this definition with the following definition of operational risk from the finance and banking industry.

The risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. This definition includes legal risk, but excludes strategic and reputational risk (BIS 2011, 3).

The financial definition of operational risk focuses on a loss that has a negative effect, rather than both negative and positive effects. However, the focus of the loss is specified, which is the internal processes, people, systems and external events. This limits the identification process to these elements, whereas operational risks may reside outside of the domain of these elements and this issue should be considered in the definition.

The belief that the ISO definition of risk, which is the ‘effect of uncertainty on objectives,’ is appropriate may not be valid as this definition covers all risks, whether they are strategic or process. For an industry that operates within a hazardous environment where safety is not only a critical success factor but is also legally mandated, this definition is not suitable for operational risk in the aviation industry. The risk definition should only focus on the negative effects that result in a loss. Risk deals in uncertainty (AS/NZS 2009). Indeed, if there is absolute certainty there is no risk. Therefore, considering the above, a more appropriate definition of flight operational risk is a combination of the above definitions:

- *the effect of uncertainty from possible harm on an airline’s objectives as a result of functions and activities that have an association with flight operations.*

This definition retains the premise of the definition of risk as per ISO 31000:2009, however it is focused on the negative effects whilst excluding positive effects.

However, it is somewhat convoluted, containing too many words, and is lacking in clarity. A clear definition of risk is required as it was noted during the data gathering phase most of the interviewees struggled to define the term ‘operational risk.’ The definition for operational risk from the banking and finance industry may be too specific in what causes the risk, although it is clear in defining what risk is; it is a ‘risk of a loss’. Combining this phrase with where risks reside creates a clear definition of risk.

The definition of ‘flight operational risk’ from this study is:

- *the risk of a loss as a result of functions and activities that have an association with flight operations.*

This definition is broad so as not to limit the identification of FORs. However, guidance material should be provided to inform risk owners where the most likely areas of FORs emanate from. As per the finance industry’s definition of operational risk, these areas should include inadequate or failed internal processes, people, systems or external events (BIS 2011). However, an additional area that directly influences FOR and should be included in the guidance material is an airline’s organisational culture, specifically risk culture. An airline that has an inappropriate risk culture such as a risk seeking culture or a pathological or reactive safety culture will have an increased likelihood of a serious incident or accident because of a heightened level of aleatory uncertainty (Helton 1997) as well as an increase in the rate of drift of FOR. An example of an accident involving an airline that had a high level of both epistemic and aleatory uncertainty as well a pathological safety culture and an inappropriate risk culture in the form of an unacceptable level of risky behaviour is the Air Ontario Flight 1362 accident with the causal pathway of this accident contained in Appendix 2-10.

This concludes the answer to SQ-1, the answer to SQ-4 is contained in the following section.

### 6.3 Sub Question SQ-4

*What are the key factors inherent in a flight operational risk management system?*

In answering this question, a discussion involving Finding-F7 is included in the answer.

Finding-F7 Excluding the risk management elements from ICAO Annex 19, the formal management of flight operational risk within these airlines is in its infancy.

The answer to this question is sourced primarily from the literature and referenced accordingly as this finding states, the formal management of FOR within these airlines is in its infancy. A generic RMS is comprised of three parts: principles, which includes the organisation's cultural aspects; framework; and processes (ISO 2009). All four airlines possess a SMS, which formally manages some of the risks these airlines face, such as safety risk, as well as risks associated with change management processes. One of the airlines had created a risk management framework, however, this framework has merged with the airline's SMS. Presently none of these airlines possesses a stand-alone formal RMS. Subsequently, only minimal data was obtained on the key factors inherent in a flight operational RMS, consequently this question is primarily answered from the literature and secondly from the data.

For the researcher to answer this question with minimal interview data, a review of the key facts, circumstances and influences involved in a flight operational RMS was conducted. Reviewing multiple sources of information, it became apparent that a gap existed in the body of knowledge of risk management in what constitutes an airline's flight operational RMS. Following this review, the researcher created a model referred to as the 'Seven Ps RMS Model', which is used to answer SQ-4.

The Seven Ps referred to in this model are; Philosophy, Program, People, Principles, Policy, Processes and Procedures, with all seven components reviewed in the following section.

### **6.3.1 The Seven Ps RMS Model**

#### **6.3.1.1 Philosophy**

The Oxford Dictionary of English defines philosophy as “A theory or attitude that acts as a guiding principle for behaviour” (2010, 1335) and, in this model, philosophy is the risk culture of an airline. This organisational-wide philosophy ensures risk is managed at all levels using a uniform and transparent methodology (Moeller 2007). For risk management to be successful it must have the full support of the executive management team and the board of directors; in essence, risk management must be anchored at this level and all risk owners must manage their risks in a consistent and clear manner (McCarthy and Flynn 2004). One of the roles of these two groups, in association with the organisation’s risk management professionals, is to provide oversight to the management of strategic risk (McCarthy and Flynn 2004). Strategic risks involves the various strategies that the organisation is implementing and can cause severe financial loss, or fundamentally undermine the competitive position of a company in relation to three key strategic areas: customers, competitors and investors (Ernst & Young 2011, 2008). Whilst this study is centred on operational risk, it is worth noting that an organisation with a flawed risk philosophy, through either poor corporate governance or a risk culture that is accepting of risky behaviour, or a combination of both, may be subject to severe financial stress if strategic risks are not adequately managed (Flouris and Yilmaz 2011). An example of this is the investment bank, Bear Stearns. This iconic bank collapsed as a result of poor strategic risk management, namely liquidity risk. Indeed, on the 6<sup>th</sup> of March 2008 Bear Stearns had USD\$21 billion in its liquidity pool. One week later this amount had reduced by 90% to \$2 billion dollars, as investors had lost confidence in the bank and, as a result, Bear Stearns was not able to meet its financial obligations (Cox 2008).

### **6.3.1.2 Program (Framework)**

In this study, the term ‘program’ is interchangeable with ‘framework.’ The Oxford Dictionary of English defines program as “...a set of related measures or activities with a particular long term aim” (2010, 1419). Information regarding a risk management framework is contained in section 2.7.3 with further information contained in Table 9-10 labelled Categories and Elements of a RMS Framework in Appendix 2-8.

### **6.3.1.3 People**

People can create uncertainty through their behaviour or cultural beliefs and, as such, they can become a threat or alternatively, a person encounters a hazard and exacerbates the harm because of their mismanagement (Shappell and Wiegmann 2000). People also manage risks through their TEM training and mitigate the harm, resulting in a lowered level of uncertainty (Klinec and Wilhelm 1999). In essence, as a group, people are both risk initiators and risk reducers. In this instance, people belong to one of three groups. Firstly, whilst carrying out their duties, the main employee body, such as the flight crew, can create uncertainty as a by-product of their actions, which has to be managed by the second group who are the owners of the risk, usually managers. The third group are the employees from the RMS whose function it is to provide a system to manage the airline’s FOR.

#### **6.3.1.3.1 Human Produced Uncertainty**

People’s behaviour and cultural beliefs are influential in determining an organisation’s level of risk by contributing to uncertainty. Behaviour and culture are separate issues, as behaviourism has its roots in psychology, and culture is considered within other scientific areas of enquiry, such as anthropology and sociology (Tharaldsen and Haukelid 2009). Whilst behaviour and culture have differing backgrounds, culture does have an impact on behaviour, where an individual observing a hazard will behave in a certain manner dependent upon their own risk perception and, in a group observing the same hazard, this behaviour may change, dependent upon the risk culture of the group (Specht, Chevreau and Denis-Rémis 2006). What is required in safety critical organisations is for both behaviour and risk culture to integrate where risky behaviour changes into safe behaviour, driving changes in the risk culture and, over the longer term, building a desired risk culture.

This can be achieved by utilising a methodology referred to as Behaviour Based Safety (BBS), which is "...an analytic, objective and data driven approach focusing on safety related behaviours performed by front line personnel" (Tharaldsen and Haukelid 2009, 376). Indeed, BBS already exists in flight operations in the form of a LOSA or FDA. Another method that contributes to improving risk culture is Safety Citizenship Behaviours (SCB) which has emerged as a consequence of researchers reaching the conclusion that people employed in a front line capacity of safety critical organisations required a mindset beyond one of pure compliance (Didla, Mearns and Flin 2009).

SCB is defined as "...behaviours that are discretionary, not directly or explicitly recognized by the formal reward system, and that in the aggregate promote the effective functioning of the organization (Didla, Mearns and Flin 2009, 476). What is required from flight crew is a compliance mindset by adhering to all SOPs, as well as a professional mindset in the form of SCB.

A compliance mindset was observed at the four airlines involved in the study, apart from some of the pilots from the USA employed by Airlines A2 and A3, as well as an observation that the flight crew appear to have a professional mindset centred on safety. Previously, flight crews from Airline A3 had a substantial SOP non-compliance issue which was identified as a finding in a LOSA. Airline A3 has subsequently introduced corrective actions to correct this serious flaw within its operations. This SCB appeared to be impeded by the onset of what appears to be a serious operational risk that the aviation industry has to deal with, which is complacency.

#### **6.3.1.3.2 Risk Owners**

This group of people are the owners of the risk and, consequently, they have to manage their risks. The airline industry has become extremely good at managing FOR as reflected in the accident statistics (IATA 2013a). Very few of these risk owners were observed to use formal risk management processes, as it was noted during this study that the majority of these risk owners manage their risks using traditional methods. This group can be divided into three categories, the smallest being the owners who have taken it upon themselves to acquaint themselves with formal risk management processes.

The second category of risk owners, apart from the DFO and DDFO who appear to manage their risks for corporate governance requirements, are a number of the senior managers from flight operations who have not been acquainted with these formal processes and have not attempted to become acquainted, preferring to use the traditional methods. The third group are predominately younger junior line managers from the flight operations division who have had minimal, or no contact, with a RMS and are, therefore, unable to venture an opinion on the suitability of these processes. The majority of these younger managers believe a RMS would deliver benefits to the airline if it were correctly introduced, including training for these risk owners.

#### **6.3.1.3.3 RMS Employees**

This group is the smallest of the three and their responsibility is to create, implement and manage the RMS, including its framework. These people do not manage the FOR, but can provide an advisory and oversight function. This group are the experts in risk management and, as such, it is imperative that they understand the formal risk management processes and are able to provide educational resources to the risk owners. For a RMS to function correctly, the airline must provide the required resources to this group so the risk owners can manage their risks on a formal basis.

#### **6.3.1.4 Principles**

ISO (2009) believes that for an organisation to have an effective RMS, it should abide by certain principles.

In brief, these principles are not limited to, but include areas such as creating and protecting value, and integrating risk management into the firm's processes. Decision makers should consider all risks and endeavour to make informed choices by addressing uncertainty, ensuring all required information is obtained, and aligning the company's internal and external context with its risk profile. Consideration is given to people and culture as outlined in section 6.3.1.1, risk is managed at all levels of the firm with transparency, and the RMS is dynamic rather than static by responding to changes in the environment (ISO 2009, 7-8).

### **6.3.1.5 Policy**

A risk management policy "...is a statement of the overall intentions and direction of an organisation related to risk management" (ISO 2009, 2).

Uncertainty exists throughout an organisation which has to be managed, with each stratum of the airline required to perform its role. A function of the Board and senior management is to articulate the organisation's approach to managing risk (McCarthy and Flynn 2004). This is achieved by taking ownership of the risk management policy and stating within this document in a concise manner the important aspects of the firm's approach to managing risk, as well as integrating this function into other corporate strategies (AS/NZS 2004a).

At the time of the data collection phase, not all of the four airlines had a risk management policy. Airline A1 did not have a risk management policy, Airline A2 claimed to have one and it does appear on the airline's internal website. Airline A3 has a risk management policy, which is signed by the CEO, although the airline believes changes have to be made to the current version. Airline A4 has the most advanced risk management framework of the four airlines, with a business continuity policy which is authorised by the Group Executive Operations. However, these policies are not always signed and returned and, therefore, the risk management team advises the required signatories that, unless they hear back to the contrary, it is assumed that the policies and amendments are approved.

### **6.3.1.6 Processes**

Following the guidance outlined by ISO 31000:2009 (2009), processes within a RMS can be segmented into two areas: those that are directly involved with risk assessment and those processes that support this function. Risk assessment involves three processes, namely risk identification, risk analysis and risk evaluation (AS/NZS 2004). The processes that are included within a RMS, in addition to risk assessment processes, are communication and consulting, establishing the context of risk management within an organisation, treating the risks, monitoring, and reviewing (AS/NZS 2004a). Risk assessment appears to be the most important part as these processes were discussed at length during the interviews, with employees from the airlines wanting to increase their knowledge in assessing risk.

The lack of formal risk assessment was also a finding by the regulator following an audit of Airline A4, who now requires this airline to increase its level of formal risk assessment. The three processes of risk assessment are reviewed next.

#### **6.3.1.6.1 Risk Identification**

The relational theory of risk includes a risk object (Boholm and Corvellec 2011), which is the source of danger or hazard, and has the possibility of causing a negative outcome for an airline. These hazards have to be identified and entered into a risk register.

Airlines that are required to have a SMS as per the requirements of ICAO Annex 19 (2013a), which includes the four airlines involved in this study, already have a risk identification process in place as part of their management of safety risk involving hazard identification. Many of these hazards are reported by line employees via the airline's reporting system, which include operational, safety and confidential reports, as well as programs like FDA, and audits such as LOSA. However not all hazards and/or risk factors can be identified by these reporting mechanisms, subsequently other types of risk identification methods are required. The safety manager from Airline A1 who conducts workshops and acts as a facilitator, holding discussions and using techniques such as brainstorming, supports this view that these traditional reporting conduits cannot identify all risks. At Airline A2, the GRM holds discussions with teams at the departmental level, such as the management pilots from a particular fleet, and then moves onto meetings with the departmental risk coordinators. In addition to this, the quality department identify risks from their annual internal audits which form the audit plan for the following year. The risk identification process at Airline A4 was introduced with the creation of the airline's risk management framework, along the with the airline's SMS framework. Since then, both programs have merged and the belief at the airline today is that risk owners identify their own risks. A key concern in identifying risks that is not part of hazard identification is identifying risks involved with change, and these risks are covered in the SMS as part of safety assurance (ICAO 2013a).

Managing change will be a major factor in the future due to inter alia the hyper competitive nature of the airline industry where airlines will, either through their own volition or compliance, amend procedures, processes or policies to obtain a competitive advantage. These changes introduce risks which have to be identified using a structured and robust methodology (ICAO 2013a), canvassing the views of all stakeholders.

#### **6.3.1.6.2 Risk Analysis**

Having identified a risk and then inserted it into the risk register, the next step is to analyse it with the objective of gaining an insight into the risk (AS/NZS 2004). The analysis process involves determining the sources of the risk, what the possible consequences of this risk if it were to materialise, and what the likelihood of this occurrence would be (AS/NZS 2009). Determining the likelihood and consequence(s) of a risk can be a complex exercise and it requires the airline to have pre-established parameters of risk. An example comes from Airline A2. The quality manager from this airline argues that the airline industry is very complex, and using a matrix is too simplistic to determine the level of risk within this complexity. The rationale for this manager's belief is that one-of-a-kind events are a result of a string of events that, in all likelihood, will not re-occur. This manager believes determining likelihood and, to a lesser extent consequence(s), is subjective which requires a personal judgement, resulting in the members of the airline's Air Safety Review Committee debating the level of a risk and whether it should be catastrophic, high, medium, or low. The ASM from the same airline has a different view, insisting that assessing risk should not be a complex operation and the aim should be to keep the process simple. This disagreement is the result of Airline A2 not formally establishing the internal context of risk management with regard to the risk management framework. Once an organisational-wide risk management framework has been adopted, these conflicts should be reduced. The safety manager from Airline A1 believes assessing risk relies on experience and subjectivity, and a risk manager from Airline A4 who believes risk assessment should be kept simple supports this belief - you do not want to complicate it because risk assessment is as much an art as it is a science, which subsequently requires judgement.

For this simplistic aspect of risk assessment, where likelihood and consequence are proportional, risk can be measured thus: Risk = Consequence x Likelihood ( $R = C \times L$ ). However, where the relationship is non-linear, a weighting factor to achieve a linear relationship has to be applied. Furthermore, an exponential operator may be required to be applied to the consequence and/or the likelihood, thus, in this case the new measure is:

Risk =  $(C \times \text{Weighting Factor})^x \times (L)^y$ . Where the likelihood is almost certain, the level of risk is the assessed consequence and, where the assessed consequence is unacceptable, the likelihood is not a factor (AS/NZS 2004a).

The three methods of analysing risk are contained in Table 6-1.

**Table 6-1 Three Methods of Risk Analysis**

<b>Method</b>	<b>Process</b>
Qualitative	Words are used rather than numerals. A deep understanding of the risk is either not available or required, and possible methods used are expert judgment, brainstorming, multi-disciplinary groups and questionnaires.
Quantitative	Numerals are used instead of words when an objective analysis is required, such as in engineering where the likelihood of a component failure is assessed using methods such as statistical analysis, fault and event tree analysis, probability analysis and network analysis.
Semi-Quantitative	Numerical values are applied to qualitative scales with the view to obtain an expansion in these qualitative scales.

(AS/NZS 2004a, 47).

Regulators are voicing the need for quantitative risk and safety assessments, however the airline industry is not (Roelen 2008). Apart from event analysis used in FDA, such as the number of hard landings per 10,000 landings, there was only one instance of quantitative analysis observed. At Airline A2, this type of analysis is used to measure the performance of individual flight crew members within a large workforce.

With a pure qualitative analysis, low performing flight crew can remain invisible and that risk remains unidentified. The results of check flights are collated and a bell curve is applied, and pilots who pass a check flight but are positioned towards the left of the bell curve are identified as marginal and corrective measures are applied.

Qualitative analysis was the preferred method, with the risk owners applying their experience and making a judgement on the likelihood and consequence(s). However, assessing likelihood on a purely qualitative basis as these airlines do, can cause conflicts between stakeholders as was the case with Airline A2. This single type of analysis can lead to a flawed assessment on the likelihood of a risk eventuating. All four airlines use a risk matrix to determine the level of each risk and the type of matrix varies between airlines. For example, Airline A3 uses the risk matrix from the QMS software and Airline A4 uses an in-house created matrix that is somewhat more complicated as it conducts an assessment on the effectiveness of the controls post-treatment. The risk owners in the airline determine the likelihood of the risk eventuating and, in the event of this eventuality, they then determine what the consequences would be against the list of the CSFs as per guidelines determined by the organisation, with the worst consequence being selected. With the level of risk having been determined, the analysis process is complete and the next process of evaluating the risk is undertaken.

#### **6.3.1.6.3 Risk Evaluation**

This process determines if the risk has to be treated, the priority of this treatment if so required, and whether the risk should be undertaken in the first place. This is conducted by comparing the level of risk determined from the previous process and the risk criteria that has been established by the airline.

There are a number of ways of doing this. ICAO (2013c, 2-30) divides the level of risks into three bands and refers to it as a ‘risk tolerability,’ as displayed in Table 6-2 as well as in Appendix 5-5, Tables 9-22 and 9-23.

**Table 6-2 Risk Tolerability Level**

<b>Band</b>	<b>Risk level</b>
Upper	Risks exceed the airline’s risk tolerance and are unacceptable, and if the risk is to be retained, it has to be treated irrespective of the cost, or the operation causing the risk is terminated. An example is non-compliance to a statutory regulation.
Middle	Risks are acceptable as they meet the airline’s risk tolerance but may require the risk owner consulting with a management supervisor on mitigating the risk. This can be done by conducting a Cost Benefit Analysis (CBA) on the risk. As a principle, risks in this grey area should be reduced to a level which is referred to As Low As Reasonably Practicable (ALARP).
Lower	Risks at this level are considered acceptable without any treatment whatsoever as the risk is considered negligible and any treatment would be deemed unnecessary.

(ICAO 2013c, 2-30).

The management of safety within the airlines involved in this study is well established, however, the management of risk on a formal basis is not. Airline A4 had a very comprehensive risk management framework in place, allowing the risk owners from this airline, if they so desired, to manage their risks on a formal basis, whereas the risk owners from the other airlines do not. For example, a line manager from Airline A2 complained that it is difficult to obtain resources to treat risks that he considered needed to be treated, whereas his supervisor believed otherwise and would not approve the treatment. This problem stems from risk being managed on an informal manner based on established belief rather than on judgement and process, and the airline’s risk criteria has not been formally established.

Appendix 5-5 contains a sample airline risk assessment matrix, with consequences measured against various CSFs. These generic airline's risk criteria have been established and have been inserted into the risk matrix using the alphanumeric codes. These codes are coloured in accordance to their risk tolerability. A risk tolerability matrix is included in Appendix 5-5. This concludes the section on risk assessment processes.

#### **6.3.1.7 Procedures**

Procedures are organisation specific and, as such, they are created dependent upon the components that comprise the airline's RMS. These components include the type of software, regulatory requirements, and associated systems such as SMS, QMS. As well as the objectives of the RMS, the level of funding and, most importantly, the level of support provided by senior management to the RMS. It is up to each airline to create a framework that reflects their requirements and builds the processes accordingly. As such, creating specific procedures for a RMS is outside the scope of this study, suffice to state that procedures are an integral part of a RMS and each airline has to create their own. This view is supported by ISO as the ISO 31000:2009 is not a certificated standard, but is a document providing generic guidelines (ISO 2009, 1).

This completes the answers to SQ-1 and SQ-4, with the study's theoretical contribution to the topic's body of knowledge presented in the following section.

## **6.4 Theoretical Contribution to the Topic's Body of Knowledge**

The theory generated from this study deals with the perpetual change in an airline's level of FOR. These organisations are not rigid units operating within a vacuum, immune to both internal and external influences, but operate within a universe of risk factors causing their level of risk to drift. Because of this drift, the level and type of uncertainty an airline has to manage will vary. As this drift is insidious, it has to be managed to ensure the sustainability of the airline over the longer term. The title of the theory created from this study is presented in the following section.

### **6.4.1 The Theory of Flight Operational Risk Float**

The theory produced by this study is 'Flight Operational Risk Float'. This theory is based on the information and knowledge contained in Chapter Two Literature Review, Chapter Four Analysis, Chapter Five Results as well as sections 6.2 and 6.3 from this chapter.

The creation of this theory requires three elements, namely 'what', 'how' and 'why'. 'What' and 'how' not only describe, they also provide the framework for interpreting patterns, whereas 'why' explains by articulating the theory's underlying dynamics of the cause and effect relationships which provides credence to the theory (Whetten 1989).

#### **6.4.1.1 What Are the Variables within This Theory?**

There are two types of variables in this theory:

1. the first type are the two independent variables, which are, the two forces that determine the floating position of likelihood, namely the net result of all the risk factors that have an involvement with FOR and the net result of the 'push-back' from the management of FOR.
2. the second type is the dependent variable, which is the floating position of the likelihood of a catastrophic event.

#### 6.4.1.2 How do These Variables Relate to Each Other?

The float is a result of FOR drifting towards failure as the likelihood of a catastrophic event increases. This drift is caused by the level of uncertainty increasing; however, all airlines manage FOR to some extent. The risk drift is ‘pushed-back’ with the management of FOR, consequently the likelihood of a catastrophic event ‘floats’ in zones between these two opposing forces with zones portrayed in Figure 6-1.

This study has defined FOR as “The risk of a loss as a result of functions and activities that have an association with flight operations”. As stated in the guidance material to this definition, the definition is broad so as not to impede risk owner’s identification processes of risk factors. Functions and activities of an operational environment would include, but not limited to, categories such as people, systems, internal processes, external events all within the universe of the airline’s risk culture. The emergence of risk factors and/or latent conditions associated with these categories would increase either or both the level of aleatory and epistemic uncertainty. If left unchecked, this uncertainty would cause the likelihood of a catastrophic event to increase, consequently the airline’s level of risk<sup>13</sup> increases as the airline drifts towards failure.

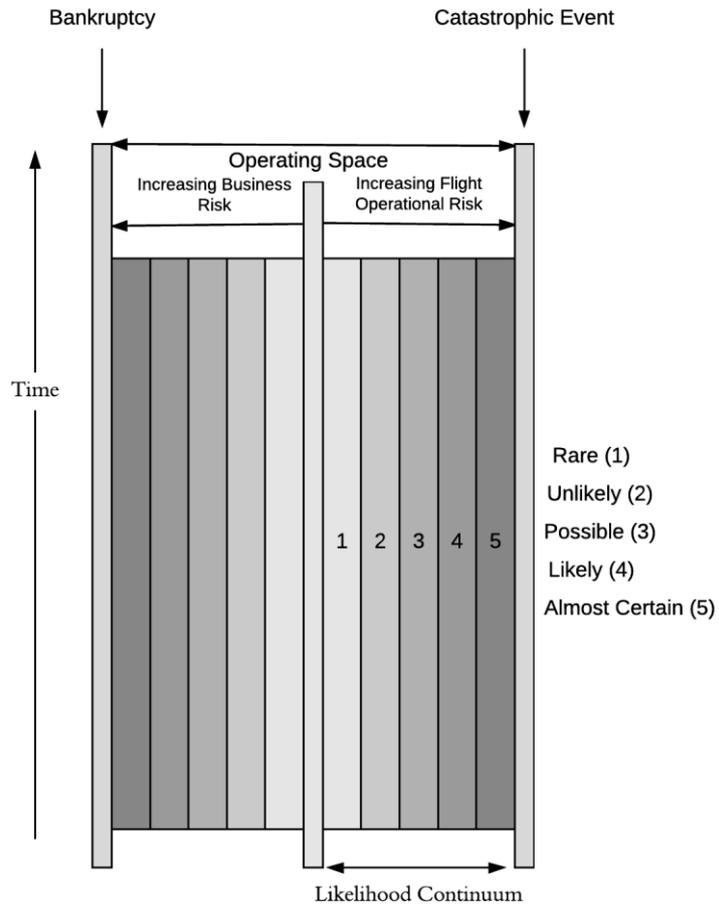
With unlimited funds, all of these risk factors can be reduced to an inconsequential level. However, as the airline industry generates very low levels of earnings, mitigating all risk factors is not possible, what is required is a form of ‘push-back’ against the airline’s drift towards failure. Most airlines have some form of ‘push-back’, that manages this risk drift to keep FOR to an acceptable level floating within an acceptable range; hence the theory of “flight operational risk float”.

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<sup>13</sup>  $R=C \times L$

The model displayed in Figure 2-3 defines the area between the bankruptcy of an airline and the airline suffering a catastrophic event as 'safety space'. This study believes a better term is 'operating space' as this is the space an airline can operate within albeit with extreme limits. This study has amended the safety space model in Figure 2-3 with the 'operating space' model, in Figure 6.1. The model is split vertically with business risk portrayed on the left and FOR on the right. This model visually portrays the position of an airline within its operating space against time. Time progresses from bottom to top and the two outer thick lines represent the outer limits of each of the two risks. The line on the left of the model reflects the bankruptcy of the airline at that point in time, and the corresponding line on the right of the model reflects a catastrophic event, such as a hull loss or a fatal accident. The business risk component will be set aside as the focus of this study is FOR. Risk is measured by combining the likelihood of an event occurring and the consequence of the occurrence of the event ( $R=L \times C$ ). In the model the consequence is fixed, that is the occurrence of a catastrophic event such as hull loss and/or a fatal accident, what varies is the likelihood. Likelihood in this model moves along a continuum ranging from 'rare', 'unlikely', 'possible', 'likely', 'almost certain', and at the end of the continuum is the catastrophic event. This concept is the basis of this study's theory, the opposing forces of FOR drift and the pushback provided by FOR management determines the likelihood. Likelihood is not fixed but 'floats' within a range on the likelihood continuum. The model in Figure 6-1 is used as a basis for the model displayed in Figure 6-2 which is the flight operational risk float model.

Figure 6-1 Operating Space Model



### **6.4.1.3 Why Should This Theory Be Given Credence?**

Answering the third element ‘why’ requires an explanation regarding the underlying dynamics that binds the theory.

Figure 6.2 portrays the two independent variables, namely, 1) flight operational risk drift and 2) flight operational risk management, with the dependent variable, being the net result of these two independent variables referred to as flight operational risk float which is positioned within a zone(s) along the continuum of the likelihood of a catastrophic event. The underlying binding dynamics of the theory of ‘flight operational risk float’ are contained in the two independent variables.

#### **6.4.1.3.1 Flight Operational Risk Drift-FORD**

The level of uncertainty will increase over time primarily due to a rise in the level of aleatory uncertainty, because of operational failures that are unmanaged. This rise in the level of uncertainty increases the likelihood of an airline suffering a catastrophic event. The five categories outlined previously<sup>14</sup> are the key dynamics that causes the airline to drift towards failure. Examples of risk factors that are associated with these categories as outlined next are derived from this study, both from the data and the literature.

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<sup>14</sup> People, systems, processes, external events and an inappropriate risk culture.

#### **6.4.1.3.1.1 Risk Drift Due to Errors Committed by People**

Selecting the right people, applying the correct training processes and ensuring the required standard of technical and non-technical skills are achieved and maintained is a prerequisite as a base to build a solid core of flight crewmembers. This will minimise the airline's drift to failure with regard to this category. The management teams from the airlines involved in this study all indicated this was the case with the exception of one airline where there was internal conflict between flight operations line managers and the HR department regarding selection criteria. Whilst these applicants could achieve the required standard on their respective final line check, the problem arose later during routine line operations where monitoring of flight crews was found to be deficient with this deficiency being addressed in the processes section. Complacency increases the level of aleatory uncertainty as flight-crews continue to complete their required tasks but at a reduced level of 'mindfulness' increasing the likelihood of errors being made and not detected. Complacency has a multitude of sources, such as fatigue, lack of engagement at all levels from not engaging with the other pilot in the crew, up to a lack of engagement with the airline. Poor industrial relations were cited as an example as well as personal issues and traits. The two major incidents during the previous ten-year period in one of the airlines was attributed to complacency as a result of flight crews 'going through the motions'. Fatigue causes the level of aleatory uncertainty to increase as the mental alertness of flight-crews is diminished resulting in an increase in the number of un-trapped errors<sup>15</sup>. Non-compliance to SOPs was identified as a key risk factor with regard to this category creating an elevated level of concern to some of the management teams from the airlines involved in the study. One reason for this concern is flight crew's non-compliance to SOPs is noted as a common contributory causal factor in major incidents and accidents.

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<sup>15</sup> Errors that are made by a flight-crew member which remains undetected.

Whilst this is a failure of the human category, it is also discussed in the processes section as this risk factor contributes to the failure of organisational processes.

#### **6.4.1.3.1.2 Risk Drift Due to Flawed Process(s)**

Compliance to SOPs by an airline's flight-crews is considered a serious issue as this activity increases the likelihood of a catastrophic event because of practical drift as the airline drifts towards failure. What is required inter alia to prevent an airline's drift to disaster are processes that monitor and report these breaches. When these processes fail to achieve their objective and flight-crews continue the practise of SOP non-compliance the airline level of aleatory uncertainty rises, as was the case with one of the airlines involved in the study. The monitoring processes that failed in this instance was the checking process where flight-crews are checked on an ongoing basis with this phenomenon not being reported to management. Another process that is used to monitor flight-crew's performance is FDA, however, unless an event has been recorded, it is somewhat more difficult to track SOP non-compliance with this method. The airline in question's internal monitoring systems failed to note and report these breaches and it was not until an external audit<sup>16</sup> was conducted that these breaches were identified and brought to the attention of the airline's management. These breaches not only increases aleatory uncertainty by conducting the flight with personal procedures not approved by the airline and national legislation, they also increase the level of conflict between crew members as this activity is considered disrespectful to the other crewmember. If left unchecked, this deviate behaviour becomes the norm, and people who are inclined to report it are muted especially if the delivery of service is expedited. This is in line with the concepts referred to as the 'normalisation of deviance' and the theory of 'practical drift' both of which caused the airline to drift towards failure because of the failure of monitoring processes.

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<sup>16</sup> LOSA

#### **6.4.1.3.1.3 Risk Drift Due to Flawed System(s)**

There were no systemic failures noted during the data gathering phase from these airlines. However, it is possible some of the systems were not performing as expected, delivering sub-optimal results that could contribute to an increasing likelihood of a catastrophic event. The system that was discussed which at times was not delivering optimal performance was the reporting system. If the reporting system is not functioning as expected, latent conditions are not identified and removed, with corrections to problems being applied at a local level rather than at a systemic level. The reporting culture of frontline employees within these airlines was considered to be pivotal rather than the tools or processes in the success or otherwise of the reporting system. The reporting culture of these airlines fluctuated because of a number of factors, such as lack of engagement, poor industrial relations between management and pilots, a culture of unwillingness to report colleagues, fatigue, and the consequences of an airline having a poor safety culture. Airlines operate within a hazardous environment, hence the legal obligation to manage safety risk. An airline that has a vulnerable system as a result of flawed organisational factors is considered to suffer from the Vulnerable System Syndrome (VSS)<sup>17</sup>. One of the airlines in the study was considered to possess VSS but was implementing changes to move a more robust operating system where the airline's safety and risk management programs were more likely to provide successful outcomes leading to a lowered likelihood of the airline suffering from a catastrophic event. This example relates to a single system, there are however, a large number of systems within an airline as these organisations are referred to as a system of systems consequently, the risk of a failure of a system leading to a loss is always prevalent.

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<sup>17</sup> Refer to Table 9-8

#### **6.4.1.3.1.4 Risk Drift Due to External Event(s)**

As pointed in the previous section, airlines operate within a hazardous environment. These hazards are the external events that if mismanaged can lead to a loss for the airline. ICAO separates hazards into three groups<sup>18</sup>, natural, technical, and economic. With the presence of natural hazards such as cyclones, tornadoes, volcanic activity, as well as public-health events in the form of an epidemic of diseases if inadequately managed increases the likelihood of the airline incurring a loss. External technical hazards such as the non-delivery of, or the sub-standard quality of required resources for example navigation aids or refuelling facilities if left unmanaged can also cause the level of FOR to drift towards failure. The third type of hazard; economic, such as a recession affects both business and FOR due to a lowered level of income to the airlines necessitating cost cutting measures which if conducted without the application of appropriate risk assessment processes being applied, can also increase the likelihood of a catastrophic event occurring.

#### **6.4.1.3.1.5 Risk Drift Due to an Airline's Risk Culture**

An organisation's risk culture is a driver of risk drift with the amount of drift dependent upon whether or not the organisation is risk seeking or risk averse. Two of the airlines involved in the study during their formative years were risk seeking, primarily because of a lack of knowledge and resources, with one airline's mantra being a 'can do airline' and the other 'just get the job done'. Over time as the level of resources including knowledge increased, the propensity to seek risk declined. The third airline is a legacy carrier, is well resourced and is risk averse, with the fourth airline having an inadvertently high-risk appetite because of the airline's bureaucratic safety culture and associated blame and punishment aspects of its organisational culture.

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<sup>18</sup> Refer to Table 9-11

This airline is moving towards a proactive safety and just culture and in doing so, lowers the level of risk drift as employees will report rather than cover up errors. This change in employee behaviour results in a lowered level of epistemic uncertainty due to an increased level of knowledge<sup>19</sup> gleaned from the reported information as well as a lowered level of aleatory uncertainty as the airline becomes more risk averse because of its improving risk culture. Elements that contribute to an organisations risk culture and thereby reducing risk drift are contained in Table 2-2, and the threats to an organisation's risk culture, which would increase the level of risk drift are contained in Table 2-3.

This completes the section on risk drift; the following section discusses the possible 'pushback' strategies and processes an airline can implement to counteract risk drift.

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<sup>19</sup> Processed through relevant ICAO SARPs and IOSA standards.

#### **6.4.1.3.2 Flight Operational Risk Management-FORM**

As pointed out in the previous section, the likelihood of the occurrence of a hull loss or fatal accident increases over time as the airline operationally drifts towards a disaster. What is required to prevent this drift and to achieve the targeted level of FOR is a strategy to pushback against the drifting nature of FOR with this study believing there are three possible options. A brief review of these options are presented in the following section.

##### **6.4.1.3.2.1 Option 1 Traditional Methods**

What this study refers to as the traditional method, which is the current strategy utilised by the airlines involved in this study. These airlines use a system based approach to manage certain functions such as safety and quality, however with the management of FOR, these airlines use a compilation of systemic and non-systemic strategies all connected by the reporting system. This informal methodology of FORM has been successful as confirmed by the hull loss statistics from the region including a decreasing trend. Compliance to regulations is a contributory factor in the lowering of the hull loss rate from the region and forms a major part of the strategy adopted by these airlines with regard to their management of FOR. These airlines are required to comply with two sets of regulations. The first set are national regulations, which reflects ICAO SARPS and sovereign legislative requirements, reinforced by the regulator through the audit process. The second set are industry regulations imposed by IATA with compliance to these standards confirmed by the IOSA. The airlines involved in this study indicated they accepted this dual regulator concept, as these are on-going processes, which produce better risk and safety outcomes. Compliance is one strategy in the management of FOR, these airlines use a multiple of other methods such as having robust selection and training of flight crew's processes, ensuring standards are maintained through audits, evaluations and electronic monitoring. Organisational culture plays an important part as these airlines want to create a strong reporting culture by moving away from a culture of punishment towards a just culture and in doing so will increase management's level of knowledge leading to a lowering of the level of uncertainty within the airline.

In summary, with this option, risk owners currently manage their FOR through a collective approach of stakeholder requirements, retained corporate knowledge, organisational culture, compliance to regulations, management decisions, and inputs from the myriad of systems, programs and processes, which are integrated through the reporting system.

#### **6.4.1.3.2 Option 2 System Based**

Is the implementation of a RMS with categories and elements similar to the ICAO mandated SMS, which can be integrated with a QMS, where all three management systems are coordinated to manage an airline's safety, quality, and risk issues within an integrated management system which ICAO refers to as an IMS. None of the airlines involved in this study currently have a RMS, therefore the categories and elements that may be contained in an airline's RMS from the Asia Pacific Region were not identified. As the research data does not include this knowledge, a substitute RMS, sourced from the literature was created and is the answer to SQ-4. This study's theoretical RMS is referred to as the 'Seven Ps RMS Model' with the seven Ps being philosophy, program, people, principles, policy, processes and procedures. Principles, program (framework) and processes are the core units of an RMS.

#### **6.4.1.3.2.3 Option 3 Traditional methods plus formal processes**

This option is a combination of traditional methods as outlined in Option 1 and formal risk management processes. The traditional methods is the current strategy adopted by the airlines involved in this study in their management of FOR. A shortcoming of only utilising traditional methods is a number of important risk essentials are not established. Some of the interviewed managers who expressed a desire to address this deficiency wanted to increase the level of resourcing to the management of risk and in doing so, develop and implement airline industry appropriate formal risk processes. These processes would include establishing the risk context for the airline, risk identification, analysis and evaluation as well as processes to treat the risk.

This concludes the review of the options for FORM. The dependent variable FORF is presented next.

#### **6.4.1.3.3 Flight Operational Risk Float-FORF**

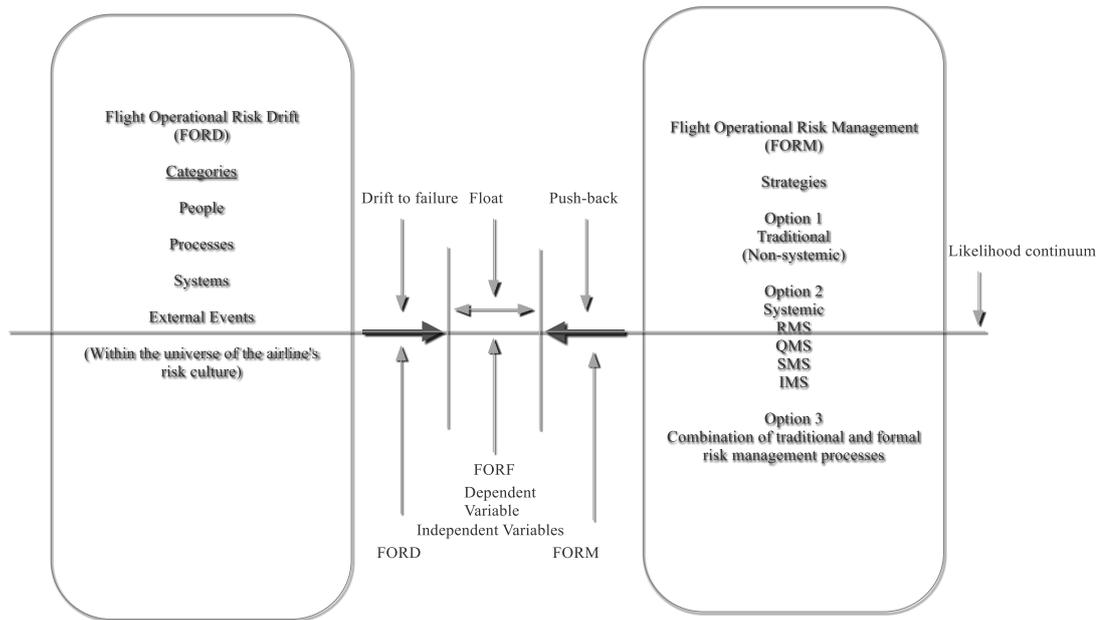
Managing FOR requires an executive level management decision to determine what is the targeted level of FOR. All of the airlines involved in the study believe they are risk averse and consequently have a low level of FOR. However, is this a realistic assessment of their actual level of FOR? As an example of this possible mistaken assessment, one of the airlines involved in the study strongly believed their level of FOR was very low as they thought their appetite for this type of risk was low as a consequence of their conservative risk culture. However, sometime after the data collection period had finished, this airline suffered two very serious incidents involving wide-bodied aircraft, both of which required emergency passenger evacuations. The reason behind the difference in this airline's perceived<sup>20</sup> position of FORF and the actual position of FORF was highlighted during the data gathering phase at this airline. A senior manager with this airline claimed, during meetings there is a substantial amount of conflict regarding assessing the likelihood of an event occurring. The reason proffered for this conflict was each serious event involves a unique combination of risk factors, therefore to determine the likelihood of such an event is complex and the laws and theories of probability and likelihood are imprecise. What is required to determine the real position of FORF is for an airline to develop and implement risk processes and procedures that establish the internal and external risk context as well as risk assessment processes including a more accurate determination of likelihood. Risk professionals from these airlines believe many of the formal risk processes including software they have used or reviewed are considered sub-optimal in achieving expected organisational objectives.

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<sup>20</sup> The floating position of the likelihood of a catastrophic event is in the Rare-Unlikely zones

Whilst a model is not a theory, a model can be used to represent a theory (Shoemaker, Tankard and Lasorsa 2004), and in doing so will provide the readers of this report a clearer understanding of the ‘theory of flight operational risk float’ which is displayed in Figure 6-2.

**Figure 6-2 Flight Operational Risk Float Model**



This completes the section on the description of the theory of Flight Operational Risk Float. The chapter summary is presented in the following section.

## 6.5 Chapter Summary

The chapter through a theoretical lens answered SQ-1 and SQ-4 as well as presenting this study's theoretical contribution to the topic's body of knowledge which is referred to as the theory of 'flight operational risk float'. The answer to SQ-1 regarding the definition of FOR was answered solely from the literature, as empirical data obtained from the interviewees was considered to be vague and lacking robustness. The answer to SQ-4 dealt with key factors within a flight operational RMS. The answer included Finding-F7, which states: 'The formal management of flight operational risk within these airlines is in its infancy.' This finding reflected the lack of empirical data regarding what the key factors are. Subsequently, in answering this question, literature was the primary source of information and data sources were secondary. The key component of the answer to SQ-4 was in the creation of what this study calls 'The seven Ps RMS' and is what the researcher believes a flight operational RMS could consist of. The seven Ps are Philosophy, Program (framework), People, Principles, Policy, Processes and Procedures. The third section of the chapter presented the theory of "flight operational risk float". All airlines possess FOR which due to risk factors has a natural tendency to drift towards failure; however, all airlines to varying degrees manage FOR and arrest the drift by applying an opposing pushback force. The resultant position of these two opposing forces at any given time represents the current level of an airline's FOR which floats on the likelihood continuum of a catastrophic event between FORD and FORM which is portrayed by:  $FORD \pm FORM = FORF$ .

This concludes the chapter summary and the study's Conclusion chapter is presented next.

## 7 Chapter Seven Conclusion

### 7.1 Introduction

After conducting a review of the literature it became apparent there had been minimal research conducted on the topic of managing FOR through a board lens within the Asia Pacific Region. Because of this gap in the knowledge, an exploratory study was undertaken to investigate this phenomenon with an objective to provide a foundation for more specific research. This study focused on countries within the Asia Pacific Region as defined by the area of responsibility of the Asia and Pacific Office of ICAO. For the above reasons, the title of this thesis is.

*An exploratory study investigating the management of flight operational risk by selected Airlines within the Asia Pacific Region.*

The research question is deliberately broad as this allowed the ubiquitous and diverse risk factors associated with FOR to be investigated, with the objective of answering the following research question.

*What is the perceived importance and approach to the management of flight operational risk by selected airlines within the Asia Pacific Region?*

Associated with the research question are four sub-questions.

1. *SQ-1 What is the definition of flight operational risk?*
2. *SQ-2 Do Airlines in the Asia Pacific Region consider the management of flight operational risk important?*
3. *SQ-3 What are the key drivers for establishing a flight operational risk management program?*
4. *SQ-4 What are the key factors inherent in a flight operational risk management program?*

This study is significant because the Asia Pacific Region is predicted to become the largest airline market in the world with one third of the world's airline aircraft domiciled within the region.

This study produced nine empirical findings which are discussed in the following section.

## 7.2 Empirical Findings

To determine if these findings can be generalised amongst the wider community of airlines from the Asia Pacific Region, a survey instrument was created and sent to 16 airlines from the region. Three completed surveys were received with one response from an airline who declined to participate in the survey, which may explain the poor response was “*Regrettably, we are only supporting company-sponsored research and doctoral studies*” (name of airline deleted). Of the three completed surveys, the majority of the responses concurred with the findings. A condensed explanation of the findings is presented next.

### Finding F1. Flight-crew’s compliance to an airline’s SOPs is a key issue

Flight crew’s compliance to SOPs is an important issue with these airlines. Airline A1 and Airline A4 believe their pilots have a compliant mindset, Airline A2 is very vigilant on this issue and any minor transgression can result in a failure on a check flight. Airline A3 were unaware of their pilots having a non-compliance mindset, which was identified during a LOSA. This lack of understanding by the management of this airline to this non-compliance mindset indicates a failure of processes and a system. A non-compliance mindset by flight-crews is a product of both national and organisational culture. This behaviour has been corrected, with Airlines A2 and A3 reporting pilots from the USA have a propensity to be non-compliant to SOPS.

### Finding-F2. Achieving and maintaining a ‘just culture’ is an objective of these airlines

All four airlines want their organisational culture to include a just culture; Airlines A1 A2 and A4 believe this to be the case, with some early misunderstanding between a just culture and a no blame culture in Airline A4, which has since been resolved. Airline A3 is in a transition phase moving from a culture of punishment to a just culture. These airlines want to instil a culture where all events are reported rather than concealed and in doing so management will have a greater understanding of what is happening at a flight operational level.

Findings F3. These airlines want to maintain a quality function associated with flight operations

These airlines are not legally required to possess a quality function associated with flight operations. They do however intend to maintain at least a quality assurance program as they believe there are a number of benefits derived from such a program. Some of these benefits are, reducing variances in process outcomes, which leads to an improvement in system integrity. This is achieved by reviewing policies, control over documentation and conducting internal audits and hosting external audits such as IOSA, which contributes to these airlines attempting to achieve world's best practise.

Finding F4. These airlines believe the balance between production and protection is acceptable

This finding relates to the management dilemma of providing the correct level of safety whilst still allowing the airline sufficient freedom to produce enough revenue to remain commercially viable. These airlines are required to be profitable; however, safety is a key issue for both flight crew and management. The majority ownership of these airlines is from the private sector; consequently, they are required to possess a commercial mindset primarily motivated to produce a financial dividend for the shareholders. The management of safety is very important; these airlines tend to be risk averse rather than risk seeking. The allocation of resources for flight operations is considered acceptable but pressure to reduce costs are ever-present.

Finding F5. The relationship between the airlines and the regulators are aligned with ICAO philosophy

The primary role of the regulator is to enforce national legislation which is acknowledged by these airlines. The relationship between the two parties is in line with ICAO philosophy; however, previously with Airline A3 this was not the case. The requirement for an open relationship between the regulator and an airline with professional courtesy was observed to be the case with Airlines A1, A2 and A4. However, with Airline A3, managers previously considered concealing safety issues because of the then poor relationship between both parties.

This relationship has improved with the generational change of managers from the airline, as well as the introduction of the SMS and the safety and risk enhancing benefits of the IOSA. Airline A4 also had an issue laden relationship with the regulator during its formative years; however, as the airline matured so did its relationship with the regulator.

Finding F6. The change management processes within these airlines are improving.

All of the airlines involved in the study have had issues with regard to their change management processes. Some examples are, Airline A1 lacked a monitoring and review process with regard to operational changes resulting in an event that could have had serious consequences. Junior managers in Airline A2 believes the airline does not consult nor communicate widely enough when considering flight operational changes. As a method to improve this shortcoming, this airline adopted the EASA methodology of electronically tagging manuals so all stakeholders from a specific manual had to be consulted prior to any change. Airline A3 believes their managers have to improve their skill sets in this area and the QA section constantly records this deficiency in their audit reports. Airline A4 has documented risk assessments procedures regarding flight operational changes, however these manuals have become shelf-ware and are not consulted by managers, with this observation being a finding in the regulator's routine audits; consequently, these airlines are endeavouring to improve their change management processes.

Finding-F7. The formal management of flight operational risk within these airlines is in its infancy.

Airline A4 is the only airline involved in the study that had created a risk management framework covering both operational and non-operational areas. This framework was created separately from the SMS, however, both the framework and the SMS have merged. The key reason why risk is not managed using a system approach such as a SMS, is apart from safety risk and risks associated with change management processes, FORs are not required to be managed on a formal basis. These airlines manage their FORs well, albeit on an informal basis due to an insufficient number of motivating elements required to create and implement a RMS.

A large amount of FOR is managed through legislation reflecting ICAO SARPS and world's best practise as reflected in the IOSA standards. Formal risk management processes are virtually unknown at the junior line manager level, whereas there appears to be a horizontal line at the DFO level managing risk with regard to corporate governance issues. The formal management of FOR is considered by the interviewees to be in its infancy when compared to the management of safety.

Finding F8. Resources to establish a flight operational RMS are deficient.

The risk policies of the airlines involved in the study are vague and not always signed by executive management. This lack of formal acceptance of a risk policy is indicative of the airline's unwillingness to commit resources to a RMS. What is required to create a RMS is capability, and this lack of funding to obtain the necessary resources for a RMS impedes this capability. Resources, which have been allocated to a parallel function such as safety, are leveraged to include risk management. Still, there is a desire to provide some resources as executive managers from two of the airlines stated they would provide the resources that are required to manage their airline's FORs on a formal basis.

Finding F9. The majority of managers from flight operations want their airline to establish a flight operational RMS.

Most of the line managers within flight operations have no experience with formal risk management processes; this is especially true for the younger managers. Despite not having any exposure to these processes, the majority of managers, especially the younger members of the management team, believe, having an understanding of these concepts would be beneficial to them and the airline. Some of the reasons proffered were; improved decision-making processes, improved change management processes, better control of documentation, improved retention of corporate knowledge, improved compliance record, better cost control, and enhanced risk assessment abilities through improved risk identification. As well as better risk analysis and risk evaluation, better outcomes for the airline's CSFs include safety, legal, improved reputation, corporate governance, better litigation outcomes, an expectation of lowered insurance premiums, and improved sustainability.

A few of the older flight operations managers were not enthusiastic about learning these processes as they believed the traditional methods such as good training, selection and standards processes, monitoring of flight crew's performance, the reporting system and robust SOPs are quite successful in managing their airline's FOR.

This completes the concluding commentary of the empirical findings with regards to the study's questions. The following section contains the concluding remarks regarding policy implications.

### 7.3 Policy Implications

The operational risk of safety critical organisations, especially those that operate within a hazardous environment such as an airline will drift towards failure and if left unchecked may result in a hull loss and/or a fatal accident. To prevent this occurrence, a 'push back' force against this drift is required with the net outcome of these two opposing forces indicating an airline's current level of FOR based on the likelihood of a catastrophic event. Based on accident statistics from the Asia Pacific Region, airlines from this region manage their FOR well with a decreasing trend in hull losses.

The airlines involved in this study manage their FORs utilising traditional methods, with the formal management of these risks being very limited. The belief is that it will take an event of some magnitude to propel these airlines towards a formalised RMS or, at the regulator's insistence, a RAP. Whilst it was noted in two of the airlines, senior management wanted to increase the resources for the formal management of non-legislated required operational risks, at the time of data gathering this was not the case. This study found that the risk policies of these airlines were vague and lacked explicit executive approval. This is in contrast to these airline's safety policies, which do have executive authority and are clear and concise. The reason for this is safety policies are required by law, whereas risk policies are not. The FORs that have to be managed by legislation are safety risks and risks associated with change management processes as per ICAO Annex 19 requirements which also includes an airline's safety policy.

The policy implication from this study is to what extent should FORM be conducted on a systemic basis? It appears as if this type of FORM is in its infancy compared to the systemic management of safety with the two policies reflecting this. One of the impediments to formalising FORM is the lack of processes including software that is directly applicable to airline industry. FORM on a systemic basis through the creation and implementation of a RMS or at least a RAP should be considered and if deemed to increase the sustainability of the airline in an ever-increasing competitive market, this type of FORM should be contemplated. This completes the concluding remarks regarding policy implications with the study's theoretical implications discussed in the following section.

## 7.4 Theoretical Implications

The 'theory of flight operational float' consists of four components, the definition of FOR, the drifting nature of FOR which this study refers to as FORD, the management or pushback of this drift which this study refers to as FORM and the resulting level of FOR as a consequence of these two opposing forces, referred to as FORF.

There is no generally accepted definition of operational risk; it is up to individual industries to develop their own definition. This study defines FOR as 'the risk of a loss as a result of functions and activities that have an association with flight operations'. This definition is broad so as not to inhibit the identification of risks with these risks emanating from, but not restricted to categories such processes, people, systems or external events that are all contained within the universe of an airline's risk culture.

Theories that contribute to FORD which were observed with an airline in this study are, 'normalisation of deviance', 'practical drift' and aspects of the 'vulnerable system syndrome' with the applicable airline undertaking remedial steps to correct these flawed organisational factors.

The theoretical implication from this study involves the determination of the likelihood of a risk eventuating. What was noted during the data collecting phase was the limitations in the science and theories of determining probabilities and likelihoods. Assessing likelihood is problematic and causes conflict between risk owners/managers in their determination of assessing the likelihood of the occurrence of an event. The theories and laws of likelihood and probability involving airlines and their multitude of risk factors requires risk management theorists and professionals to integrate with experienced flight operational personnel to better understand and apply a more accurate likelihood to the occurrence of an event. This will lead to a reduction in the gap between the perceived and actual position of FORF on the likelihood continuum. As these risk owners have substantial domain knowledge, a good theory to use as a base for an improved determination of likelihood as per section 2.3 is Bayesian subjective probability which is a common method in reducing epistemic uncertainty. The study's recommendation for future research is presented in the following section.

## **7.5 Recommendations for Future Research**

An objective of this study was to provide a foundation for future research on the management of FOR by airlines within the Asia Pacific Region. Reflecting the broadness of the research question, the data that was gathered and subsequently analysed was extensive, covering a large part of the spectrum of an airline's FORs. It is recommended that future research be conducted on general topics that are contained within the 11 complex concepts, with more specific research areas focusing on these complex concepts and their associated elements.

The study's limitations are discussed in the following section.

## **7.6 Limitations of the Research**

There are two noted limitations from this study.

1. The LCC segment of the airline market within Asia is currently 12 percent and the possibility exists that this figure could substantially increase in the future (IATA 2013d). In line with the requirement to include airlines who are servicing different segments of the market, it was envisaged that one of the four airlines involved in the study would be a LCC. With this intention, three LCCs were approached and all three LCCs rejected the request to be included in the study. Consequently, a limitation of this study was that it did not include any data from a LCC.
2. The study focused on the Asia Pacific Region as defined by those countries that are included in the Area of Responsibility of the Asia and Pacific Office of ICAO. There are 38 countries within this area, resulting in an extensive level of diversity. With only four participating airlines, this study could only capture a part of this diversity.

The concluding remarks to this study are presented next.

## 7.7 Concluding Remarks

This study defined FOR as the ‘The risk of a loss as a result of functions and activities that have an association with flight operations’. This definition is deliberately broad so as not to inhibit risk owners from identifying risk factors and risks that are included in FOR. The categories that include these risk factors and risks include processes, people, systems and external events. An additional area that directly influences FOR and should be included in the guidance material of the definition is an airline’s organisational culture, specifically risk culture. An airline that has an inappropriate risk culture such as a risk seeking culture or a pathological or reactive safety culture will have an increased likelihood of a serious incident or accident as a result of a heightened level of aleatory uncertainty.

Four airlines were involved in this study, which would be the minimum number required for case study type research, with this study producing nine findings. A survey of these findings was conducted with 16 airlines from the Asia Pacific Region, with only three responding with a completed survey, with another airline stating *“Regrettably, we are only supporting company-sponsored research and doctoral studies”* This reply explains the poor response to the survey request and why only the minimum number of four airlines participated in the study. The three airlines that did respond with completed surveys in the main concurred with this study’s findings indicating the generalisability of the findings.

These airlines place a high level of importance on the management of FOR and allocate and consume an extensive amount of resources in this endeavour. The approach to the management of FOR is primarily on a non-systemic basis using traditional methods and strategies. Examples of these traditional methods are reports, regulatory compliance both sovereign and industry, stakeholder requirements, corporate knowledge, organisational culture and management’s decisions. These methods are integrated through airline’s reporting system connecting the various areas that are required in the management of this risk. Systems are used such as the SMS, QMS/QA, and others which contribute to the management of FOR. Safety risk management and change management processes are required to be managed by the airline’s SMS, whilst hazard management is the cornerstone of managing FOR, risk owners from these airlines believe there are other benefits that a RMS or at least a RAP would deliver.

Some of these benefits are, improved decision-making processes, better control of documentation, improved retention of corporate knowledge, improved compliance record, better cost control, and enhanced risk assessment abilities through improved risk identification. As well as better risk analysis and risk evaluation, better outcomes for the airline's CSFs such as safety and legal, improved reputation and corporate governance issues, better litigation outcomes, an expectation of lowered insurance premiums, and improved sustainability. These processes/outcomes already exist within these airlines, what these risk owners believe a RMS/RAP would do is to improve these processes/outcomes. Risk management from the DFO level and above appears to be managed on a formal basis possibly for corporate governance requirements. Risk management below this level is managed on an informal basis, however, there appears to be a difference between the senior managers (older) who manage their risks on an informal basis and the junior managers (younger) who are inclined towards the systemic based approach which is indicative of the occurrence of generational change.

This study's contribution to practise is the answer to SQ-4, which is *What are the key factors inherent in a flight operational risk management system?* In answering this question this study produced a RMS referred to as the 'Seven Ps RMS Model'. The Seven Ps referred to in this model are; Philosophy, Program, People, Principles, Policy, Processes and Procedures; a complete description of this model is contained in section 6.3.

This study's contribution to theory is the theory of 'Flight Operational Risk Float'. There are three variables to this theory, Flight Operational Risk Drift (FORD), where an airline drifts towards failure, Flight Operational Risk Management (FORM), which is the corrective force with the net result of these two opposing forces being Flight Operational Risk Float (FORF) which reflects the current likelihood of an airline suffering a catastrophic event. The determination of likelihood is problematic as the methods that are used to decide likelihood require improvement as there was a noted difference between the perceived and actual likelihood of an airline suffering a serious incident.

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## **9 Appendices**

### **9.1 Appendix 1-1 Business Risk Rating of the Airline Industry**

The airline industry is one of the most difficult industries to operate within for the following reasons.

1. Profitability of the industry is often weak because it is:
  - a) labour intensive
  - b) capital intensive
  - c) energy intensive
  - d) sensitive to the state of the economy and
  - e) highly seasonal, with stronger results in the third quarter and weaker results in the first and fourth quarters.
2. Barriers to entry into the industry are often low, helped by the ability to lease aircraft and outsource most other support services.
3. Stability of income is low because of the fixed nature of costs and fluctuating passenger loads.
4. Regulation is high and, rather than reducing competition, regulation (especially related to security matters) increases costs and reduces flexibility of operations.
5. Safety and reputation are key issues, and any airline that has an accident is hurt severely in lawsuit settlement costs, reputation loss and future insurance rates (DBRS 2011, 6).

## 9.2 Appendix 1-2 Managing Safety Risk and Safety Assurance

Before an aircraft such as the Boeing 777 is permitted to operate on a commercial basis; substantial certification requirements covering all systems within the aircraft including the fuel system have to be complied with. The reason the certification processes did not include this icing phenomenon was simply due to the fact that this risk was not recognised at the time. This risk is considered so unlikely that data mining showed that the accident flight was unique amongst 175,000 flights as having a low cruise fuel flow and a high fuel flow during approach while at a low fuel temperature (AAIB 2010, 156).

After this aircraft came to a stop, an emergency passenger evacuation was conducted. The standard Boeing B777 non-normal checklist titled 'Evacuation' consists of nine items and these are actioned in a sequential and coordinated manner between the flight crew (Boeing 2009a). British Airways had changed this non-normal checklist by creating two separate checklists, one for each pilot's actions. The problem with this change is that all actions were still completed, but not in a coordinated manner, resulting in the possibility of the fuel spar valves to the engines not closing. Because of the severe damage sustained by the aircraft and the uncoordinated closing of the fuel control switches and fire handles (switches), the fuel spar valves did not close. This resulted in 6,750 kg of fuel to leak out of the damaged fuel lines, substantially increasing the risk of a fire until the valves were manually closed by maintenance personnel (AAIB 2010, 169).

Whilst this change to the non-normal checklist was done with the best of intentions, in this case to reduce the time to complete the checklist (AAIB 2010), it highlights the perils of change management. As a consequence of this accident, Safety Recommendation 2008-009 from the Air Accidents Investigation Branch (AAIB) (2010) was issued.

Boeing should notify all Boeing 777 operators of the necessity to operate the fuel control switch to cut-off prior to operation of the fire handle, for both the fire drill and the evacuation drill, and ensure that all versions of its checklists, including electronic and placarded versions of the drill, are consistent with this procedure (AAIB 2010, 177).

### 9.3 Appendix 2-1 Risk Factor Examples with Description.

Table 9-1 Risk Factors 1-5

No.	Risk Factor	Description
1	Design and construction flaws.	The building or components lacking the required structural integrity to withstand internal and external operational forces.
2	Deferred maintenance.	Due to operational or financial constraints, maintenance is deferred, if this behaviour becomes part of the norm, multiple failures may occur.
3	Economic pressures.	Economic pressure may cause budgetary constraints or cutbacks, contributes to an increase in human errors.
4	Schedule constraints.	Inclination to remove tasks from the project, to take "short cuts," completing safety critical functions before safeguards have been put in place, completing tasks in a hurry contributing to an increase in human errors.
5	Inadequate training.	Many organisations today are technically complex requiring initial and recurrent training, management maybe inclined to reduce this level of training causing an increased level of human factor errors.

(Abkowitz 2008, 2-7).

**Table 9-2 Risk Factors 6-10**

No.	Risk Factor	Description
6	Non-conformance to procedures.	Employees not following standard operating procedures and supervisors not monitoring worker compliance are one of the root causes of failures.
7	Lack of planning and preparedness.	Due to the low likelihood of a catastrophic event, occurring coupled with the lack of such events in the firms recent past; inadequate resources are allocated to planning and preparing for an undesirable outcome. Therefore, this risk factor is evident in almost all catastrophic events.
8	Communication failure.	Failures in communication may occur at all levels both internal and external to the organisation. Can be both a contributing cause and a consequence of the disaster, is found in nearly all disasters
9	Arrogance.	Causes over confidence and dismissive of risk, can be both at an individual and institutional level, one reason why risk is culturally perceived.
10	Stifling political agendas.	Government policies are a major contributor to acts of terrorism. In developing countries governments may not adequately police required safety standards in pursuit of nation building.

(Abkowitz 2008, 2-7).

## 9.4 Appendix 2-2 Observed Risk Factors in Disasters.

Table 9-3 Applicable Risk Factors in Disasters Part A

Disaster	Risk factor number	1	2	3	4	5	6	7	8	9	10
Hyatt Regency Kansas City, 1981, an elevated walkway in the hotel collapsed; 114 fatalities, 216 injured.		x		x	x		x		x	x	
Bhopal India, 1984, 40 tons of methyl isocyanate (MIC) accidentally released, 3,800 fatalities, 11,000 injured.		x	x	x		x	x	x	x	x	x
Chernobyl Ukraine, 1986, reactor core explosion in a nuclear power station, fatalities unknown, injured unknown.		x	x				x		x	x	x
Exxon Valdez Alaska, 1989, oil tanker impacts a reef leaking 11 million gallons of crude oil creating an environmental and economic disaster. 0 fatalities, 0 injuries.		x		x			x	x	x	x	x
Challenger and Columbia space shuttle accidents. USA, 1986, Challenger space shuttle exploded shortly after take-off, 7 fatalities. 2003 Columbia space shuttle disintegrated on re-entry to Earth's atmosphere, 7 fatalities.		x	x	x	x		x		x	x	x
Oklahoma City bombing. USA, 1995, domestic terrorists using explosives destroy the Alfred P. Murrah Building, 168 fatalities, unknown injured.		x				x		x	x		x

(Abkowitz 2008, 259).

**Table 9-4 Applicable Risk Factors in Disasters Part B**

Disaster	Risk factor number	1	2	3	4	5	6	7	8	9	10
Aum-Shinrikyo. Tokyo, 1995, A Japanese religious cult released sarin gas into the subway system, 12 fatalities, 5,000 injured.						X		X	X		X
USS Cole. Yemen, 2000, US warship attacked by terrorists using explosives, 17 fatalities, 39 injured.				X			X	X	X	X	X
World Trade Centre (WTC). New York, 2001, Terrorists hijacked aircraft and flew them into the buildings of the WTC, nearly 3,000 fatalities, unknown injured, estimated 120 billion USD in damages.	X			X				X	X		X
Mount St. Helens Washington State, 1980, volcanic eruption and associated mudslides, inadequate communications and planning, 57 fatalities, unknown injured.				X				X	X		
South Canyon fire. Colorado, 1994, Inadequate resources allocated to a small fire, “blew up” to a large fire, 14 fatalities (firemen).					X	X	X	X	X	X	
Sumatra-Andaman tsunami. Indian Ocean, 2004, movement in the Earth’s crust caused a tsunami to affect coastal regions surrounding the Indian Ocean, 300,000 fatalities, unknown injured.				X		X		X	X		X

(Abkowitz 2008, 259).

## 9.5 Appendix 2-3 Latent Conditions

Table 9-5 Latent Conditions with Specific Examples Part A

Latent Conditions (resides within these categories)	Specific examples
Design.	Design shortcomings Manufacturing defects.
Regulatory Oversight.	Deficient regulatory oversight by the state or lack thereof.
Management Decisions.	Cost cutting Stringent fuel policy Outsourcing and other decisions, which can impact operational safety.
Safety Management.	Absent or deficient Safety policy and objectives Safety risk management (including hazard identification process) Safety assurance (including Quality Management) Safety promotion.
Change Management.	Deficiencies in monitoring change; in addressing operational needs created by, for example, expansion or downsizing Deficiencies in evaluation to integrate and/or monitor changes to establish organisational practises or procedures. Consequences of mergers and acquisitions

(IATA 2009, 85-86).

**Table 9-6 Latent Conditions with Specific Examples Part B**

<b>Latent Conditions (resides within these categories)</b>	<b>Specific examples</b>
Selection Systems.	Deficient or absent selection standards.
Operations Planning and Scheduling.	Deficiencies in crew rostering and staffing practises. Issues with flight and duty time limitations Health and welfare issues.
Technology and Equipment.	Available safety equipment not installed Enhanced Ground Proximity Warning System (EGPWS), Predictive Windshear (PWS), and Traffic Alert and Collision Avoidance System/Airborne Collision Avoidance System. TCAS/ACAS.
Flight Operations Standard Operating Procedures and Checking.	Deficient or absent: (1) Standard Operating Procedures (SOPs), (2) operational instructions and/or policies, (3) company regulations, (4) controls to assess compliance with regulations and SOPs.
Flight Operations Training System.	Omitted training, language skills deficiencies, qualifications and experience of flight crews, operational needs leading to training reductions, deficiencies in assessment of training or training resources such as manuals or Computer Based Training (CBT) devices.

(IATA 2009, 85-86).

## **9.6 Appendix 2-4 Aviation Risk Mitigating Tools, and Audits**

### **9.6.1 Airline Risk Management Solutions (ARMS)**

Subjectivity in risk management has been identified by the Airline Risk Management Working Group (ARMS Group) who declare that “Risk assessment is the most challenging part of risk management in aviation operations. This is due to the subjectivity involved in determining the severity of the consequences and the lack of quantitative information on the probability of the risk occurring” (ARMS Working Group 2010, 4). The Mission of the ARMS Working Group is to produce Airline Risk Management Solutions (ARMS) which are useful and cohesive operational risk assessment methods for airlines and other aviation organizations and which will underpin the important role that risk management has in aviation (ARMS Working Group 2010).

### **9.6.2 Approach and Landing Accident Reduction (ALAR) Toolkit**

The approach and landing phases of a flight are the two phases in which the majority of airline accidents occur. For example, in 2012 there were 75 airline accidents, 48 of which occurred during the approach and landing phases (IATA 2013a). This phenomenon has occurred over a number of years. Research conducted in 1998 indicated that for the previous 18 years, on average 17 fatal Approach and Landing Accidents (ALA) occurred per year, involving passenger and cargo aircraft weighing 5700kgs or more. As an industry counter measure to this, an ALAR campaign began with various members of the Flight Safety Foundation (FSF) Controlled Flight into Terrain (CFIT) and Approach and Landing Action Group (CAAG) conducting numerous ALAR workshops around the world. The FSF has distributed more than 40,000 copies of the FSF ALAR Tool Kit which contains a unique set of pilot briefing notes, videos, presentations, risk-awareness checklists and other products designed to prevent approach and landing accidents (FSF 2009a).

### **9.6.3 Controlled Flight into Terrain (CFIT)-Reduction Products**

A CFIT accident “occurs when an airworthy aircraft is flown, under the control of a qualified pilot, into terrain (water or obstacles) with inadequate awareness on the part of the pilot of the impending collision” (FAA 2003, p.3). In the early 1990s, accidents resulting from an aircraft suffering from a CFIT was the major cause of fatalities. As a consequence of this, in 1992 a FSF-led international CFIT Task Force was created to reduce the level of CFIT accidents (FSF 2009a). Notwithstanding the efforts by the aviation industry in managing this occurrence, for the five year period 2008-2012, 31% of fatal airline accidents globally were the result of a CFIT event (IATA 2013a).

### **9.6.4 Runway Excursion Risk Reduction (RERR) Toolkit**

The most common airline accident each year during the five-year period between 2008-2012 were runway excursions (IATA 2013a). Collaboration between the members of the Runway Safety Initiative (RSI), FSF and IATA produced the report titled ‘Reducing the Risk of Runway Excursions.’ This toolkit highlights significant risk factors with associated recommendations to mitigate this risk with the targeted audience being aircraft operators, pilots, air traffic controllers, and regulators (FSF 2009b). In cooperation with industry bodies such as airlines, manufacturers and pilot associations, navigation service providers from various parts of the world under the stewardship of the FSF created the Global Plan for the Prevention and Mitigation of Runway Excursions in 2009. The objective of this exercise was to reduce the number of runway excursions from either the side, referred to as a veer-off, or from the end, which is termed an overrun. Countermeasures were created in highlighting, and consequently mitigating, the risk of these events occurring (FSF 2009c).

### **9.6.5 Line Operations Safety Audit (LOSA)**

A LOSA is conducted by trained observers sitting in a non-control seat in the cockpit recording the threat error management of the flight crew. Information derived from these audits is collated and analyzed, providing feedback to the airline regarding the organisation’s resilience to systemic threats, operational risks and front line personnel errors. This information allows the airline to develop and implement strategies to mitigate risks and enhance safety. Examples of these strategies include inputting the recorded data into the Crew Resource Management (CRM) Threat and Error Management (TEM) training, with observed exemplary performances in the field of TEM used as models (ICAO 2002).

### **9.6.6 IATA Operational Safety Audit (IOSA)**

In a standardized manner and adopting quality audit principles, IATA's operational safety audit assesses an airline's operational management and control systems. IATA members are required to be audited both on an initial and ongoing basis. The audit standards are continually updated, reflecting current best practises. An immediate benefit from this audit is the redundancy of a large number of pre-existing audits such as code share audits. The audit covers various parts of an airline, such as corporate organization and management, flight operations, operational control/flight dispatch, ground handling, engineering and maintenance, cabin operations, cargo operations and operational security (IATA 2014).

## 9.7 Appendix 2-5 Drift and Complexity

Table 9-7 Interaction between Characteristics of Drift and Complexity

Characteristic	Interaction
Resource scarcity and competition	Leads to a chronic need to balance cost pressures with safety. In a complex system, this means that the thousands smaller and larger decisions and trade-offs that get made throughout the system each day can generate a joint preference without central coordination, and without apparent local consequences: production and efficiency are served in people's local goal pursuits while safety is sacrificed, but not visibly so.
Incrementalism	Constant organizational and operational adaptation around goal conflicts and uncertainty produces small, step-wise normalization where each next decrement is only a small deviation from the previously accepted norm, and continued operational success is relied upon as a guarantee of future safety.
Sensitive dependence on initial conditions	Because of the lack of a central designer or any part that knows the entire complex system, conditions can be changed in one of its corners for a very good reason and without any apparent implications: it is simply no big deal. This may, however, generate reverberations through the interconnected webs of relationships; it can be amplified or suppressed as it modulates through the system.
Unruly technology	Introduces and sustains uncertainties about how and when things may fail. Complexity can be a property of the technology-in-context. Even though parts or sub-systems can be modelled exhaustively in isolation (and therefore remain merely complicated), their operation with each other in a dynamic environment generates the unforeseen abilities and uncertainties of complexity.
Contribution of the entire protective structure	The organization itself, as well as the regulator, legislation, and other forms of oversight that is set up and maintained to ensure safety. Protective structures themselves can consist of complex webs of players and interactions, and are exposed to an environment that influences it with societal expectations, resource constraints, and goal interactions. This affects how it condones, regulates and helps rationalize or even legalizes definitions of "acceptable" system performance.

(Dekker 2013, 249).

## 9.8 Appendix 2-6 Vulnerable System Syndrome (VSS)

Table 9-8 Elements from the Vulnerable System Syndrome (VSS)

Feature	Explanation
Blame	<p><i>The fundamental attribution error</i> Everyone is capable of a wide range of actions, sometimes ill judged, sometimes inspired, but mostly somewhere in between. One of the basic principles of error management is that the best people can make the worst mistakes.</p> <p><i>The illusion of free will</i> When people are presented with accident reports and asked to judge which causal factors were the most avoidable, they almost invariably pick out the human actions.</p> <p><i>The just world hypothesis</i> Bad things only happen to bad people, and conversely.</p> <p><i>Hindsight bias</i> When we look back at some salient event, our knowledge of the outcome unconsciously colours our perceptions of how and why it occurred (knew-it-all-along).</p> <p><i>Penalties of a blame culture</i> The focus of the error investigation is solely on the individual operational employees involved and the organization lives with the illusion that they have created safety by naming, blaming and retraining the staff members who made the errors.</p>
Denial	<p>Generative organizations encourage individuals to report, conversely pathological organizations muzzle, malign, or marginalise whistle blowers, shirk collective safety responsibility, punish or cover up failures, and discourage new ideas. Bureaucratic or calculative organizations will not necessarily ‘shoot the messenger’ but new ideas often present problems. Safety management tends to be compartmentalised. Failures are isolated rather than generalised, and are treated by local fixes rather than by systemic reforms.</p>
Incorrect excellence	<p>There are many companies engaged in hazardous operations that still measure their plant safety by the lost time injury frequency rate. Unfortunately, this relates specifically to personal injury accidents and provides little or no indication of a system's liability to a major disaster.</p>

(Reason, Carthey and de Leval 2001, ii21-ii24).

## 9.9 Appendix 2-7 ICAO SMS Framework

**Table 9-9 ICAO Safety Management System (SMS) Framework**

<b>Category</b>	<b>Element</b>
1. Safety policy and objectives	1.1 Management commitment and responsibilities 1.2 Safety accountabilities 1.3 Appointment of key safety personnel 1.4 Coordination of emergency response planning 1.5 SMS documentation
2. Safety risk management	2.1 Hazard identification 2.2 Risk assessment and mitigation
3. Safety assurance	3.1 Safety performance monitoring and measurement 3.2 The management of change 3.3 Continuous improvement of the SMS
4. Safety promotion	4.1 Training and education 4.2 Safety communication.

(ICAO 2013a, APP 2-1).

## 9.10 Appendix 2-8 Categories and Elements of a RMS Framework

Table 9-10 Risk Management System (RMS) Framework

Categories and elements of a RMS framework
<p>Mandate and Commitment:</p> <ul style="list-style-type: none"> <li>• Define and endorse risk management policy</li> <li>• Align risk management policy and organisational culture</li> <li>• Align risk management performance indicators with the airline's performance indicators</li> <li>• Align risk management objectives with the objectives and strategies of the airline</li> <li>• Ensure legal and regulatory compliance</li> <li>• Assign accountabilities and responsibilities</li> <li>• Ensure adequate resources are obtained</li> <li>• Ensure effective communication channels to stakeholders</li> <li>• Ensure stakeholders are aware of the benefits of formalised risk management</li> </ul>
<p>Framework Design:</p> <ul style="list-style-type: none"> <li>• Obtain an understanding of the airline within both an internal and external context</li> <li>• Establish risk management policy</li> <li>• Identify standards, guidelines and models to be adopted</li> <li>• Ensure accountability, authority and competence</li> <li>• Integrate into the airline's processes</li> <li>• Review and obtain risk management resources</li> <li>• Establish internal and external communication and reporting mechanisms</li> </ul>
<p>Implementing, Monitoring and Improving the Framework:</p> <ul style="list-style-type: none"> <li>• Implement the risk management framework</li> <li>• Monitor framework to ensure appropriateness and effectiveness</li> <li>• Improve framework on an ongoing basis which leads to an improvement of the airline's management of risk and its risk culture</li> </ul>

(ISO 2009, 9-13).

## 9.11 Appendix 2-9 Classification of Hazards with Examples

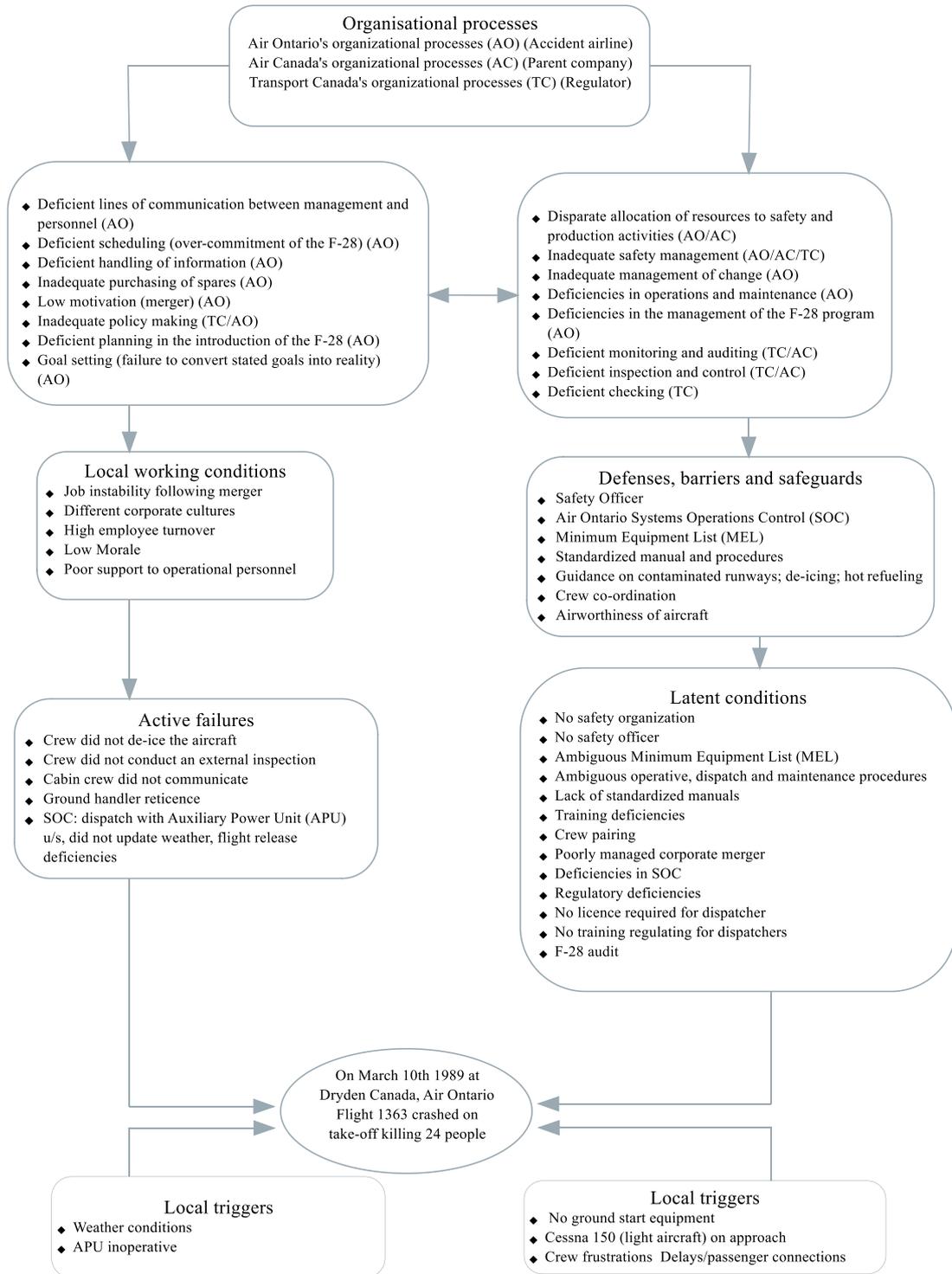
Table 9-11 Classification of Hazards with Examples

Hazard type	Examples
<p><u>Natural hazards.</u> Are a consequence of the habitat or environment within which operations related to the provision of services take place.</p>	<p><u>Severe weather or climatic events</u> hurricanes, winter storms, droughts, tornadoes, thunderstorms, lightning and wind shear. <u>Adverse weather condition</u> icing, freezing precipitation, heavy rain, snow, winds and restrictions on visibility. <u>Geophysical events</u> earthquakes, volcanoes, tsunamis, floods and landslides. <u>Geographical conditions</u> adverse terrain or large bodies of water. Environmental events: wildfires, wildlife activity, and insect or pest infestation. <u>Public health events</u> epidemics of influenza or other diseases.</p>
<p><u>Technical hazards.</u> Are problematic energy sources; electricity, fuel, hydraulic pressure, pneumatic pressure. Alternatively, safety-critical functions necessary for operations related to the delivery of services.</p>	<p>Aircraft and aircraft components, systems, subsystems and related equipment. An organization's facilities, tools and related equipment. Facilities, systems, subsystems and related equipment that is external to the organization.</p>
<p><u>Economic hazards</u> Are the consequence of the socio-political environment within which operations related to the provision of services take place.</p>	<p>Growth. Recession. Cost of material or equipment.</p>

(ICAO 2009, 4-3-4-4).

## 9.12 Appendix 2-10 Air Ontario Flight 1362 Accident

Figure 9-1 Causal Pathway of the Air Ontario Flight 1362 Accident



Adapted from (Maurino et al. 1995, 82).

### 9.13 Appendix 3-1 Quantitative Versus Qualitative.

Table 9-12 Quantitative Versus Qualitative Analysis in Organisational Research

Year	Articles	Non empirical articles	Empirical articles			
			Empirical articles	Quantitative articles	Qualitative articles	Mixed articles
2003	50	10	40	40	0	0
2004	47	4	43	35	2	6
2005	50	18	32	28	1	3
2006	56	15	41	33	5	3
2007	55	20	35	27	5	3
2008	60	20	40	34	4	2
2009	55	14	41	38	0	3
Total	373	101	272	235	17	20

(Azorín and Cameron 2010).

## 9.14 Appendix 3-2 Interviewee's Titles

Table 9-13 Titles of Interviewees

Title of Interviewees	Airline A1	Airline A2	Airline A3	Airline A4
Chief Executive Officer	√ <sup>21</sup>	X <sup>22</sup>	X	X
Chief Operating Officer	X	X	√	X
Director of Flight Operations	√	√	√	√
D/Director of Flight Operations	√	√	N/A	N/A
Mgr. Line Operations	X	√	X	√
Fleet Managers	√	√	√	√
Pilot Standards Managers	√	√	√	√
Pilot Training Managers	√	√	X	X
Safety Managers	√	√	√	√
Quality Managers	√	√	√	X
Risk Managers	√	√	√	√
Human Factors Manager	X	√	X	√
Aircraft Performance	X	X	√	√
Technical Manager	X	X	X	√
Risk Coordinator	X	X	X	√
Route Planning Manager	X	X	√	X
Check/Training Captains	√	√	X	√
Line Captains	√	X	√	X
First Officers	√	X	√	X
Cabin Services	√	X	√	√

<sup>21</sup> √ indicates interview(s) were conducted

<sup>22</sup> X indicates interview(s) were not conducted

## 9.15 Appendix 3-3 Participant Information Sheet and Consent Form

Figure 9-2 Information Sheet and Consent Form

Curtin Business School

Date

**Curtin**   
University of Technology

Graduate School of Business

78 Murray Street  
(Cnr Pier & Murray St)  
Perth Western Australia 6000

Telephone +61 8 9266 3460  
Facsimile +61 9266 3368  
Web [www.business.curtin.edu.au/gsb](http://www.business.curtin.edu.au/gsb)

CRICOS Provider Code 00301J

My name is David Prior. I am currently completing a PhD with the Graduate School of Business at Curtin University of Technology.

I am investigating the management of flight operational risk within Airlines in the Asia Pacific Region. I am interested in finding out your perceptions and opinions in relation to risk management strategies within your Company. I will ask you a series of questions during an interview, which will take approximately 30-40 minutes.

**Consent to participate**  
Your involvement in the research is entirely voluntary. You have the right to withdraw at any stage without it affecting your rights or my responsibilities. When you have signed the consent form, I will assume that you have agreed to participate and allow me to use your data in this research.

**Confidentiality**  
The information you provide will be kept separate from your personal details, and I will only have access to this. The interview transcript will not have your name or any other identifying information on it and in adherence to University policy, the interview tapes and transcribed information will be kept in a locked cabinet for five years, before it is destroyed.

**Further Information**  
This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval No. GSB-02-09). If needed, verification of approval can be obtained by writing to the Curtin University Human Research Ethics Committee c/- Office of Research & Development, Curtin University of Technology, GPO Box U1987, Perth 6845, or telephone 9266 2784. If you would like further information about the study, please feel free to contact me by email: [prior911@hotmail.com](mailto:prior911@hotmail.com). Alternatively, you can contact my supervisor, Associate Professor Verena Marshall, on +61 8 9266 3236, Mobile no. +61 417 946 674, or email: [verena.marshall@gsb.curtin.edu.au](mailto:verena.marshall@gsb.curtin.edu.au).

**Thank you very much for your involvement in this research, your participation is greatly appreciated. I will also be pleased to share summary findings of the study with you.**

Curtin Business School has received accreditation under the standards for European Quality Improvement Systems (EQUIS) 

Curtin Business School



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CRICOS Provider Code 00301J

**Name of Airline**

**CONSENT FORM**

**Research into the management of Flight Operational Risk within Airlines in the Asia Pacific Region**

**Researcher's name:** David Prior

The nature and purpose of the research project has been explained to me. I understand and agree to take part.

I understand that I can withdraw from the study at any stage and that this will not affect my status now or in the future.

I confirm that I am over 18 years of age.

I understand that my interview will be audio-taped.

I understand that the tape will be securely stored in a locked cabinet in the researcher's office for five years. Only the researcher and his supervisors will have access to the data for reporting purposes.

I understand that while information gained during the study will be published neither I nor my organisation will be identified. Further my personal information, or that relating to my organisation, will remain confidential.

**Name of participant:**.....

I have explained the study to the subject and consider that he/she understands what is involved.

**Interviewee's signature and date:** .....

**Researcher's signature and date:**.....



## 9.16 Appendix 3-4 Individual Interviewee Data

Table 9-14 Gender and Education of Interviewees

<b>Education</b>	<b>Airline A1</b>	<b>Airline A2</b>	<b>Airline A3</b>	<b>Airline A4</b>
Secondary	4	4	3	3
Certificate	2	2	1	0
Diploma	2	4	7	4
Degree	8	6	1	4
Post Grad.	0	1	1	1
Masters	2	2	0	3
Doctorate	1	0	0	0
Not stated	2	3	0	0
Females	1	0	2	2
Males	20	22	11	13
Totals	21	22	13	15

## **9.17 Appendix 3-5 Interview Guide**

### **Interview Guide**

This guide serves as a checklist and ensures that the same information is obtained from a number of people, and at the same time ensuring boundaries are defined regarding the topics and themes to be discussed. However, the guide is flexible allowing the interview to move around within these boundaries.

It is stressed that all information sourced from this research is completely confidential.

Semi structured interviews will be conducted with primary and secondary risk management stakeholders from each airline.

As note taking cannot capture all of the data, all interviews (unless denied by the interviewee) will be audio recorded and subsequently transcribed for data analysis purposes.

The interview will be compartmentalized into categories, which will be further segmented into elements.

Each of the categories will commence with straightforward informal type questions, which will achieve two objectives;

1. Provide the interviewer with basic need to know data regarding that category
2. Allow the interviewee time to focus his/her thoughts on the category.

The objective of these visits are to obtain rich data by asking probing questions and allowing the interviewees to reply in their own words which will in turn produce new perspectives and themes allowing this rich data to emerge.

Prior to attending the respective Airline's facilities to conduct the interviews, the following will be completed;

1. An email will be sent to the staff member deemed responsible for the research confirming the intended visit.
2. Back ground information on the airline will be obtained.

## Interviewee Data

Interview Code

--	--	--	--	--

Airline \_\_\_\_\_

Division \_\_\_\_\_

Department \_\_\_\_\_

Section \_\_\_\_\_

Date \_\_\_\_\_ Time \_\_\_\_\_

Title \_\_\_\_\_

Name \_\_\_\_\_ (Transcription purposes only)

Contactable? Email \_\_\_\_\_ Yes/No

Tape recording Folder \_\_\_\_\_ Number \_\_\_\_\_

Education. 1...Primary 2...Secondary 3...Certificate 4...Diploma 5...Bachelor  
Degree 6...Graduate Certificate/Diploma 7... Master's Degree 8...Doctoral Degree  
9...Refused.

### **Flight crew**

Tell me about the pilots within this airline

(Response joggers)

Where do you source your newly hired pilots?

Do you prefer a particular source?

Describe the problems new flight crew may face fitting into the organizational culture?

What is the average length of stay of flight crew within this airline?

Does any group have superior/inferior technical, non-technical skills?

What is the level of industrial action conducted by the flight crew?

Describe the number and composition of the pilots

Total Captains.....First Officer ...Bases

### **Safety**

I would like to explore in some details, so can you tell me your perception of senior management's behaviour and attitudes towards the human and organizational factors that can endanger this operation and why do you believe this?

(Response joggers)

Is safety the highest priority in the airline?

Is a list of priorities published in the FOM?

[Safety, passenger comfort, schedule, economy]

Does this airline publish a safety policy?

If so who signed it?

Is it abided by?

Who does the head of safety answer to?

Following on from the above question, what is your belief regarding top management's commitment to aviation safety and are adequate resources provided to serve this end? Why do you have this opinion?

After some mishap, is the primary aim of top management to identify the failed system defences and improve them, or is it rather to divert responsibility to particular individuals.

When such an event occurs that is caused by human error does the company accept this as part and parcel of life? Can you give me some examples?

At times, it is appreciated that commercial goals and safety issues can come into conflict. Tell me about the measures, if any that are in place to recognize and resolve such conflicts in an effective and transparent manner.

(Response joggers)

Does senior management/board actively and genuinely support safety?

What about when commercial goals and safety come into conflict, what happens then?

Tell me about the SMS that is in operation within this airline.

Can you describe to me in detail your perception of the safety culture of this airline?

Reporting-Informed-Punishment-Just

Can you explain to me the FOQA [FDA] program that is in place within this airline?

(Response joggers)

Does the airline have one?

Primary purpose of it? Trend analysis or punishment?

Is it required by law?

Has the data ever been used to punish pilots?

What safeguards are in place to prevent this from occurring?

What is the data used for?

What is your belief regarding this programs ability to contribute to the airlines safety level and at the same time reduce the level of risk that the airline is exposed to?

### **Risk**

#### General

Can you describe to me in some detail how risk is managed by the airline with regard to flight operations?

(Response joggers)

Is there a structured risk management framework within this airline?

Does this airline have a CRO? If not, who is accountable or responsible for the management of risk within this airline?

Is the management of risk ERM?

Does each division/department have its own risk register?

How is the process of hazard identification carried out?

Is the risk appetite for the airline defined?

Are risk matrixes used?

Are there risk committees?

#### Framework

In the event of a risk materializing, how are the consequences measured?

(Response joggers)

Is the management of risk subservient to safety?

Against Critical Success Factors such as Reputation, Financial, Legal, Safety?

There are a number of Risk Management Standards that an organisation can adopt such as ISO 31000:2009, AS/NZS 4360:2004. Has this airline adopted any of these standards with regard to the management of risk?

Have you implemented the ISO 31000 guide lines?

Risk Culture

How would you describe the airlines attitude to risk management?

(Response joggers)

What are the principles of the airlines risk management program?

Is it embedded into the processes and culture of the airline?

Is it transparent?

What does risk management mean to this airline?

This thesis is limited to the management of FOR. How is the management of this particular risk conducted?

What do you believe the advantages of managing FOR are?

(Response joggers)

Creates long term value

More effective operational planning

Increased likelihood of achieving the Divisions operational objectives

Improved organizational resilience against negative outcomes

Improved decision making processes

Enhanced stakeholder management

Addresses uncertainty.

Is the risk management program reactive, proactive, predictive, and why do you believe this to be the case?

What is the annual budget for risk management?

(Response joggers)

How much of this amount is insurance premiums?

How do the functions such as auditing, compliance, quality assurance, risk management relate to each other?

What is the relationship like between executive management and the management of this division?

For example

Do corporate policies e.g. industrial have an enhancing or detrimental impact?

Do these executives interfere with the day to day running of the division?

What is your definition of FOR?

What is your working definition of risk?

How important is risk management in your organization today and why?

How do you identify and assess risk in your airline?

Do you use a formal risk management methodology? If so, how does it work?

When do you use it?

What effective or ineffective risk management practices have you implemented?

Do you address risk management issues with users? Why or why not?

What are the risks of not doing risk management and/or the benefits of doing risk management?

Do you agree that risk assessment should be a primary management tool?

What are the strategic issues with regard to RM?

Do you believe RM failed and caused the GFC?

We manage our risk therefore we can be riskier than our competitors.

Did RM fail at the top level?

### **IOSA**

Describe this airlines experience with IOSA

(Response joggers)

When was the initial?

How much preparation is done in the pre IOSA period?

How many IOSA audits have been completed?

Findings; How many and in what areas?

Do you believe IOSA has a credibility issue?

### **LOSA**

Has the Airline conducted a LOSA? (If not, why not?)

Can you talk about the outcome(s) from an internal and external perspective?

(Response joggers)

When was the first LOSA conducted?

Who conducted the first LOSA?

How many LOSAs have been conducted?

What was the focus of each LOSA?

Does the Airline consider LOSA to be value adding?

Does management at all levels consider conducting a LOSA to be beneficial?

What lessons did the airline learn from its LOSA experience?

Was trust an issue?

How was the Airline assessed against other airlines and does management accept this assessment?

### **NTS**

What level of importance is placed upon NTS?

(Response joggers)

How often are NTS skills assessed?

What methodology is used?

Does the Airline have a HF team?

Are LOFT sessions conducted?

### **ISO**

Can you tell me what ISO audits have been conducted here?

### **Regulator**

We talked briefly before about the regulator; can you expand on this topic and tell me a bit more about the Airline's relationship with the regulator.

What is the audit program conducted by the regulator?

What other external audits has the Airline been subjected to? (Such as alliance and code share audits).

### **Internal Audits**

How is the service of oversight carried out on the Flight Operations Division?

(Response joggers)

Is there a Quality Assurance/Internal Audit section?

Number of Auditors?

Full time or part time?

Is it embedded within Flight Operations or external?

What controls are put in place to ensure the transparency of the service?

Is there a duplication of services? If so what are the roles of each?

How does the Quality department contribute to the management of Risk?

### **Organizational Structure**

What departments are contained within the Flight Operations Division?

Describe how the airline is structured and what divisions/ departments impact upon Flight Operations.

Describe the relationships between these departments and this division

What flight operations services are outsourced to a third party and why does this occur?

How is security managed within the Airline?

Are there any anecdotes that you would like to share with me regarding this airline and the topic of this research?

Is there anything you would like to share with me regarding this topic or that you really would like to know about?

(Response joggers)

What have I missed question or what they really want to know about FOR?

### **Line Pilot Interviews**

Could you please tell me a bit about yourself and your relationship with your airline?

(Response joggers)

Your aviation back-ground?

How long you have been here?

Your job capacity?

Can you talk about your perception of the level of safety in your airline?

(Response joggers)

Is safety the highest priority in the airline?

Is a list of priorities published in the FOM?

[Safety, passenger comfort, schedule, economy]

Does this airline publish a safety policy?

Do you believe senior management support the policy by their actions?

Can you describe to me in detail your perception of the safety culture of this airline?

Reporting-Informed-Punishment-Just

Is the safety culture of the airline a competitive advantage?

What is your belief regarding top management's commitment to aviation safety and are adequate resources provided to serve this end? Why do you have this opinion?

(Response joggers)

Standard of maintenance, training, flight standards

What is your belief and if any concerns regarding FDA?

Industrial relations issues-union involvement-relationship between management and the Pilot's union-morale is the pilot group engaged with the airline-fatigue issues

After some mishap, is the primary aim of top management to identify the failed system defences and improve them, or is it rather to divert responsibility to particular individuals.

When such an event occurs that is caused by human error does the company accept this as part and parcel of life? Can you give me some examples?

At times, it is appreciated that commercial goals and safety issues can come into conflict. [Production/Safety balance] (*On time departures arrivals*)

**End of Interview Guide.**

## 9.18 Appendix 3-6 Labels of the 133 Free Nodes

Figure 9-3 Labels of the 133 Free Nodes

Accidents Events and Incidents	Air Traffic Control	Aircraft	Audits	Audits-IOSA	Audits-LOSA	Automation
Behavioural Marker System	Black Swan Events	Cabin Services	Change Management	Clear Air Turbulence	Cockpit Briefings	Cockpit Culture
Cockpit Threat Mitigating Strategies	Communication	Complacency	Compliance	Contingency Planning	Corporate Contingency Plan	Corporate Governance
Costs	Crew Training	Culture Generative	Decision Making	Dispatch	Emergency Planning	Employee Engagement
Employees	Environmental Threat Level	Fleet Renewal Program	Flight Data Analysis	Flight Operations	Flight Operations Risks	Fuel
Hazards	Human Factors	Industrial Relations	Insurance	Just Culture	Latent Threats	Learning Culture
Maintenance	Management	Manager Air Safety	Managers Operational	Manuals and Documentation	Manufacturer	Motivation
National Culture	Non Technical Skills	On Time Performance	Organisational Culture	Organisational Factors	Organisational Objectives	Stakeholders
Performance	Pilot Fatigue	Pilot Handling Skills	Pilot Selection	Pilot Standards	Pilot Training	Pilots
Pilots over 60	Professionalism	Project Risk-Bird Hazards	Project Risk-CROPS	Project Risk-Fatigue	Project Risk-New Airports and Routes	Project-Risk
Punishment Culture	Quality-Engineering	Quality-Flight Operations	Quality-Strategies	Regulations	Reporting Culture	Reputation
Resources	Risk	Risk Volcanic Activity	Risk Advisors	Risk Appetite	Risk Assessment	Risk Board and CEO Involvement
Risk Business	Risk Committees	Risk Controls	Risk Coordinator	Risk Culture	Risk Definition	Risk Environment
Risk Flight Operational	Risk Identification	Risk Management Benefits	Risk Management Budget	Risk Management Drivers	Risk Management Evolution	Risk Management Standards
Risk Management Strategies	Risk Management Training	Risk Management-Overlap	Risk Management-Resources	Risk Management-Shortcomings	Risk Management-Structure	Risk Manager
Risk Matrix	Risk Operational	Risk Oversight	Risk Policy	Risk Qualitative Analysis	Risk Quantitative Analysis	Risk Quotient
Risk Registers	Risk Security	Risk Tools and Techniques	Risk Training	Risk Third Party	Safety Artifacts	Safety Culture
Safety Management System	Safety Philosophy	Safety Production-Balance	Safety Risk	Safety-Quality-Risk-Combined	Schedule Risk	Shelf ware
Software	Standard Operating Procedures	Technology	Test Flights	Threat Error Management	Threats	Uncertainty

### 9.19 Appendix 3-7 List of Emergent Themes per Category

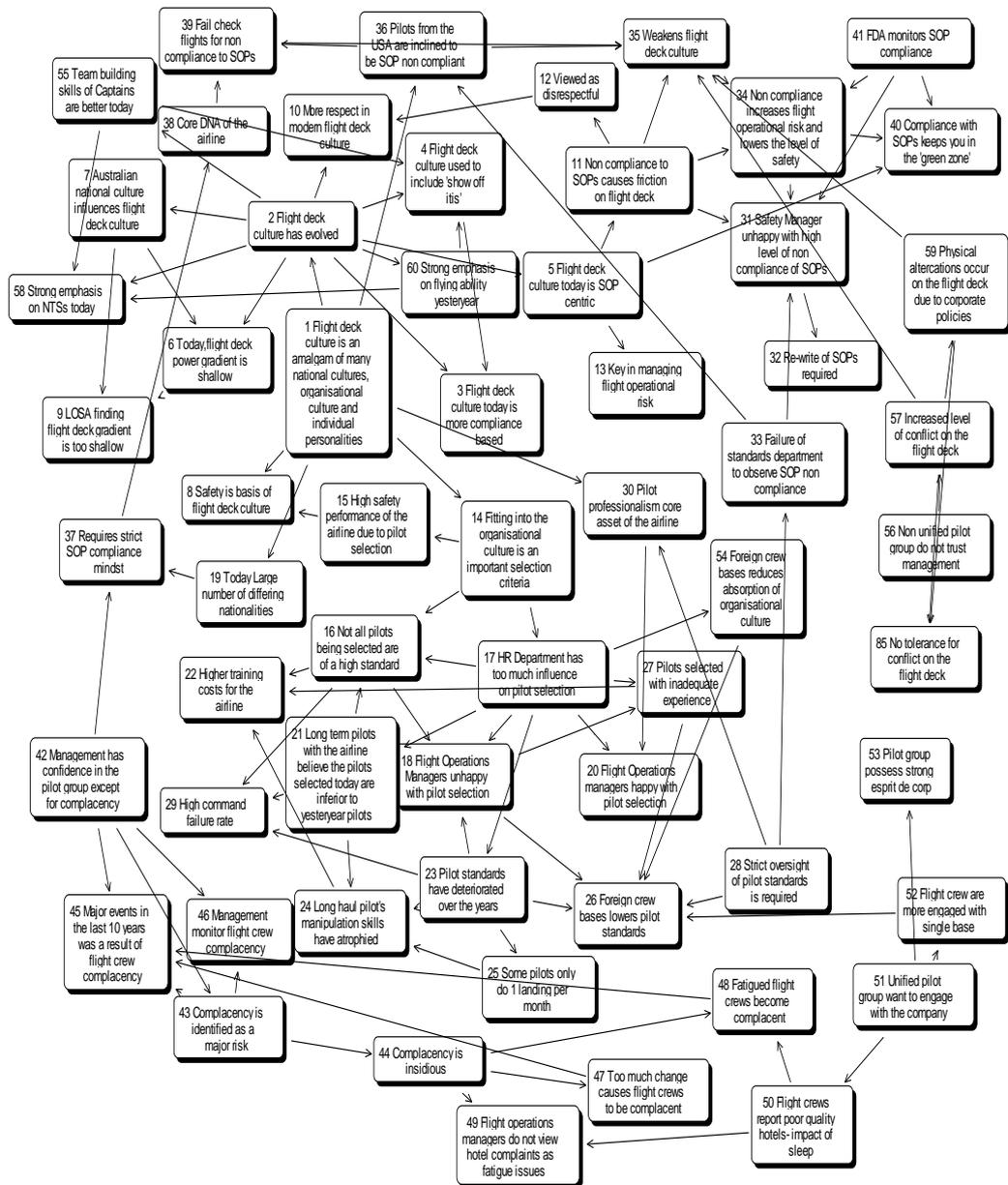
Table 9-15 Emergent Themes per Category

Categories	Emergent themes
Culture	162
People	260
Organisation	204
Safety	78
Regulator	32
Quality	80
Risk	428
Total emergent themes	1,244

## 9.20 Appendix 3-8 Cognitive Map of Concept C-1

Figure 9-4 Cognitive Mapping of Concept C-1

The beliefs and behaviour on the flight deck.



## 9.21 Appendix 3-9 Samples of the Concepts from Cognitive Mapping

Table 9-16 Sample of the 550 Concepts from Cognitive Mapping

<p>Employees do not take advantage in the change from a punishment to a just culture</p> <p>Generational is used to describe the difference within the pilot group</p> <p>Pilot group is an organisational core asset</p> <p>Pilot selection is a key contributor to the success of the airline</p> <p>Lack of company direction guidance has a negative impact on the pilot group</p> <p>Relying on employees to do the right thing is a weak defence</p> <p>Familiarity of the network causes complacency</p> <p>Pilot group has the confidence of management except with regards to complacency</p> <p>Airline is safe as can be-complacency is the danger-destroy years of hard work</p> <p>All departments can be complacent-being a corporate problem not operational</p> <p>Complacency is an “un-rocked boat” – can lead to black swan events</p> <p>Two big negative events in the last ten years was caused by complacency</p> <p>Complacency increases the level of risky behaviour</p> <p>Organisations have metrics to measure the level of complacency</p> <p>Industrial issues cause complacency</p> <p>Fatigue is a serious issue-causes complacency</p> <p>Management do not see fatigue as an issue-crews become complacent</p> <p>Constantly changing procedures increases complacency</p> <p>Pilots want to engage with the airline</p> <p>Dissent within the pilot group</p> <p>Pilots become less engaged when the airline grows into a corporation</p> <p>Pilots are more engaged with a single base instead of global bases</p> <p>Pilots are more engaged with the union than the airline</p> <p>Management believe the pilot group wants to engage</p> <p>Pilot group will share the pain-instead of junior pilots becoming redundant</p> <p>Pilot group morale is improving with new management</p> <p>Lack of recognition of the profession leads to low morale</p> <p>Flight deck gradient can be inverse due to Gen Y influence</p> <p>Baby boomers have a healthy disrespect for automation</p> <p>Gen Y have complete faith in automation and expectation of 100% reliability</p>
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## 9.22 Appendix 3-10 Attributes of Little t Theory Concept

Table 9-17 Attributes of Little t Theory Concept

Group	Characteristic	Type
Intrinsic	Focus	Narrow
	Assumptive constraints	Many
	Generality	Low
	Basis	Qualitative
	Complexity	Low
	Cycle time	Short
	Ease of development	High
	Completeness	Low
	Primary area of interest	Processes
	Primary perspective	Forward
	Variable basis	Usage
	Foundation	Activity
	Time sensitivity	High
	Application	Theory application
Usage		Low
Domain		Single discipline
Applicability		Limited
Use by other theories		Low
Teaching ease		Usually high
Research use		Theory building
Prediction accuracy		Low
Theory application		Connective
Perception		Direct relevance to practice
	Recognition	Low
	Ease of understanding	Easy
	Acceptance	Limited
	Credibility	Low
	Validity	Tenuous

(Schneberger, Pollard and Watson 2009).

## 9.23 Appendix 3-11 Coding Reliability

### Re David Prior dissertation: coding reliability

Coding reliability is a vexed question in qualitative research. The expectation to provide measures of coding reliability typically arises in disciplines with a strong positivist or post-positivist orientation, where data are often quantified and dealt with statistically, and objectivity can be confused with validity. Qualitative researchers recognise that coding itself involves a double hermeneutic, in so far as the coder is interpreting the participant's interpretation of their experience. Coding unstructured or semi-structured material, therefore, can be influenced by and reflects one's worldview and one's particular perspective on the topic. If a second person is to code the same material, they are likely to have a different perspective and understanding of the topic and the issues involved. Alternatively, they need to have a good understanding of the topic, and to be trained by the original coder to work more or less like a machine in a way that is antithetical to the general spirit and purpose of qualitative interpretive analysis, and which proves nothing about the quality of the original coder's work.

Coding serves as a management tool, to organise the data and it serves as a thinking tool to help the analyst see and interpret what the participant is saying. Coding systems often develop during a project as understanding of the issues involved becomes deeper and more refined – indeed, if it does not do so, one would be concerned about whether anything was being learned from the data. Whether the coding that was used has achieved its purpose eventually becomes evident in the organisation and the depth and quality of the analysis and writing up. Similarly, if bias was present in the coding (whatever bias might mean in the situation), that will also be evident in the written results.

In an attempt to test the reliability of David's coding, I was provided with a list of codes and asked to code three interviews, based on paragraph structure. I had a superficial knowledge of David's work, with no experience at all of involvement with airlines or with pilots other than as a traveller, thus some terms were unfamiliar. The result was less than would be normally considered desirable, averaging just over 55% agreement in the codes assigned to the paragraphs (where 70% would be considered more acceptable). In the majority of cases, the differences were more issues of labelling and level of abstraction than of the kind of interpretation that would make a difference to the eventual writing. For example, some passages that David coded as non-technical skills, I coded as professionalism, or some passages that David coded as safety culture, I coded as risk appetite. These (and other) differences were unlikely to be material in influencing the eventual results. In my opinion, if there were any issues in David's work and in the analysis and presentation of his results, these were not a consequence of bias in coding or lack of coding reliability.



Associate Professor Pat Bazeley PhD  
Centre for Primary Health Care and Equity  
University of New South Wales  
Research Support P/L, Bowral, NSW.

Author: Qualitative Data Analysis: Practical Strategies (Sage, 2013)  
Qualitative Data Analysis with NVivo (2e) (Sage, 2013).

## 9.24 Appendix 3-12 Survey Instrument

Thank you for participating in this survey, your responses will be de-identified and treated in accordance with the ethics requirements of Curtin University. The initial ethics approval for this study was granted in 2009 with the approval identifier GSB-02-09. This approval was renewed annually over a four-year period. In 2013, a fresh application was lodged and approved with the approval identifier GSB 17-14; with this approval being renewed on an annual basis. All aspects of the research were conducted in compliance with the requirements stipulated on the ethics approval documentation and no adverse events occurred.

To complete the survey:

If you *strongly agree* with the statement place an X in column **1**

If you *somewhat agree* with the statement place an X in column **2**

If you *somewhat disagree* with the statement place an X in column **3**

If you *strongly disagree* with the statement place an X in column **4**

Code	Statement	1	2	3	4
S-1	Flight-crew's compliance to an airline's SOPs is a key issue for this airline.	1	11		
S-2	Achieving and maintaining a 'just culture' is an objective of this airline.	1	1	1	
S-3	This airline wants to maintain a quality function associated with flight operations.	11	1		
S-4	This airline believes the balance between production and protection is acceptable.	1	11		
S-5	The relationship between this airline and the regulator is aligned with ICAO philosophy.	1		1 1	
S-6	The change management processes within this airline are improving.		11 1		
S-7	Excluding the risk management elements from ICAO Annex 19, the formal management of flight operational risk within this airline is in its infancy.		1	1	1
S-8	Excluding the risk management elements from ICAO Annex 19, the resources to establish a flight operational RMS within this airline are deficient.		1	1	1
S-9	The majority of managers from flight operations want this airline to establish a flight operational RMS.		11	1	
Total (27)		6	13	6	2

Thank you very much for completing this survey, could you please attach and return email it to me.

Best regards,  
David Prior.

The thesis from this study provides substantial contextual information with regard to the findings from the study with this information contained in the Literature Review, Results and Discussion chapters. Some of that contextual information is presented here.

### **S-1**

Refers to whether or not your airline considers compliance to SOPs by your flight-crews is important (operational performance caused by practical drift vs baseline performance); and not to the concept of having a large set of SOPs in lieu of flight crew's lack of non-technical skills such as situation awareness and decision making.

### **S-2**

There is no universal definition of a 'just culture'; broadly speaking it refers to a way of safety thinking that promotes a questioning attitude, is resistant to complacency, is committed to excellence, and fosters both personal accountability and corporate self-regulation in safety matters.

This study has adopted the following definition of a 'just culture'.

*A culture in which front line operators or others are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but where gross negligence, wilful violations and destructive acts are not tolerated.*

### **S-3**

Quality function refers to a Quality Assurance (QA) section or a separate Quality Management System (QMS) which provides oversight through the audit process ensuring flight operations procedures, processes and policies are complied with, and if required contribute to their improvement.

### **S-4**

Safety management processes provide effective and objective mechanisms to identify and manage the risk(s) presented by hazards. The result of these processes is to facilitate achievement of an acceptable level of safety while balancing the allocation of resources between production and protection.

### **S-5**

The relationship this statement is referring to is taken from ICAO SMM Second Edition 2009 which is:

*The relationship that line management has with the representatives of the regulatory authority is also indicative of a generative organizational culture. This relationship should be marked by professional courtesy but with enough distance so as not to compromise accountability. Openness will lead to better safety communications than will strict enforcement of regulations. The former approach encourages constructive dialogue, while the latter encourages concealing or ignoring the real safety problems.*

**S-6**

Are the change management processes involving changes to flight operations procedures, processes and policies in your airline improving?

The interviewees from the airlines involved in this study claimed these processes are better today. Documentation of these processes has improved which is a major reason for this improvement. At the time of data collection, these respondents (71 interviews were conducted) believed their airline's change management processes were improving.

**S-7**

There are two risks that must be managed via the SMS in accordance with ICAO Annex 19, (1) Safety risk management (2) The management of change.

There are however, a large number of risks and risk factors involving flight operations that are external to these two.

This statement refers to whether or not your airline has established a Risk Management System (RMS) or some other formal risk management system such as a Risk Assessment Program (RAP) whose objective is, to manage flight operational risk on a formal/systemic basis, the same as safety is managed via a SMS.

**S-8**

This statement refers to the above RMS or RAP that manages flight operational risk on a formal/systemic basis.

The level of resources allocated by the airlines involved in the study to a RMS or a RAP was considered by the interviewees (managers from flight operations) to be deficient.

**S-9** Self-explanatory.

## 9.25 Appendix 3-13 Commentary from a Legacy Carrier on the Findings

S1. Flight-crew's compliance to an airline's SOPs is a key issue for this airline.

*In general, our compliance rate to SOP is very high. Our pilots are well trained and disciplined. However, when we review many of the Incident Investigations it does appear that compliance with SOP is often an issue. Despite the small number of incidents, we do consider it an issue that needs constant attention. This attention includes management review to determine whether our SOPs are adequate.*

S2. Achieving and maintaining a 'just culture' is an objective of this airline.

*As a Safety Manager, I would argue that this is our biggest challenge. This is especially true with our cabin crew whereby the challenge of balancing good service with good safety is always present. Our culture is improving, but it requires constant support and work.*

S3. This airline wants to maintain a quality function associated with flight operations.

*Our operational business units (Flight Operations, Cabin Crew, Engineering and Ground Services) all contain their own internal quality sections. These sections work with both QMS and SMS issues. At the corporate level we monitor the BU's to ensure compliance.*

S4. This airline believes the balance between production and protection is acceptable.

*A constant challenge. On occasions I wish the regulator would be a little more prescriptive with how they want some regs [regulations] enforced. This would give us a clearer picture. However, the current culture of regulators is to let the airline determine how they want to do things and they sit on the fence. This has both good and bad points from our perspective.*

S5. The relationship between this airline and the regulator is aligned with ICAO philosophy.

*Our regulator follows ICAO closely and our relationship is good, despite my comments in the previous question. They understand that we have business objectives and try to work with these whilst still maintaining safety oversight.*

S6. The change management processes within this airline are improving.

*Our biggest weakness in the change management process is review. After we have implemented a change many of the stakeholders do not revisit assumptions and initial risk assessment to determine if the real world operation is in line with the anticipated. It often takes an Incident report to force the review.*

S7. Excluding the risk management elements from ICAO Annex 19, the formal management of flight operational risk within this airline is in its infancy.

*Our organisation has established procedures and formal process for Risk assessment at many levels. These practices have been established for many years, since at least 2009 when we formally adopted an SMS. However, my concern is that many stakeholders see risk assessments as a beaurcratic process and just want to tick the box.*

S8. Excluding the risk management elements from ICAO Annex 19, the resources to establish a flight operational RMS within this airline are deficient.

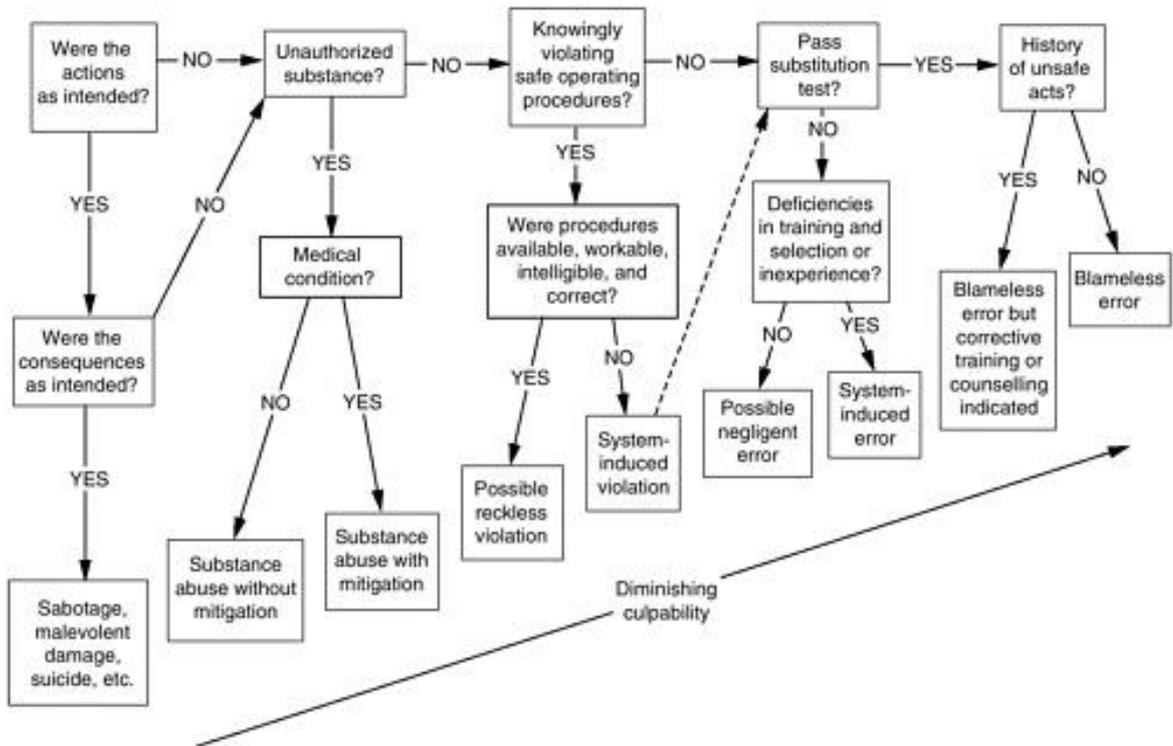
*Our resources for risk management are adequate, please see above re stakeholder engagement.*

S9. The majority of managers from flight operations want this airline to establish a flight operational RMS.

*Already established. However, I am not sure all managers are fully engaged. Our challenge at the corporate level is to address this. We employ prescriptive processes to ensure compliance and educate to change attitudes. A work in progress.*

## 9.26 Appendix 5-1 Culpability Model

Figure 9-5 Decision Tree for Determining the Culpability of Unsafe Acts



(Reason 1997, 209).

## 9.27 Appendix 5-2 Relational Theory of Risk

Table 9-18 Relational Theory of Risk

<b>Relational theory of risk</b>
<p><u><i>Risk Objects</i></u></p> <p>Risk objects resembles hazards in the sense that they refer to something that is identified as dangerous. Designating an object as risky is a creative act, in the sense that it introduces risk into the social space. However, it is not an act that exists in a social vacuum. The designation of a risk object depends on conditions of possibility in the natural and social world. It cannot run counter to acknowledged natural laws or ignore established principles of scientific discovery, rules of media representation, or the game of social forces.</p>
<p><u><i>Objects at Risk</i></u></p> <p>The key characteristic of objects at risk is to be endowed with a value that is considered at stake. Objects at risk are constituted around traits such as value, loss, vulnerability, and need for protection.</p>
<p><u><i>Relationship of risk</i></u></p> <p>A relationship of risk refers to the relationship an observer establishes between a risk object and an object at risk, the former being held to threaten the value of the latter. There are three characteristics within the relationship of risk which are:</p> <p>Risk is a proposition about a change that <i>could</i> take place, but does not necessarily do so.</p> <p>A relationship of risk must establish that it is the risk object that threatens the object at risk, how, and possibly why. It must indicate a causal link between precisely these two objects.</p> <p>Risk is conditioned by a modern will to know that remains welded to a will to decide and act under conditions of uncertainty. Such knowledge contributes to the capacity to assess, decide on, and govern life, even under conditions of uncertainty.</p>

(Boholm and Corvellec 2011, 179-181).

## 9.28 Appendix 5-3 Decision Making

This is an example of the very different outcomes in the decision making processes between two airlines faced with the same problem resulting in the possible creation of a large number of latent conditions for one of the airlines using real data.

Different outcomes in the decision-making processes between Airline A and Competitor Airline involving the fleet modernisation program.

Both airlines are similar in size and operation and both have long haul international routes using B747-400 type aircraft. Both airlines have a fleet of 20 aging B747-400 aircraft and are deciding whether to phase out the B747-400 and purchase the B777-300ER. Airline A concluded at the end of its decision-making process regarding its fleet modernisation program not to purchase the B777-300ER, but to retain the B747-400 aircraft. By contrast, the Competitor Airline, at the conclusion of its decision-making process of the same program, decides to purchase the B777-300ER and phase out the B747-400.

For the operation of these twenty aircraft, Airline A's annual fuel cost is USD\$214,456,340 more than its Competitor Airline<sup>23</sup>. All other things being equal, the Competitor Airline's operating profit is this amount more than Airline A's. With the low operating margin of the airline industry, and because of the outcome of the decision-making process regarding the fleet modernisation program, Airline A will require management at all levels to focus on survivability, rather than enhancing and growing its position in the market. With this relative loss of EBIT, the level of Airline A's operational risk will increase, as Airline A could be forced to implement a cost-cutting program introducing latent conditions and incorrectly assessing the likelihood of the occurrence of risk factors.

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<sup>23</sup> Refer to Appendix 5-4 for the calculations

An additional issue is the negative impact this flawed decision has on the airline's balance sheet. In May 2004 the B777-300ER entered service (Boeing 2013a), and a large number of airlines purchased this aircraft and began to phase out the B747-400.

The supply of B747-400 increased as these aircraft were exchanged for the B777-300ER, reducing their market valuation. As an example of this slump in the value of B747-400 aircraft, Kelly (2013) claims that "A B747-400 manufactured in 1992 had an appraised value in 2008 of USD\$41.6 million, five years later in 2013, this aircraft was valued at USD\$16.7 million" (Kelly as quoted in Johnsson 2013, par 7), which represents a 60% reduction in market value. Assuming Airline A still retained ownership of the B747-400 aircraft, a write down in the valuations of these assets would be required, with a corresponding reduction in equity on Airline A's balance sheet. Decision making is a key principle in risk management and the implementation of an organisational wide RMS should improve the decision-making skills of all risk owners, as decisions will be made after assessing all associated risks. As a confirmation of this example, "Singapore Airlines was one of only fourteen airlines during the 2000s to achieve an EBIT margin in excess of 15%; and was the only airline from the Asia Pacific Region. A major factor in this result was the large number of B777 aircraft Singapore Airlines operates" (IATA 2011, 14-16).

### 9.29 Appendix 5-4 Fuel Cost B747-400 vs. B777-300ER

An assumption in this model is Airline A has a fleet of twenty B747-400s and Airline B has a fleet of twenty B777-300ERs.

**Table 9-19 B747-400 Cruise Data**

<b>Element</b>	<b>Data</b>
Mid cruise weight 80% of Maximum Take Off Weight (MTOW)	700,000lbs or 312,500 Kgs.
Altitude	FL350 (35,000 feet at standard pressure)
Mach No. (percent speed of sound)	M0.861
Speed	LRC (Long Range Cruise)
True Airspeed (TAS)	496 Knots
Fuel consumption	5,989 lbs/Hour/Engine

(Boeing 2008, 4-8).

$5,989 \text{ (lbs/per hour per engine)} \times 4 = 23,956 \text{ (lbs/per hour per aircraft)} = 10,694 \text{ Kgs. per hour.}$

**Table 9-20 B777-300ER Cruise Data**

<b>Element</b>	<b>Data</b>
Mid cruise weight 80% of Maximum Take Off Weight (MTOW)	610,000lbs or 272,321 Kgs.
Altitude	FL350 (35,000 feet at standard pressure)
Mach No. (percent speed of sound)	M0.840
Speed	LRC (Long Range Cruise)
True Airspeed (TAS)	484 Knots
Fuel consumption	8,795 lbs/Hour/Engine

(Boeing 2010, 3.2.16).

$8,795 \text{ (lbs/per hour per engine)} \times 2 = 17,590 \text{ (lbs/per hour per aircraft)} = 7,852 \text{ Kgs. per hour.}$

$10,694 - 7,852 = 2,842 \text{ Kgs. per hour}$  is the difference in fuel consumption between the B747-400 and the B777-300ER. In essence, the B777-300ER consumes 26% less fuel per hour than the B747-400.

- Passenger adjustment

On a standard Boeing seating layout the B747-400 carries 51 more passengers than the B777-300ER<sup>24</sup> (Boeing 2013).

Reducing the in-flight weight of the B747-400 by the combined weight of 51 passengers and their baggage will result in a lowered fuel consumption with these calculations set out below.

51 passengers' x 120 Kgs. per passenger = 6,480 Kgs. This reduction in payload will lower the hourly fuel consumption by 263 Kgs.

Hourly fuel consumption for the B747-400 with 365 passengers is 10,694 – 263 = 10,431 Kgs.

- Speed adjustment

B747-400 is 12 knots faster than the B777-300ER, which requires a reduction in the fuel consumption for the B747-400. An aircraft increasing or decreasing speed does not produce a linear adjustment in fuel consumption. Form drag changes by the square of the change in speed, if the speed of the aircraft were to double the form drag increases fourfold with a corresponding increase in fuel consumption. There is a 2% difference in speed between the two aircraft and with the parabolic increase in form drag<sup>25</sup> the fuel consumption of the B747-400 reduces by another 2% with a combined adjustment for the speed differential of 4%

Hourly fuel consumption for the B747-400 speed adjusted is 10,431 – (10,431 x 0.04) = 10,014 Kgs.

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<sup>24</sup> 416 vs. 365

<sup>25</sup>  $y=x^2$

To put these figures into perspective, on a return flight of ten hours for each sector such as Sydney - Tokyo – Sydney, the fuel consumption for each aircraft is:

B747-400: 10,014 Kgs. per hour x 20 hours = 200,280 Kgs.

B777-300ER: 7,852 Kgs. per hour x 20 hours = 157,040 Kgs.

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Assuming an aircraft utilisation daily rate of 15 hours x 335 days per year = 5,025 hours per year.<sup>26</sup>

In a single year based on this utilisation, each aircraft will consume:

B747-400: 50,320,350 Kgs. of fuel

B777-300ER: 39,456,300 Kgs. of fuel

Based on the October 2013 jet fuel price published by Platts (2013) of \$987 per metric ton and the assumptions of this model are, a single,

B747-400 will consume USD\$49,666,185 of jet fuel per year

B777-300ER will consume USD\$38,943,368 of jet fuel per year

The difference for one aircraft is USD\$10,722,817 is per year

The difference for twenty aircraft is USD\$214,456,340 per year.

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<sup>26</sup> Maintenance requirements for the remaining 30 days

**Table 9-21 Jet Fuel Price (USD)**

<b>11 Oct 2013</b>	<b>Share in World Index</b>	<b>cents/ gallon</b>	<b>\$/ barrel</b>	<b>\$/metric ton</b>
Jet Fuel Price	100%	297.8	125.1	985.8
Asia & Oceania	22%	297.5	124.9	987.0

(Platts 2013).

These calculations are based on October 2013 prices, whereas in December 2015, the price of jet fuel was trading at USD\$395.35 (Platts 2015). This steep decline in jet fuel price is indicative of the complexity airlines have to deal with and require their decision-making processes to be exemplary. With this substantial reduction in the price of jet fuel, airlines may be inclined to delay the purchase of more fuel-efficient aircraft. This is not the case industry wide as airlines such as Emirates are accelerating the retirement of 50 of their less fuel-efficient aircraft, as they believe these aircraft will have limited value in the future (Elder 2015).

### 9.30 Appendix 5-5 Risk Assessment Matrix

Table 9-22 Risk Assessment Matrix Part A

CSFs	» » Consequence » »				
Human Resources	Minor skills impact.	Minor impact to capability.	Unavailability of skills affecting services.	Unavailability of core and critical skills affecting services.	Protracted unavailability of critical skills.
Safety	Minor injuries.	Hospitalisation is required. Less than one month.	Hospitalisation is required. More than one month.	Single fatality or multiple critical injuries.	Multiple fatalities.
Reputation	Localised media only. Quickly forgotten.	Executive management review is required. Internal investigation conducted. Local media concern.	National media attention. Regulator involvement. Medium term brand impact.	Persistent intense national media attention. Long-term negative impact on the brand.	International media with sustained adverse attention. Brand is significantly negatively affected.
Environment	Insignificant impact on flora and fauna.	Minor impact on flora and fauna.	Short-term impact on flora and fauna with some destruction.	Substantial impact on flora and fauna.	Long-term damage to the flora and fauna.
Financial	Losses of up to \$50,000 USD.	Losses of up to \$250,000 USD.	Losses of up to \$1,000,000 USD.	Losses of up to \$10,000,000 USD.	Losses in excess of \$10,000,000 USD.

**Table 9-23 Risk Assessment Matrix Part B**

CSFs	» » Consequence » »				
Legal <sup>27</sup>	Fines and settlements up to \$50,000.	Fines and settlements up to \$250,000.	Fines and settlements up to \$1,000,000.	Fines and settlements up to \$10,000,000.	Fines and settlements in excess of \$10,000,000.
Property & Equipment <sup>28</sup>	Negligible damage to assets up to \$50,000.	Minor damage to assets up to \$250,000.	Moderate damage to assets up to \$1,000,000.	Substantial damage to assets up to \$10,000,000.	Extensive damage to assets in excess of \$10,000,000.
Capability	Minimal impact on services.	Some impact on services, delays.	Moderate impact on the airline, extensive delays.	Substantial cancellation of flights, over extended period.	Long-term reduction in flights, survivability of airline is questioned.
Severity »»	Negligible E	Minor D	Moderate C	Extensive B	Catastrophic A
Likelihood ↓↓↓					
Almost Certain 5	5E	5D	5C	5B	5A
Likely 4	4E	4D	4C	4B	4A
Possible 3	3E	3D	3C	3B	3A
Unlikely 2	2E	2D	2C	2B	2A
Rare 1	1E	1D	1C	1B	1A

Adapted from (ICAO 2013c; Talbot and Jakeman 2008).

**Table 9-24 Risk Tolerability Level**

Unacceptable, exceeds airline’s risk tolerance
Acceptable, based on risk mitigation and CBA
Acceptable, within airline’s risk tolerance, mitigation not required

<sup>27</sup> All amounts in USD

<sup>28</sup> All amounts in USD