

CRANFIELD UNIVERSITY

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MEASURING THE INDEPENDENCE OF AIRCRAFT ACCIDENT  
INVESTIGATION AUTHORITIES IN ICAO MEMBER STATES

SCHOOL OF ENGINEERING  
Department of Air Transport

PhD  
Academic Year: 2008 - 2013

Supervisor: Professor. Graham Braithwaite  
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This thesis is submitted in partial fulfilment of the requirements for  
the degree of PhD

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## **ABSTRACT**

This project examines the safety management of civil aircraft accident investigation authorities in International Civil Aviation Organization (ICAO) Member States, with particular emphasis on the independence of the investigations. The research aims to establish the current level of resources and methodology adopted by Member States' accident investigation authorities. The output of this work not only identifies the current situation but informs initiatives for some of the States in the process of establishing their investigation capability.

ICAO Annex 13 was analysed and found to be based on the principle of independent accident investigations. Also, a four dimensional measuring index (4DMI) has been developed to measure the independence of accident investigations in ICAO Member States. Data were collected from 45 States and are presented in the thesis. As a result of applying the 4DMI to the collected data, the States were ranked according to their scores, and divided into four categories of independence. Analysis of the four categories and the scores from the four dimensions revealed that States approach the concept of investigation independence in different ways; however, there are several practices that are common within the highest independence category and several other practices that are common within the lowest independence category.

The research recommends that States should work towards improving their overall investigation independence by implementing the seven identified practices in the High-Independence category and distance themselves from the five practices identified as common in the Low-Independence category.

Keywords: Aviation Safety, 4DMI, Measuring Index, Criminalisation, Investigation Authority, Just Culture, ICAO Annex 13, ICAO USOAP, Accident Investigation



## **ACKNOWLEDGEMENTS**

All praises and thanks be to Allah, the Most Gracious, Most Merciful. I thank Him for giving me the patience and strength to finish this research.

I take this opportunity to thank the Saudi General Authority of Civil Aviation (GACA) who awarded me this scholarship to further my education and knowledge. My thanks especially go to His Highness Prince Fahad Al-Abdullah, the President of Saudi Arabian GACA. I also want to thank his Excellency Dr. Faisal Al-Sugair, GACA's Vice President, and his Excellency Mr. Abdul-Aziz Al-Angari, GACA's Executive Vice President. Thank you for your generous support and for your confidence in me.

Also, many thanks go to the people and staff of the Safety and Economic Regulation (S&ER) Sector in GACA, especially Captain Mohammed Ali Jamjoom, VP S&ER and Captain Abdul-Aziz Nagadi, GM Standards. Thank you for your continued support and encouragement.

Special thanks to my supervisor and friend Professor Graham Braithwaite who did not spare any effort or thoughts to help me make this project come to life. I can sincerely say you have reshaped my thoughts and rebuilt my confidence, thank you. I also want to thank everyone in the Air Transport Department for their help and support during my research at Cranfield University.

In addition, I want to thank the contributing individuals and organisations who made this work possible. These include Captain Omar Barayan, former VP PCA-ASSD, Dr. David King and Mr. Ken Smart, former UK AAIB Chief Inspectors, Mr. David Miller, Deputy Chief Inspector of the UK AAIB, the UK AAIB staff, IFALPA, and the accident investigation authorities who contributed to this research.

My thanks and gratitude to my parents who supported me with their prayers and positive thoughts throughout this project. My thanks also to my wife and children who have been very patient and supportive, and who continued to encourage me until I concluded this work.

Last, but not least, I would like to thank all my friends in Saudi Arabia and here in the UK for their encouraging words and confidence in me.



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## LIST OF ABBREVIATIONS

4DMI	Four Dimensional Measuring Index
AAIB	Air Accidents Investigation Branch
ADREP	Accident/Incident Data Reporting system
ANAC	National Agency of Civil Aviation - Brazil
Annex 13 SARPs	Annex 13 Standards and Recommended Practices
AOC	Air Operator Certificate
ASC	Aviation Safety Counsel – China
ATSB	Australian Transport Safety Bureau
BASI	Bureau of Air Safety Investigation
BEA	Le Bureau d’Enquêtes et d’Analyses - The French civil aviation accident and incidents investigation authority
BFU	German Investigation Authority
BOS	Bristol Online Survey system
CAA	Civil Aviation Authority
CAAC	Civil Aviation Administration of China
CAIB	Columbia Accident Investigation Board
CASA	Civil Aviation Safety Authority
CBI	Central Bank Independence
CENIPA	The Brazilian Air Force
CU	Cranfield University
CVR	Cockpit Voice Recorder
DGCA	Directors General of Civil Aviation
DOT	Department of Transportation
EC	European Commission
ECAC	European Civil Aviation Conference
ECOSOC	Economic and Social Council
ENCASIA	European Network of Civil Aviation Safety Investigation Authorities
EU	European Union
FAA	Federal Aviation Administration
FDR	Flight Data Recorder
FSF	Flight Safety Foundation

GACA	General Authority of Civil Aviation – Saudi Arabia
HMRI	Her Majesty’s Railway Inspectorate
HSE	Health and Safety Executive
IAC	Interstate Aviation Committee – a RAIO in Russia
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
ICAO AIG	ICAO Accident Investigation and Prevention Group
IFALPA	International Federation of Airline Pilots’ Associations
IFATCA	International Federation of Air Traffic Controllers’ Association
IOSH	Occupational Safety and Health
IRA	Independent Regulatory Agencies
MAAIB	Military Air Accident Investigation Branch
MAIB	Marine Accident Investigation Branch
NTSB	National Transportation Safety Board
PCA-ASSD	Presidency of Civil Aviation – Aviation Standards & Safety Department
PICAO	Provisional International Civil Aviation Organisation
RAeS	Royal Aeronautical Society
RAIB	Rail Accident Investigation Branch
RAIO	Regional Accident and Incident Investigation Organisation
ROSAT	Road Strategy for Accident in Transport
RSSB	Rail Safety and Standards Board
SARPs	Standards and Recommended Practices
Saudi AAIB	Saudi Aircraft Accident Investigation Bureau
SEREC	Cranfield University Science and Engineering Research Ethics Committee
SMS	Safety Management System
SPSS	Statistical Package for Social Sciences
TSB	Transport Safety Board of Canada
UKFI	United Kingdom Financial Investment Ltd.
USOAP	Universal Safety Oversight Audit Program



# **1 INTRODUCTION**

## **1.1 Thesis Statement**

A methodology can be developed to measure the independence of accident investigation authorities in ICAO Member States. The effect of different dimensions (functional, financial, structural, and operational) on the overall measured score of each participating State can also be examined to learn how to improve the independence of that State in accident investigation. Moreover, guidance can be given to other States which are interested in building their own independent accident investigation authority.

## **1.2 Motivation**

The Kingdom of Saudi Arabia had a particularly bad experience with accident investigations in 1996 when a Saudi Arabian airliner was involved in the worst mid-air collision in the history of aviation. The Indian authority, which is the State of Occurrence here, led the investigation into the accident. The details of this accident are discussed in section 1.2.1 of this thesis.

Recently, the Kingdom of Saudi Arabia has decided to establish an independent accident and incident investigations office. There are several reasons behind this decision. First, the number of air operators has increased after certifying new operators in Saudi Arabia, such as SAMA and NAS AIR. Moreover, Saudi Arabian Airlines has been adding more aircraft to its fleet to meet the increasing seats demand. Second, the Saudi Government is opening its airspace to other carriers to operate within Saudi airspace. Third, ICAO has strengthened its requirements for independent accident investigation authorities in ICAO Member States and the Saudi Government intends to comply with the new requirements. This is discussed in detail later in this thesis.

Additionally, the aviation industry has seen an increase in the criminalisation of human error. This threat to the advancement of aviation safety needs to be countered by increasing the credibility of air accident investigation authorities by ensuring their independence from judicial authorities and any other pressure, which will ensure the continued sharing of information from the industry without the fear of being criminalised.

In addition to the above, the importance of looking at the issue of investigation independence at this particular time has been highlighted by the recent changes in ICAO Annex 13 (10<sup>th</sup> edition) and the latest EU Regulation 996/2010, which strengthen the requirements for independent investigations. These changes will be discussed in more detail later in the thesis.

The work to establish an independent accident investigation office in Saudi Arabia has started but it is not progressing as fast as initially expected, due to lack of both experience and guidance. The guidance available in this regard is ICAO documents, which have the minimum requirements needed to bring an ICAO Member State to compliance with the requirements. ICAO requires the investigation authority to be “functionally” independent from the regulator according to the 9<sup>th</sup> edition of Annex 13 and its supporting documents. Recently, however, the 10<sup>th</sup> edition of Annex 13 has strengthened these requirements to include structural independence.

There are many countries around the world that have had independent accident investigation authorities for many years now. However, their experiences are inadequately documented and the details of the concept of investigation independence remain vague. For the above reasons, this study has been designed from the beginning to explore and understand what really works and what does not. The data were collected by using a questionnaire to ask professionals who have done this before, and by interviewing some of the experts to learn from their experiences. The data were also collected from different countries around the world in order to understand the similarities and differences in how it is done in real life, not just in theory.

Today, there is a real need to establish independent accident investigation capabilities in countries where this either did not exist before, or did not exist in the new required form. Understanding how this crucial part of investigation independence works is very important and will help these countries to accomplish this task.

### **1.2.1 Saudi Arabian Airline Mid-Air Collision 1996**

On November 12, 1996 a mid-air collision involving Saudi Arabian Airlines flight 763 and Kazakhstan Airlines flight 1907 occurred over the village of Charkhi Dadri,

Haryana, India. Everyone on-board both flights (349 people) was killed. The crash was described as the worst mid-air collision in aviation history (Holman, 1996; Daffa, 2002; Havelly, 2002; Burns, 1996; Lahoti, 1997).

During the investigation of this accident, the Saudi Arabian government pointed out to the Lahoti court of inquiry that neither the Saudi nor the Kazakhstan governments were represented in the investigations of this collision. Captain Omar Barayan, on behalf of the Saudi government, argued before Justice Lahotia that according to ICAO Annex 13, the Saudi and Kazakhstan governments must be involved in the investigation process. Captain Barayan said that “there could have been better participation by the three governments concerned.” (Rediff On The Net, 1997).

There were several theories at the time trying to explain what happened and who was responsible. Saudi Airlines’ counsel Lalit Bhasin blamed the ATC for failing to inform both aircraft about the “instructions passed to any of the flights”, because the controller did not give any traffic advisory information to the Saudi aircraft. Bhasin also indicated that the absence of modern technology at the airport was a contributory factor, which was disputed by the Indian Airport Authority counsel Air Commodore N. Sarma (retired). Sarma stated that the lack of modern technology at the airport is known to all operators coming into this airport and they should take this into consideration when operating to India. Bhasin, however, indicated that the Airport Authority of India had bought a highly sophisticated radar for Delhi airport, but did not install it before the accident, which meant there was a clear indication of the need for it.

Kazakh Airlines said that its pilot descended because of bad weather. It also blamed the Delhi airport’s ATC for not providing information about the Saudi flight.

#### **1.2.1.1 Interviewing the Head of the Saudi Investigation Team**

The researcher interviewed the head of the Saudi investigation team that was sent to India to participate in the Indian investigation. The Saudi team was composed of representatives of the Saudi civil aviation authority, the Presidency of Civil Aviation – Aviation Standards and Safety Department (PCA-ASSD), and the Saudi Arabian Airlines’ Safety Department. Captain Omar Barayan, Vice President PCA-ASSD at the time, was the head of the investigation team.

The researcher asked Captain Barayan the following questions with regard to the Saudi Arabian Airline mid-air collision over India in 1996:

- 1- Was there an official representation for the Saudi team from the civil aviation authority, for example as accredited representative according to ICAO Annex 13?
- 2- What could have changed if the KSA had had an independent accident investigation office at the time?

Captain Barayan explained that the right of participation in accident investigations is granted to ICAO contracting States regardless of their internal set up of accident investigation.

Barayan also believes that the dispute with the Judge over reading the FDR in India was a matter of national pride and that the Judge obviously under-estimated the complexity of the task with partially damaged recorders. He thought that India being an advanced country with space technology should be able to perform this comparatively simple task. However, the Judge was finally convinced that the two recorders would have to be sent to Russia and the UK for the readout under the supervision of the whole investigation team.

In answering the second question, Barayan thinks that nothing would have changed if Saudi Arabia had had an independent accident investigation office at the time. According to Barayan the Saudi investigation team would not have benefited any more by the existence of the independent office then, as the success of any participating team depends heavily on the knowledge and experience of those team members.

The researcher asked for more clarification from Captain Barayan with regard to the benefits of having an independent accident investigation authority.

Barayan explained that based on his experience the success of any aircraft accident investigation efforts depends heavily on the knowledge and experience of each participating member of the team, rather than how their organisation is internally structured. Since Saudi Arabia was the State of Registration and the State of Operator, full participation in the investigation of the Delhi mid-air collision would have been granted, even if we were non-Saudis, as long as the team members were officially delegated by the Saudi Government.

Therefore, according to Barayan, the matter lies upon the individual credentials and work ethics, rather than where the investigation teams come from or how they are organised. Barayan further explain that he still thinks that in order to better serve impartiality countries should try to designate an independent body for aircraft accident investigations whenever and wherever possible.

### **1.3 Research Outlines**

The idea and scope of this research can be illustrated through the following questions and research goal.

#### **1.3.1 Research Questions**

Reviewing the literature led to the following observations that in turn led to the formulation of the research problem:

- ICAO requires its Member States to have independent aircraft accident and incident investigation authority (10th Ed.)
- Accident investigation independence is not clearly defined by ICAO.
- The literature does not clearly define investigation independence.
- Even those who have tried to define investigation independence did not agree on one definition or description and their definitions are vague.
- Almost every piece of literature that discussed accident investigation independence stated that it is very important.
- If a State wants to have a truly independent investigation authority, it is not clear how can it achieve this. There is not enough clear guidance.
- There is conflict even in the way authors have looked at examples of investigation independence. Some authors, for example, discussed having a safety board to accentuate the independence of the authority; however, others say a safety board could allow political interference and therefore is a sign of lack of independence.
- The threat to investigation independence may lead to criminalisation, as one outcome of the investigation.

The research tries to establish an answer to the following question:

***Is it possible to measure the independence of air accident investigation in ICAO Member States?***

While trying to answer the above main question, these questions also need to be answered:

- What is independence? Is it relative or is it well defined in the context of accident investigation?
- Do all Contracting States to the Chicago Convention have the same understanding of accident investigation independence?
- What are the conditions that need to be satisfied in order to ensure the independence of the investigation?
- Why is the independence of aviation accident investigation important? What are the benefits and what are the challenges?

### 1.3.2 Research Objectives

This research work is intended to achieve the following objectives:

- ❖ Study current measures of independence that exist in aviation and other disciplines such as the Economy, Legal, and Political Science.
- ❖ Develop a methodology to measure the formal and informal (*de jure* and *de facto*) independence of air accident investigation in ICAO Member States.
- ❖ Use the developed methodology to expose the gaps that need to be filled to bring an ICAO Member State accident investigation to the desired level of independence.
- ❖ Analyse the results from applying the developed measuring index to a sample of ICAO Member States.

### 1.4 Benefits of Independent Accident Investigation

Guo Fu (2011) claims that there are elements that are considered to be the basic requirements for ensuring an objective investigation such as law, organisation, and investigator's behaviour. Relevant regulation or law can both dominate and protect the investigative process and investigators, and guarantee the independence of the investigation. In Guo Fu's opinion, the investigators who perform the investigation are the decisive factor in how authentic the investigation is. Their personal behaviours have a great influence over the investigation (Guo Fu, 2011). Mr. Guo Fu is the deputy director of the Aviation Safety Office of East China Regional Administration of Civil Aviation Administration of China (CAAC), which is part of the CAAC but functionally independent from it.

Independence is the basic guarantee to find the root causes without outside manipulation. Absolute independence is hard to attain because different countries have different traditions. Having laws or regulations in position to provide a legal framework is the most important element to protect independent investigations (Guo Fu, 2011).

Guo Fu highlighted four basic principles, in addition to Annex 13, that must be implemented, according to China's regulation, when an investigation is conducted:

- Independent: the investigation shall be conducted independently; no other organisation or individual is allowed to interfere.
- Objective: the investigation shall be fact driven, objective, fair, and scientific and cannot have any intent of subjectivity.
- Detailed: the investigation shall analyse and determine the causes of the accident or incident and contributing factors, including any defect concerning aircraft design, manufacture, operation, maintenance, personnel training, company's management policies, and regulator's rules and regulations and their implementation.
- Thorough: the investigation shall not only analyse and determine the cause of the accident and contributing factors, but also analyse and determine factors that are not directly related to the accident but that have a potential impact on flight safety and related issues.

In road safety, according to (Jähi et al., 2006):

1. Accident investigation should identify the factors leading to accidents including:
  - a. physical/psychological (e.g. driver fatigue)
  - b. social (e.g. acceptability of speeding)
  - c. political (lack of will for more effective road safety enforcement)
  - d. economic (incentives to take risks in the road transport industry)
  - e. engineering (road infrastructure and vehicle design issues)
2. Accident investigation should lead to the design and implementation of an effective plan for change.
3. The results of investigations should be used to challenge social attitudes to long-known dangers. For example, by identifying and working to remove inducements to take risks.
4. The lessons from accident investigations should not be lost, so that future accidents could be prevented.

## **1.5 Contributions**

The independence of air accident investigations is a required characteristic that ensures the credibility of investigation authorities and allows stakeholders to trust them and voluntarily provide sensitive and valuable information that could ensure the safety of air transport. Although a fundamental principle, very few studies have attempted to understand and measure the concept of independence, such as the studies concerned with the independence of Central Banks, independence in transportation in general, and the independence of Regulatory Agencies. However, there are no in-depth studies in this area specific to aircraft accident investigations. In addition, the development of a comprehensive measuring index for the independence of aircraft accident investigations in ICAO Member States has not been done before. This research fills this gap by introducing a comprehensive four dimensional measuring index (4DMI) that is specifically developed for measuring the independence of aircraft accident investigation authorities in ICAO Member States. This research also presents the analysis and results of applying the 4DMI index to 45 ICAO Member States.



## 2 LITERATURE REVIEW

### 2.1 Chicago Convention and ICAO

On 7 December 1944 the Convention on International Civil Aviation (the Chicago Convention) was signed by 52 States and the Provisional International Civil Aviation Organization (PICAO) was established pending ratification of the Convention by 26 States. PICAO was functioning from 6 June 1945 until 4 April 1947 when ICAO came into being after the 26<sup>th</sup> ratification was received on 5 March 1947. Six months later, ICAO became part of the United Nations as a specialized agency linked to the Economic and Social Council (ECOSOC) (ICAO, 2006; Wood and Sweginnis, 1995; Smart, 2004).

The Convention on International Civil Aviation set forth the purpose of ICAO in its preamble that was signed in Chicago on 7 December, 1944:

*"WHEREAS the future development of international civil aviation can greatly help to create and preserve friendship and understanding among the nations and peoples of the world, yet its abuse can become a threat to the general security; and*

*WHEREAS it is desirable to avoid friction and to promote that co-operation between nations and peoples upon which the peace of the world depends;*

*THEREFORE, the undersigned governments having agreed on certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner and that international air transport services may be established on the basis of equality of opportunity and operated soundly and economically;*

*Have accordingly concluded this Convention to that end."* (ICAO, 2006).

Article 26 of the "Measures to Facilitate Air Navigation" chapter of the Chicago Convention is the base for ICAO Annex 13 titled "Aircraft Accident and Incident Investigation." This article sets down two main rules: accidents shall be investigated when they occur, and the country where the accident took place shall be the one that carries out the investigation (ICAO, 2006; Com. Ortiz and Dr. Capaldo, 2004; Tench, 1985).

## **2.2 ICAO Annex 13**

The Council adopted the Standards and Recommended Practices (SARPs) for Aircraft Accident Inquiries on 11 April 1951. These SARPs were designated as Annex 13 to the Chicago Convention (ICAO, 2001). Aircraft accidents' investigations are very often international events because of the involvements of the State of Operator, State of Design, State of Registry, State of Occurrence, and State of Manufacture. ICAO Annex 13 was put together as a reference for all people involved in an aircraft accident or incident investigation to prevent conflicts between States during the investigation. The Annex defines which States can participate and their level of involvement. Compliance with the standards of ICAO Annex 13 is a requirement of all contracting States (ICAO, 2009; Stoop and Kahan, 2005; Tench, 1985; Stoop and Roed-Larsen, 2009).

The ninth edition of Annex 13 consists of eight chapters, four attachments and an appendix. Definitions, applicability and general information are covered in the first three chapters. Protection of evidence and the State of Occurrence responsibility with regard to the custody and removal of the aircraft are stated in Chapter 3 of the Annex (ICAO, 2001). The latest, 10<sup>th</sup> edition, of ICAO Annex 13 is discussed in section 2.3.

The responsibilities for conducting an investigation and the procedures for notification of all stakeholders are detailed in Chapter 4. The investigation process itself is contained in Chapter 5. Flight recorders, investigator-in-charge, autopsy, coordination with judicial authorities, disclosure of records, informing aviation security authorities, and re-opening of an investigation, are also discussed in Chapter 5 (ICAO, 2001).

The investigation final report SARPs are defined in Chapter 6. Details of the recommended final report format can be found in the Appendix to the Annex.

Chapter 7 contains the requirements of ICAO Accident/Incident Data Reporting (ADREP) system. Chapter 8 describes processes that form a part of a safety management system (SMS) which aims to reduce the number of occurrences worldwide. Mandatory and voluntary reporting systems, safety information

databases, and analyses of the safety data are also contained in Chapter 8 (ICAO, 2001).

Annex 13 states that the objective of accident and incident investigation is prevention. In order to prevent repeated occurrences, accidents and serious incidents, as a minimum, must be investigated to identify the causes (ICAO, 2009).

The Merriam-Webster's online dictionary defines accident as (Merriam-Webster, 2010):

- an unforeseen and unplanned event or circumstance
- lack of intention or necessity
- an unfortunate event resulting especially from carelessness or ignorance
- an unexpected and medically important bodily event especially when injurious
- an unexpected happening causing loss or injury which is not due to any fault or misconduct on the part of the person injured but for which legal relief may be sought

The dictionary definitions are very general and cannot be used to identify aircraft accidents, especially when there is an obligation to investigate them. Because of this, Annex 13 of the International Civil Aviation Organization (ICAO) defines aircraft accidents in a more specific manner. Its definition is the one recognised internationally which will be used throughout this research.

Annex 13 defines an aircraft accident as (ICAO, 2001):

*An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, 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 the engine, its cowlings or accessories; or for damage limited to propellers, wing tips, antennas, tires, brakes, fairings, small dents or puncture holes in the aircraft skin; or

c) The aircraft is missing or is completely inaccessible.

Note that the 10<sup>th</sup> edition of Annex 13 revised the definition above to accommodate unmanned aircraft (ICAO, 2010).

Contracting states are also required to investigate serious incidents. ICAO Annex 13 defines aircraft incident as (ICAO, 2001):

“An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.”

ICAO Annex 13 uses the prefix “Recommendation” to indicate *Recommended Practices* and considers the compliance with that recommendation as “desirable in the interests of safety, regularity or efficiency of international air navigation...”

On the other hand, standards are considered necessary for the safety or regularity of international air navigation. Compliance with a standard is compulsory under Article 38 of the Chicago Convention.

Chapter 5, section 5.4 of the Annex states that (ICAO, 2001):

“The accident investigation authority shall have independence in the conduct of the investigation and have unrestricted authority over its conduct, consistent with the provisions of this Annex.”

This section makes the *independence* of accident investigation a requirement on all contracting States. However, the Annex does not define what *independence* is.

Section 5.4.1 makes an ICAO recommendation that “*Any judicial or administrative proceedings to apportion blame or liability should be separate from any investigation conducted under the provisions of this Annex.*” This section was later upgraded to a standard in the 10<sup>th</sup> edition of Annex 13.

The upgrade of this section from recommendations to standards in Annex 13 the 10th edition is a major step to support the independence of safety investigations.

These standards when implemented correctly help increase the flow of safety-critical information and the chances to learn from accidents. Flight data recorders (FDRs), ATC reports, Pilots reports, witnesses’ statements, and safety data can be better protected from being used in judicial and administrative proceedings in ICAO-Member States because of the strengthening of the safety investigation independence.

Independence of safety investigations ensures the trust and confidence of the people who are involved in the aviation accident, which encourages them to provide vital information to the investigations without being afraid that they might be prosecuted or blamed for their mistakes. This in turn will ensure that the safety investigation can achieve its goals, which are: to understand what happened, why it happened, and how to prevent the reoccurrence of similar events.

Also, with this upgrade the perception of independence is strengthened. It is very important that the public, safety personnel, manufacturers, operators, and the aviation industry in general perceive the accident investigation body as being independent. Otherwise, without this perception of independence there can be no trust in the investigation process or its results. Moreover, the persons that are involved in the accident that is being investigated would be reluctant to provide any voluntary information.

Annex 13 section 5.4.1 improves the perception of independence of the investigation body by mandating the establishment of an independent body that is separated from the regulator and other interested parties. This independent body is tasked only with

the sole function of impartially investigating aviation accidents and incidents to improve safety and prevent similar events from reoccurring.

One problem with the implementation of this is that some ICAO-Member States cannot afford setting up a separately funded investigation body. The answer to this is to share resources with other neighbour States by means of regional organizations such as RAIOS. If a RAIO is setup correctly and its independence is ensured it could be a very effective way to manage resources and at the same time conduct high quality and impartial investigations. Moreover, the States involved in the regional organization setup will be in compliance with ICAO Annex 13 SARPs.

The emphasis put by the international community represented by ICAO on the concept on independence, of both the investigation process and the investigating body, is a clear indication of its importance. By upgrading the recommendations to standards ICAO is “forcing”, as oppose to “encouraging”, Member States to be part of this international effort to ultimately ensure the advancement of aviation safety.

Because sections 5.4 and 5.4.1 are standards, ICAO-Member States have one of two choices to make; either comply with the new standards or file a difference. Filing a difference will put the Member State under the spotlight, which will, hopefully, encourage the State to seek compliance status as soon as possible.

Moreover, to encourage “implementation uniformity”, in 2000 ICAO issued the first edition of Doc 9756 titled *“Manual of Aircraft Accident and Incident Investigation”*. Paragraph 2.1.2 in Part I of this ICAO document discusses what ICAO means by independent aircraft accident investigation. The paragraph states that “the investigation authority must be strictly objective and totally impartial and must also be perceived to be so.” The document also encourages States to set up an independent investigation body that is separate from the CAA. In the same document ICAO acknowledges that “in many States it may not be practical to establish a permanent accident investigation authority.” As an alternative, ICAO mentioned the appointment of a separate commission to do the investigation. This commission must report directly to a ministerial level of government (ICAO, 2000). This makes it clear that the independence required and described by ICAO documents is functional independence.

### **2.2.1 Is Functional Independence Enough?**

There has been a recent occasion where the establishment of a separate, structurally independent investigation body was proved to be crucial. In Australia, the accident investigation body has been functionally and structurally separate from the regulator. The multi-mode Australian Transport Safety Bureau (ATSB), formerly known as the single-mode Bureau of Air Safety Investigation (BASl), has enjoyed a strong independent position which allowed it to criticise the regulator. The Civil Aviation Safety Authority (CASA), which is the Australian regulator, has been under scrutiny from the Australian Government for several years now, especially after the Lockhart River air disaster in 2005. CASA has been accused, amongst other accusations, of being too close to the Air Operator Certificate (AOC) holders and that it has been “captured” by the industry. The regulator was also heavily criticised for its lack of oversight (Australian ABC News, 2010; The Canberra Times, 2008).

The independence, functionally and structurally, of the investigation body in Australia has been the key factor that helped in pointing out the deficiencies in the way the regulator (CASA) conducts its business.

ICAO Annex 13 requirement with regard to structural independence has changed with the new 10<sup>th</sup> edition of Annex 13. The requirement used to be for functional independence only and structural separation used to be desired. Now, however, section 5.4 of Annex 13 makes structural separation a Standard and therefore a requirement (ICAO, 2000; ICAO, 2001; ICAO, 2010).

### **2.3 Strengthening Investigation Independence Related Regulations in ICAO Annex 13 10<sup>th</sup> Edition**

A new edition of ICAO Annex 13 came out in July 2010. The new edition strengthens the requirements for independent accident investigations in ICAO Member States. The new amendments strengthen some of the issues related to the independence of air accident investigations.

The first thing to notice is the upgrade of section 5.4.1 from a recommendation to a standard. The section now requires the separation of Annex 13 investigations from judicial and administrative proceedings that are set up to apportion blame or liability. This upgrade was presented by the Secretariat in the Accident Investigation and

Prevention (AIG) Divisional Meeting in 2008. In its Working Paper 04, the Secretariat recognises the need for other types of investigations that might apportion blame or liability to fulfil “other needs.” However, it recognises the purpose of Annex 13 investigations and the need for them to be separated from other investigations. The recommendation was introduced in Annex 13 fourteen years before (i.e. in 1994) and it is time for it to be fully aligned with the spirit of Annex 13 by upgrading it to a Standard (AIG Secretariat, 2008b, d; ICAO, 2010).

It is also worth noting that the international community suggested the replacement of the term “separate from” with the term “independent of” as mentioned in ICAO WP79. In addition, the international community at the meeting suggested a standard should be made to give priority to safety investigations over judicial and administrative investigations. The first suggestion was rejected by the meeting and the second was felt to be a recommendation rather than a standard (AIG Secretariat, 2008d).

Another important change in this edition of Annex 13 is the removal of any reference to the pilot’s name who reports an accident or major incident. Moreover, there is now a provision to protect the names of the persons involved in accidents and incidents from being disclosed. Also, the changes addressed the disclosure of records to include the image recordings in cockpits and their transcripts (AIG Secretariat, 2008d; ICAO, 2010).

Several definitions were revised in this 10<sup>th</sup> edition of Annex 13 including the definition of accident (now includes unmanned aircraft systems), serious incident, investigation, safety recommendation, and accredited representative (ICAO, 2010).

The 10<sup>th</sup> edition of ICAO Annex13 now allows for delegating the investigations to regional accident investigation organisations. In addition, the participation of States “which suffered fatalities or serious injuries to its citizens” provision has been revised (ICAO, 2010).

There is also a new provision with regard to the development of documented policies and procedures for investigations. Also, the provision that the final report needs to be made publicly available has been revised (ICAO, 2010).



In addition, two more new provisions were introduced in this edition; a provision to ensure that judicial investigations or administrative investigations are not impeding annex 13 investigations, and a provision on the control of safety recommendations' responses and the monitoring of the actions taken (ICAO, 2010).

## **2.4 USOAP – Measure of Compliance**

Because of the network nature of the industry, the level of safety of one country could be very high but it will not help when its citizens are flying under much lower safety levels in another country. Both countries must be in an acceptable level of safety when it comes to air transportation in order to protect the citizens of both countries. In the absence of appropriate international agreement, or the enforcement of it, one country with an inadequate safety structure will impact, not only on the safety of its own traffic, but also on the safety of other countries to which it flies (Button et al., 2004).

The Universal Safety Oversight Audit Program (USOAP) was launched by ICAO in 1999. Its management is the responsibility of the Safety Oversight Audit (SOA) Section of the ICAO Safety and Security Audits (SSA) Branch. The SOA Section is responsible for developing and maintaining the standard safety oversight auditing procedures and tools. It is also responsible for the quality of the audit process and products. Moreover, it is responsible for training and approval of the auditors (ICAO, 2009).

ICAO USOAP is intended to audit States' compliance with their own regulations and with the Chicago Convention. States' conformance with the ICAO SARPs, guidance material, related procedures, and relevant industrial practices in general use, are also audited. Eight critical elements for a State's safety oversight system have been defined by ICAO to ensure the effective implementation of that system. The eight critical elements are (ICAO, 2009, 2010):

1. Primary aviation legislation
2. Specific operating regulations
3. State civil aviation system and safety oversight functions
4. Technical personnel qualification and training
5. Technical guidance, tools and the provision of safety-critical information

6. Licensing, certification, authorization and approval obligations
7. Surveillance obligations
8. Resolution of safety concerns

With regard to Annex 13, the ICAO USOP is not a measure of the “effectiveness” of the accident investigation itself; it is a measure of compliance with ICAO SARPs regardless of the process or outcome of the investigation.

#### **2.4.1 USOAP Results and Transparency**

In the 32<sup>nd</sup> Assembly Resolution A32-11, the voluntary and confidential assessment programme called the Safety Oversight Assessment Program (SOAP) was changed to become the mandatory and transparent audit programme known as the Universal Safety Oversight Audit Program (USOAP). All Contracting States were urged “to ensure that the results of the audits be used for safety-related purposes only.” The scope and degree of transparency and disclosure of information in the release of audit results were not discussed (ICAO Assembly, 1998).

In the 163<sup>rd</sup> Session of the ICAO Council “Summary of the Minutes of the 10<sup>th</sup> Meeting”, it was agreed to post the analysis of the audit findings at global and regional levels and that the posting would be on a password protected ICAO Safety oversight webpage. However, in the 33<sup>rd</sup> Assembly, it was proposed that ICAO should publish a non-confidential audit summary report for each complete audit. Sufficient information would need to be contained in the summary report to enable Contracting States to form an opinion of the safety oversight status of the Audited State. Moreover, it was proposed that improvements made by the State, if any, should be included in the summary report. States were asked to upload their own improvements on the ICAO website and then these improvements were verified by ICAO through a follow-up mission or an on-site audit. No resolution was made with regard to Transparency and Disclosure, despite the fact that they were discussed extensively during the 33<sup>rd</sup> Assembly, except for a request from the Secretary General to solicit information from States to publish the results of their successful achievement in resolving major deficiencies so that others could learn from the experience. During the ICAO Council’s 165<sup>th</sup> session, however, the Council decided to share non-confidential and safety-enhancing information (ICAO Assembly, 2001).

In the 35<sup>th</sup> Assembly, the European Civil Aviation Conference (ECAC) presented their views on the proposed ICAO “unified strategy” to resolve safety-related deficiencies. The ECAC discussed the need for transparency and disclosure of USOAP audit results. ICAO unified strategy involved different elements including the aforementioned transparency and disclosure of results, such as: enhancement of safety oversight performance; mutual recognition of airworthiness certificates and licences issued in accordance with the adopted SARPs; cooperation, assistance and partnerships between ICAO, Contracting States, airspace users and air navigation services providers; and uniform implementation of SARPs.

Two actions came out of this Assembly targeting transparency and disclosure: a generic mandate for greater transparency in the release of audit results; and the identification of non-compliant States. The aim of exposing non-compliant States, even after trying to assist them, is to give a chance to other States to protect their interests from aviation safety risks. ICAO Contracting States were informed by the Secretary General that all audit summary reports were to be published and distributed by 31 October 2004 (ICAO Assembly, 2004).

A Working Paper concerning, *inter alia*, the transparency and sharing of safety information was presented by Austria, on behalf of the European Community and its Member States, other State Members of the European Civil Aviation Conference (ECAC), and by EUROCONTROL in the Directors General of Civil Aviation (DGCA) Conference on a Global Strategy for Aviation Safety in Montreal in March 2006. The paper has several proposals for further improvement of worldwide aviation safety. One of the proposals made was that ICAO should allow all Contracting States to have access to all reports of USOAP and should also make them available to the general public (EC et al., 2006).

The DGCA conference agreed on the following recommendations with regard to Transparency and public access to information (ICAO DGCA, 2006):

- Consent should be given to ICAO to publish the results on the public website as soon as possible.
- States sharing their audit information should have the opportunity to provide their comments on the ICAO website where the audit information is posted.

- Consent should be given to ICAO to publish the safety oversight audit information conducted under the *comprehensive systems approach*.
- All contracting States should give their consent to ICAO to publish the relevant information before 23 March 2008.
- ICAO would make public the name of any State that does not give consent by the date mentioned.
- ICAO should set up a system to enable the quick resolution of major safety concerns identified by a USOAP audit.

ICAO released the names of six States that had not given their consent for the release of audit information in the 28 March 2008: Iran, Kazakhstan, Kiribati, Sierra Leon, Swaziland, and Zimbabwe. Apparently this technique worked in putting pressure on these six States to give their consent. A news release from ICAO on 16 July 2008, about four months from the first release, confirmed that all Member States that have been audited have given their consent to release the audit results (Blumenkron, 2009).

#### **2.4.2 Deficiencies Identified by ICAO-USOAP**

In the ICAO Accident Investigation and Prevention (AIG) divisional meeting in October 2008 the Secretariat presented a summary of the deficiencies identified by ICAO USOAP in the accident and incident investigation area. The Secretariat summarised the results of the some 80 ICAO Member States that had been audited since December 2007 until the time of this meeting in October 2008. Several areas of deficiency were identified and discussed in this Working Paper (AIG Secretariat, 2008a).

Legislation and regulations were discussed as being insufficient for correct and effective implementation of ICAO Annex 13 SARPs in some countries. There were insufficient or missing provisions with regard to:

- Conduct of serious incident investigations
- Independence of the investigation or its separation from administrative and judicial proceedings
- Immediate notification to the State's authorities of all accidents and serious incidents

- Empowerments of investigators
- Protection and custody of evidence
- Non-disclosure of records listed in paragraph 5.12 of Annex 13
- The participation of accredited representatives from relevant States

The USOAP also found a lack of some States' legislation and regulations with regard to the use of materials from Annex 13 investigations in judicial proceedings without consideration for the adverse effects of this practice and the fact that it violates paragraph 5.12 of ICAO Annex 13 (AIG Secretariat, 2008a).

USOAP results also showed that with regard to accident and incident investigation authorities, Member States can be grouped into three different groups in general. Some States have established a permanent investigations authority separate from the CAAs, others have established a permanent investigation office within the CAA, and others have not established any permanent authority or office to be in charge of accident and incident investigations. Moreover, there are several States that do not have the capability to establish an investigation system on their own, and do not have guidance on how to cooperate with other States in this matter. The audit also showed that some States were having problems regarding the training of investigators and problems related to the funding of investigations and the accessibility to adequate equipment, transportation and communication means. Other problems concerning the notification procedures, investigation procedures, and the non-compliance with ICAO guidance with regard to final reports and safety recommendations have also been discussed in this Working Paper (AIG Secretariat, 2008a, e, f, g).

The final recommendation was that "...ICAO to conduct a study to prioritize Annex 13-related deficiencies identified during USOAP audits in order to resolve them in the most efficient way possible" (AIG Secretariat, 2008a).

## **2.5 Definition of Independence in Literature**

In the civil aviation world, ICAO is the ultimate authority for "*universal*" definitions and requirements. The independence of aircraft accident investigation is an ICAO requirement that is required through ICAO Annex 13 to the Chicago Convention. ICAO, however, does not indicate a clear definition of independence but it does

indicate that the Annex defines terms used in the SARPs “...which are not self-explanatory in that they do not have accepted dictionary meanings” (ICAO, 2001). Therefore, since Annex 13 does not define a specific meaning for independence, the general dictionary meaning is acceptable to ICAO.

The Merriam-Webster’s online dictionary (Merriam-Webster, 2010) defines “independent” in different ways as:

- not subject to control by others: self-governing
  - not affiliated with a larger controlling unit
- not requiring or relying on something else: not contingent
  - not looking to others for one's opinions or for guidance in conduct
  - not bound by or committed to a political party
- not requiring or relying on others (as for care or livelihood)
  - being enough to free one from the necessity of working for a living

The Road Strategy for Accident in Transport (ROSAT) is a Working Group within the Group of Experts to advise the Commission of the European Communities on a Strategy to Deal with Accidents in the Transport Sector. In their report, ROSAT benefited from three different definitions of “independence” in the context of in-depth accident investigations to form their own understanding (Monclus et al., 2006):

1. The Methodology Working Group, another group within the Group of Experts to advise the Commission on a Strategy to Deal with Accidents in the Transport Sector, understand it as:

*“The accident investigation authority shall be set up permanently and carry out its tasks impartially. Its functional, financial and legal independence from any other public bodies or third parties shall be guaranteed, and in particular from any national authorities responsible for the establishment or the enforcement of safety requirements imposed on the transport sector. The independence and impartiality of all safety investigators need to be assured. Appropriate measures shall apply to the accident investigation authority’s workforce.”*
2. Professor Dietmar Otte from the Medical University of Hannover, Germany believes that in this context independence means the “...freedom to: decide

what to investigate, choose how to investigate, and publish the results of the investigation.”

3. In the framework used by the SafetyNet Integrated Working Package 4 “Independent Accident Investigation”, that was presented to the ROSAT group, three different domains are identified to understand independence of accident investigation (Jähi et al., 2005):
  - a. Structural independence (independence from authorities and protection from a clear legal status).
  - b. Financial independence (to conduct investigations).
  - c. Functional independence (liberty to investigate, access to evidence and witnesses, publication on findings...).

Based on these definitions, the ROSAT Group came up with their own understanding of the ‘independence’ of accident investigation: “the structural (separation from authorities and clear legal status) and financial (yearly stability of funds) ability to decide what and how to investigate, and to publish the results of the investigations” (Monclus et al., 2006).

On the other hand, Dechy et al. (2012) argue that the concept of independence is relative and not absolute. The authors define the “practical aspect” of investigation independence as “...the evaluation and assessment of facts and findings without direct interference from governmental agencies and authorities, or vested industrial interests, leaving the drafting of recommendations and reporting to the discretion of the investigation agency” (Dechy et al., 2012).

The above described “practical aspect” of accident investigation independence can be illustrated with the following example. On 1 June 2009, Airbus A330-203 aircraft operated by Air France Flight AF447, scheduled to fly from Rio de Janeiro, Brazil to Charles de Gaulle airport in Paris, France, crashed into the Atlantic Ocean killing all 228 onboard. It took the French BEA close to 2 years to locate and recover the wreckage. The black boxes were located and recovered in May 2011. The BEA issued first interim report in July 2011, and the final report was released in July 2012 (BEA, 2011).

The BEA’s interim report caused a big controversy because of some criticism of the Manufacturer (Airbus) was removed from the report at the last moment before its

release. The interim report had a recommendation from the BEA to replace or improve the stall warning system in the A330 aircraft. The confirmed removal of this recommendation caused the largest Air France pilots' union walk away from the investigation indicating that the investigation had turned into a "one-sided" prosecution of the aircraft crew. The BEA was accused of "protecting" the Manufacturer and focusing on blaming the accident on pilots' error. Moreover, an association of French victims' families protested against the BEA's "alleged" persistence to blame the 3 dead pilots for the accident. The association's president expressed strong feelings against the removal of criticism against Airbus from the report before its release and said that it "...definitively discredits the investigation" (Lichfield, 2011).

This example in particular shows the "perceived" influence of the Manufacturer on the safety accident investigation. The "alleged" relationship between the BEA investigators and the Manufacturer (Airbus) has already deterred the pilots' union from providing support to the investigation. Regardless if the BEA investigators were trying to protect the Manufacturer interest or not, such perception of lack of independence of the BEA investigation from an interested party (the manufacturer in this case) can harm the credibility of the investigation author (BEA), and eventually hamper the flow of safety information which may result in missing safety lessons to prevent reoccurrences.

In addition, Baxter (1995) did not give a direct definition for the meaning of independence of accident investigation; however, he discussed its effect and mentioned some the benefits of having it. Baxter listed two main reasons for the need for independent agency; to avoid conflicts of interest, and eliminate any real or imagined influence when the agency investigates itself. The independent investigation agency would be able to do in-depth investigations and freely make recommendations, according to Baxter. The outcome of being independent, as explained by Baxter, is that the general public and policy makers would see the credibility of the investigation (Baxter, 1995).



## 2.6 Strengthening Investigation Independence in the European Union (EU)

EU Directive 94/56/EC of 21 November 1994 was introduced to establish the fundamental principles governing the investigation of accidents and incidents in civil aviation. The Directive has been revoked and was replaced by EU Regulation 996/2010 in October 2010. In addition to upgrading the directive to a regulation which is legally stronger and more binding, the new regulation focuses more on the separation of safety investigations from judicial proceedings. The Regulation aims to prevent pressure from regulators and other authorities to influence safety investigations. Articles 3 and 4 of the Regulation 996/2010 require, *inter alia*, each EU Member State to have a permanent, functionally independent body to investigate accidents and serious incidents in civil aviation. Article 5 of the Regulation implies that the sole purpose of the investigation is to prevent future accidents and not to apportion blame or liability. Article 5 (5) states that "...they shall be independent of, separate from and without prejudice to any judicial or administrative proceedings to apportion blame or liability" (European Union, October, 2010).

The Regulation also protects statements taken from witnesses from being used for any purposes other than safety investigations, unless the authority competent to decide on the disclosure of records according to national law or administration of justice decides that disclosure of the records "...outweigh(s) the adverse domestic and international impact that such action may have on that or any future safety investigation" (European Union, October, 2010).

Another thing that came out of the EU Regulation 996/2010 is the establishment of the European Network of Civil Aviation Safety Investigation Authorities (ENCASIA). ENCASIA's goal "consists of further improving the quality of investigations conducted by safety investigation authorities and to strengthen their independence." In its first year, ENCASIA created four Working Groups: Working Group 1 (WG1) "Network Communication and Internet Presence"; Working Group 2 (WG2) "Inventory of best practices of investigation in Europe"; Working Group 3 (WG3) "Procedures for asking and providing help"; and Working Group 4 (WG4) "Training of investigators" (European Union, October, 2010; ENCASIA, 2011).

After the approval of EU 996/2010, the European Parliament commented on the Regulation saying “this will ensure the people can testify without fear to the safety investigators.” The European Commission stated that the passing of the legislation will emphasise that accident investigations’ sole objective is to prevent future accidents. The European Commission adds “while the regulation will not affect the prerogatives of the national courts and competent judicial authorities of member states, it will ensure that accident investigators have immediate access to evidence material and information which may be relevant for the improvement of aviation safety” (Kaminski-Morrow, 21 Sept 2010).

## **2.7 The Effect of Independence on the Success of Accident Investigation**

Without adequate levels of independence, accident investigation bodies cannot perform their intended functions. Accident investigation commissions have the following main functions (Kjellén, 2000; Hovden et al., 2011):

- Improve the understanding and knowledge of how accidents happened
- Inform the public about the causes of accidents
- Establish trust and confidence
- Suggest measures to prevent similar accidents
- Disclose safety policies’ weaknesses and violations.

Since the ICAO Annex 13 first draft, it was successfully agreed that technical investigations must be kept separate and independent from judicial investigation (Stoop and Kahan, 2005). In order to realise the benefits of accident investigations, the accident investigation body itself must be independent. The “independence” factor of accident investigation has a profound effect on the investigation. This factor supports “the impartiality, the integrity, the objectivity, the credibility, the transparency, and the confidence of the stakeholders”. Legal rights were put in place in many countries to encourage free speech, protect witnesses, and prevent the use of published accident investigation reports from being used in court. On the other hand, the investigation board credibility and access to information can be jeopardised if it is totally independent. The safety board could come up with unrealistic recommendations because of its total independence from the industry and operational practices. Investigators are part of the political and cultural system and it

is not possible for them to be totally independent from these systems. Investigation independence must not lead to the isolation of investigators from the industry. The aim should be for a balanced independence where being independent does not mean isolation. The target should be to achieve the benefits that are expected from this implementation of the concept of investigation independence (Dechy et al., 2012).

In its White Paper on “European transport policy for 2010: time to decide” in 2001, the European Commission emphasises that there is a “need” for independent technical accident investigations that are concerned with finding the causes of accidents and how to improve the law (European Commission, 2001).

The European Union bases its approach to accident investigations on the principle of “independence”. This EU approach is to ensure that the conduct of the accident investigation itself, its results and final recommendations should not aim to apportion blame or liability. Several criteria are identified for the “needed” type of accident investigation (Marinho de Bastos, 2004):

- Designed to find the real, root and technical causes
- Separated from other investigations to apportion blame or determine compensation for damages
- Conducted autonomously and impartially (functionally independent)
- Independent from judicial authorities, industry, insurance companies, regulators and operators and any entity that may have an interest that could conflict with the goals of the investigation
- Make safety recommendations and follow-up on them

In the USA, the American Congress noted the importance of accident investigation independence for appropriately carrying out of the responsibilities assigned to the NTSB when passing the Independent Safety Board Act of 1974. Congress stated that “No Federal agency can properly perform such functions unless it is totally separate and independent from any other... agency of the United States.” (Baxter, 1995).

Independent investigators should conduct an investigation in order to raise the quality of the investigation process. The independence of the accident investigators ensures the objectivity of the investigation (Baxter, 1995; Lindberg et al., 2010).

Objectivity in the context of accident investigations, however, is sometimes misunderstood. Some people believe that the investigator should not have any preconceived ideas about the accident. This is not true because the investigator is consulted or hired for his experience and he should make use of it. The real meaning of objectivity is to approach the accident with an open mind. Lack of objectivity occurs when evidence says that a certain part of the aircraft was functioning correctly, but the investigator does not accept this evidence because it does not fit his preconceived ideas (Wood and Sweginnis, 1995).

## **2.8 Lessons from Financial Systems and the Financial Crisis**

The financial auditing profession suffered a big hit after the fall of Enron and the Arthur Andersen accounting giant firm, which caused the public to start to lose confidence in auditors' independence in the financial industry.

Gevurtz (2010) claims that Citigroup's financial crisis was not caused by bad luck after the "taking of reasonable business risks", but that there was a "lack of independence" of the risk managers from the executives who are supposedly monitored by those managers. This lack of independence was the result of two reasons (Gevurtz, 2010):

1. Personal connections between the risk managers and the executives
2. Risk managers' lines of authority where they reported to the person with an interest in promoting the activities they were monitoring.

According to (Moorthy et al., 2010), in order to help an organisation achieve its goals and objectives by evaluating and improving the control, effectiveness, and governance processes of risk management, an independent internal auditing activity is needed. The authors argue that public confidence in the audit's effectiveness must be restored before any attempt is made to reposition the auditor's role in society. The social usefulness of the audit is lost if public confidence is shattered. "*The theory of inspired confidence (Limperg Institute 1985) says that there is a dynamic theory that connects society's need for reliable financial information to the ability of auditing*

*methods to meet that need. The theory explains that changes in the needs of society and changes in auditing methods interact to bring about changes in the auditors' function."*

According to Moorthy et al. (2010), a separate function is created in any production process when there is a more efficient way of effecting that production. The creation of a separate function of auditing, therefore, was a result of differentiation in production. In public accounting, however, efficiency in the production process was not the only factor for the development of the separate function of auditing. Independent auditors are considered as a community's "confidential agent" and a society's "agent of confidence". It is these authors' opinion that reinstating the public's perception of the auditing profession is the most difficult. There need to be "reforms and changes" in the auditing profession, and "education" of the public. Also, the public needs to be "convinced" about the reforms in order to restore the profession's position as an admirable and respectable profession. Their study concluded that although the "once glorious and noble" profession has been "demised" as a result of a "grave mistake" by one of the greatest audit firms, there have been tremendous efforts to inspire changes in the auditing profession to restore the confidence of people. New regulations and guidelines have been put in place to allow for a new way of auditing and auditors. Now auditors must have social sciences and information technology knowledge, in addition to their accounting knowledge, to be able to face the fast pace of the world. The most important thing is to follow the "ethical code" of the profession in "its true spirit and in action" (Moorthy et al., 2010).

The United Kingdom Financial Investment Ltd. (UKFI) is a Companies Act company owned solely by HM Treasury. It manages the Government's investments in the RBS (Royal Bank of Scotland), Lloyds (Lloyds Banking Group), and UKAR (UK Asset Resolution Ltd) (UKFI, 2012).

UKFI has been established to operate as an institutional shareholder, rather than to enforce the Government's will with respect to banks. It was set up to operate commercially at "arm's length" from the Treasury. According to the report, it is the UK Government's belief that banks should be run commercially by proper independent

boards. UKFI's role is not running the banks – its role is to manage the shareholdings (House of Commons Treasury Committee, 2009).

There are several issues affecting the independence of the UKFI from the Treasury. For example, the UKFI offices are located within HM Treasury's building. Also, the UKFI and the Treasury share some of their support services in order to keep costs down. In addition, many of UKFI staff are "seconded" from the Treasury, including the Chief Executive. This situation exists because of the fear that "...if UKFI had spent more money on offices and staff then it would be criticised for not achieving potential economies of scale with the Treasury."

Moreover, although the UKFI was originally set up to be at "arm's length" from the Treasury, the Framework Document for the UKFI gives the Treasury the power to give directions to the UKFI and states that the UKFI's board "will comply with such directions or resign". The Chief Executive of UKFI, however, stated "I would see directions as being an extremely unusual event." (House of Commons Treasury Committee, 2009)

The report states that although it is important to maintain this "arm's length" philosophy, it is equally important to clearly define what is meant by "arm's length" in this instance. The committee thinks that despite the cost saving that might result from placing the UKFI in HM Treasury building, "the effectiveness and independence of UKFI should not be compromised for the sake of relatively inconsequential sums of money". The Committee recommended that UKFI considers moving out of the Treasury building.

In addition, the Committee sees that the existence of the power in the hands of the Treasury to direct the UKFI, even if it is a "nuclear option", undermines the independence of the UKFI. The Committee further recommended that the Treasury defines clearly the "precise circumstances in which it envisages this power being used."

Moreover, the Committee recommended that the UKFI should be established on a proper statutory basis. The Committee believes that UKFI cannot have real operational independence under the current *ad hoc* administrative arrangements (House of Commons Treasury Committee, 2009).

There are several causes behind the financial crisis and there is no simple remedy to fix it (Jickling, 2006). Jickling argues that the crisis is not yet fully understood and it is likely that “the causes of the current crisis will be debated for decades to come.” A summary table was presented summarising a number of factors that have been identified as causes of the financial crisis. Table 2-1 shows some of the identified causes, arguments, and rejoinders that are related to this research. Jickling also identified several causes for the financial crisis that are related to the independence of the auditors, or lack of it, such as: lack of transparency and accountability in Mortgage Finance, conflicts of interest and lack of effective regulation, deregulatory legislation (unregulated risky transactions), mortgage lending moved out of banks into unregulated institutions (unsupervised risk-taking), and fragmented regulation (as a result, no agency is well-positioned to monitor emerging system-wide problems.)

**Table 2-1 Causes of the Financial Crisis (partially reproduced from (Jickling, 2006))**

Cause	Argument	Rejoinder
Lack of Transparency and Accountability in Mortgage Finance	<p>“Throughout the housing finance value chain, many participants contributed to the creation of bad mortgages and the selling of bad securities, apparently feeling secure that they would not be held accountable for their actions. A lender could sell exotic mortgages to home-owners, apparently without fear of repercussions if those mortgages failed. Similarly, a trader could sell toxic securities to investors, apparently without fear of personal responsibility if those contracts failed. And so it was for brokers, realtors, individuals in rating agencies, and other market participants, each maximizing his or her own gain and passing problems on down the line until the system itself collapsed. Because of the lack of participant accountability, the originate-to distribute model of mortgage finance, with its once great promise of managing risk, became itself a massive generator of risk.”</p>	<p>Many contractual arrangements did provide recourse against sellers or issuers of bad mortgages or related securities. Many non-bank mortgage lenders failed because they were forced to take back loans that defaulted, and many lawsuits have been filed against MBS issuers and others.</p>
Rating Agencies	<p>The credit rating agencies gave AAA ratings to numerous issues of subprime mortgage-backed securities, many of which were subsequently downgraded to junk status. Critics cite poor economic models, conflicts of interest, and lack of effective regulation as reasons for the rating agencies’ failure. Another factor is the market’s excessive reliance on ratings, which has been reinforced by numerous laws and regulations that use ratings as a criterion for permissible investments or as a factor in required capital levels.</p>	<p>All market participants underestimated risk, not just the rating agencies. Purchasers of MBS were mainly sophisticated institutional investors, who should have done their own due diligence investigations into the quality of the instruments.</p>
Fragmented Regulation	<p>U.S. financial regulation is dispersed among many agencies, each with responsibility for a particular class of financial institution. As a result, no agency is well-positioned to monitor emerging system-wide problems.</p>	<p>Countries with unified regulatory structures, such as Japan and the UK, have not avoided the crisis.</p>



Cause	Argument	Rejoinder
No Systemic Risk Regulator	No regulator had comprehensive jurisdiction over all systemically-important financial institutions. (The Fed had the role of systemic risk regulator by default, but lacked authority to oversee investment banks, hedge funds, nonbank derivatives dealers, etc.)	Some question whether the problem was lack of authority or failure to use existing regulatory powers effectively.
Black Swan Theory	This crisis is a once-in-a-century event, caused by a confluence of factors so rare that it is impractical to think of erecting regulatory barriers against recurrences. According to Alan Greenspan, such regulation would be “so onerous as to basically suppress the growth rate of the economy and ... [U.S.] standards of living.” Testimony before the House Oversight and Government Reform Committee, Oct. 23, 2008.	“Some might be tempted to see recent events in the financial markets as just such black swans. But this would be quite wrong, in our view. Many of the flaws that have led to current turbulent conditions have not ridden on the back of a black swan. Instead, they are the result of weaknesses and failings in the interpretation of risk analysis and the process of oversight.” (Booth and Mazzawi)

## 2.9 Learning from Accident Investigations

A recent study was published about the multilevel learning from accident investigations focusing on accident investigations in the Norwegian transportation sector (Hovden et al., 2011). The study identified a set of learning criteria as a result of analysing accident investigation reports with investigation related documents, and organisational learning literature. The identified criteria are based on:

- The accident investigation process
- The follow-up efforts
- Contextual aspects

The study is based only on the analysis of three Norwegian transportation accidents (air, marine, and rail) namely: the Twin Otter air crash near Namoss 27 October 1993; the high-speed craft MS Sleipner accident 26 November 1999; and the railway accident at Asta 4 January 2000. These specific cases were selected because they are “the most discussed, investigated, and frequently referred to accidents within each transport sector in the last 20 years” (Hovden et al., 2011).

The results are grouped in tables Table 2-2, Table 2-3 and Table 2-4 (table Table 2-4 is of particular interest with regard to independent investigation):

**Table 2-2 Key points-group discussions regarding the investigation process adapted from (Hovden et al., 2011)**

Investigation process	The Namsos air crash	The Sleipner high-speed craft accident	The Asta train crash
<b>Competence and resources</b>	Permanent investigation commission with support from research institute	Governmental accident investigation commission	Governmental accident investigation commission
<b>Methodological approach</b>	Among the first in Europe with new approach to root cause analysis in aviation (ICAO Annex 13)	Part of the accident investigation was directed by administrative regulations; several graphical methods applied (STEP, FTA, etc.)	The investigation was guided by a working model; but no graphical representation of the accident sequence
<b>Focus</b>	A multilevel, socio-technical approach	A multilevel, socio-technical approach	A multilevel, socio-technical approach
<b>Other comments</b>	Report issued 3 years after the accident	Report issued within 1 year	Report issued within 1 year

**Table 2-3 Key points-group discussions regarding follow-up efforts<sup>a</sup> adapted from (Hovden et al., 2011)**

Follow-up of the investigation report	The Namsos air crash	The Sleipner high-speed craft accident	The Asta train crash
<b>Authorities</b>	New requirements on safety standards on small airports (STOL b port)	The high-speed craft code was changed (regarding raking damage, life saving system, etc.)	Strengthening the Norwegian Railway Inspectorate, revision of safety regulations
<b>Sector/trade</b>	Procedures for “black hole” effects and for in-flight (approach)	Ship-owners have become more autonomous regarding compliance to regulations; turn-out time for Search and rescue helicopters reduced to 15 min	Massive changes in Norwegian rail services, risk based safety management
<b>Company management</b>	All recommendations closed within 6 years; safety responsibilities of top management and company board of directors emphasised	Several organizational changes implemented	New management regime; safety expressed as a line management responsibility
<b>Individual/personal</b>	Intensive pilot training for new aircrafts, intensified crew selection	Intensified crew selection and training introduced	Intensive training and education (incl. simulation training)
<b>Technology</b>	New aircrafts introduced (decided before the accident)	Electronic navigation system, electronic chart display and information system (ECDIS) implemented	Acoustic alarm in rail traffic control centres, GSM (global systems for mobile) train radio system, upgrading signalling systems and rolling stock

<sup>a</sup> Data about actual results such as fewer accidents, near misses, errors, etc. have not been collected.

<sup>b</sup> STOL ~ short take-off and landing.

**Table 2-4 Key points-group discussions regarding the contextual aspects adapted from (Hovden et al., 2011)**

Contextual aspects	The Namsos air crash	The Sleipner high-speed craft accident	The Asta train crash
<b>Mandate</b>	Look for causes and remedial actions, not liability	Look for causes and remedial actions, as well as grounds for liability	Look for causes and remedial actions, not liability
<b>Media coverage</b>	A surviving journalist onboard; intense, but constructive dialogue, conscious media policy	Intense, but useful media pressure during the investigation	Intense media pressure during the investigation
<b>Pressure groups</b>	Active group of relatives, but with trust to the commission and their findings	Trade unions were rather inactive	Spontaneous organization of survivors and relatives (for dialogue with the train operator)
<b>Conflicts</b>	The commission wanted to deny police access to the cockpit voice recorder (CVR); the court decided that police access would require a court decision in each case	Approved life jackets proved not satisfactory for Norwegian sea conditions	Systems approach vs. scapegoats (train engine drivers)
<b>Juridical and court trial</b>	Indictment against the company withdrawn due to passed time limit; as a result, the Air Navigation Act has been changed	Ship-owner and captain accused of negligence; captain was sentenced to 6 months jail (suspended sentence); ship owner was acquitted	The Norwegian Rail Administration accepted a corporate penalty (10 mill. NOK)
<b>Other comments</b>		What actually caused the navigation error was never revealed	The mandate was extended to include the investigation of another rail accident; gas leak at Lillestrom station

The participants in this study were asked to choose “the most significant for learning” statements from about 30 different statements. The following were considered the most important (Hovden et al., 2011):

1. The investigation should be independent.
2. The mandate should give a broad scope for looking at causal factors at all levels from the operational sharp end, to the responsible company, and to the role of regulatory authorities.
3. The investigation team should both hold factual knowledge about the activity and technology involved, and knowledge and experience in systematic investigation methodology.
4. The mandate should exclude questions about liability and blame.

The results of this study show that participants believe the independence of the investigation is one of the most important factors in learning from accidents.

The participants also recommend establishing an independent accident investigation board to investigate accidents outside the transportation sector in Norway (Hovden et al., 2011).

### **2.9.1 Lessons from Australia**

Two accident investigations in Australia that have many lessons to illustrate the importance of the independence of accident investigations are reviewed. Note that the Bureau of Air Safety Investigation (BASI) became part of the multi-modal Australian Transport Safety Bureau (ATSB) in 1999.

#### **2.9.1.1 BASI Findings on the VH-INH Accident**

The aircraft departed Sydney, Australia for a flight to Osaka, Japan. After about one hour the crew had an indication of an oil leak in engine number one and shut it down. They returned to Sydney and started the approach process. A warning horn started to sound when the crew tried to lower the landing gear. The crew decided to continue their landing despite the warning, as they could not understand why it had sounded. The aircraft landed with the nose landing

gear retracted. There was no fire and no emergency evacuation ordered by the Captain (BASI, September 1996).

The investigation into this accident identified many contributing factors involving the operator (Ansett) and the regulator CASA (Civil Aviation Safety Authority) such as (BASI, September 1996):

- Inadequate waivers from the regulator that allowed the same crew to complete the flight in another aircraft.
- Management and supervision of the CAA's role in Ansett's B747 introduction to service was inadequate.
- The air operator certificate was issued by CAA's project manager to Ansett before the company met all the regulated requirements.
- Inadequate CAA's staff training in the procedures for issuing an air operator's certificate.
- CAA's organisational climate was biased towards commercial considerations rather than compliance and safety.
- CAA staff did not take sufficient action to ensure that concerns raised during inspections and surveillance were addressed.
- Real or imagined pressure probably influenced some of the actions taken by CAA staff.

#### **2.9.1.2 ATSB Findings on Lockhart River Air Accident (VH-TFU, 2005)**

A Fairchild aircraft SA227-DC Metro 23 aircraft operated by Transair crashed on 7 May 2005 close to Lockhart River aerodrome in Australia when 13 passengers and two crew members were killed. According to the Australian Transport Safety Bureau (ATSB), formerly known as BASI, the accident was a result of a "controlled flight into terrain." (ATSB, 2007).

The final report was issued by the ATSB on 4 April, 2007. The ATSB report identified many safety problems with Transair operations that contributed to the accident. Soon after the accident, on 4 December 2006, Transair surrendered its Air Operator's Certificate and stopped its operations. Because of this, no

recommendations were issued with regard to the serious safety problems the Operator had.

The ATSB report identified several contributing factors related to the way the Australian Civil Aviation Safety Authority (CASA) conducts its business. In addition, several safety-related shortcomings from CASA, which do not fit the “contributing factors” category, were identified in the ATSB report.

The “contributing safety factors” are defined as (ATSB, 2007):

“Factor that, if it had not occurred or existed at the relevant time, then either:

The occurrence would probably not have occurred; the adverse consequences associated with the occurrence would probably not have occurred or have been as serious; or another contributing safety factor would probably not have occurred or existed.

In this context, the term ‘probably’ is defined as meaning a likelihood of more than 66 per cent.”

The identified contributing safety factors relating to CASA were (ATSB, 2007):

- CASA Inspectors were not able to “effectively and consistently” evaluate operator management systems because of insufficient guidance from CASA.
- CASA did not require operators to conduct structured and/or comprehensive risk assessments, or conduct them itself, for the initial issue or changes of Air Operator Certificates.

Moreover, the ATSB report specified the following safety factors, which did not fit the definition of contributing factors related to regulatory requirements and guidance (ATSB, 2007):

- *Although CASA released a discussion paper in 2000, and further development had occurred since then, there was no regulatory requirement for initial or recurrent crew resource management training for RPT operators. (Safety Issue)*



- *There was no regulatory requirement for flight crew undergoing a type rating on a multi-crew aircraft to be trained in procedures for crew incapacitation and crew coordination, including allocation of pilot tasks, crew cooperation and use of checklists. This was required by ICAO Annex 1 to which Australia had notified a difference. (Safety Issue)*
- *The regulatory requirements concerning crew qualifications during the conduct of instrument approaches in a multi-crew RPT operation were potentially ambiguous as to whether all crew members were required to be qualified to conduct the type of approach being carried out. (Safety Issue)*
- *CASA's guidance material provided to operators about the structure and content of an operations manual was not as comprehensive as that provided by ICAO in areas such as multi-crew procedures and stabilised approach criteria. (Safety Issue)*
- *Although CASA released a discussion paper in 2000, and further development and publicity had occurred since then, there was no regulatory requirement for RPT operators to have a safety management system. (Safety Issue)*
- *There was no regulatory requirement for instrument approach charts to include coloured contours to depict terrain. This was required by a standard in ICAO Annex 4 in certain situations. Australia had not notified a difference to the standard. (Safety Issue)*
- *There was no regulatory requirement for multi-crew RPT aircraft to be fitted with a serviceable autopilot. (Safety Issue)*

Moreover, the ATSB identified the following factors relating to CASA processes (ATSB, 2007):

- *CASA's oversight of Transair, in relation to the approval of Air Operator's Certificate variations and the conduct of surveillance, was sometimes inconsistent with CASA's policies, procedures and guidelines.*
- *CASA did not have a systematic process for determining the relative risk levels of airline operators. (Safety Issue)*

- *CASA’s process for evaluating an operations manual did not consider the usability of the manual, particularly manuals in electronic format. (Safety Issue)*
- *CASA’s process for accepting an instrument approach did not involve a systematic risk assessment of pilot workload and other potential hazards, including activation of a ground proximity warning system. (Safety Issue)*

At the end of the report, ATSB evaluated CASA’s replies to some of these issues and issued safety recommendations against the items that ATSB believed were not addressed adequately. The ATSB also issued several other recommendations to address safety issues that CASA had not yet accomplished (ATSB, 2007).

### **2.9.1.3 Coroner’s Inquest into the Lockhart River Crash**

On 17 August 2007, an inquest into the Aircraft Crash at Lockhart River was conducted by Michael Barnes from the Office of the State Coroner in Brisbane. The inquest is “not a trial between opposing parties but an inquiry into the death”, and “... the function of an inquest is to seek out and record as many of the facts concerning the death as the public interest requires” (Barnes, 2007).

In his report, Coroner Barnes blamed the pilot for the accident. He also indicated that Transair also share the blame. The Coroner also highlighted deficiencies in CASA’s surveillance and audit of Transair, but made it clear this did not mean CASA was to blame for the crash.

The Coroner also criticised the relationship between CASA and the ATSB. The report described this relationship as having “... a degree of animosity that is contrary to the productive and collaborative focus on air safety in Australia.” The Coroner recommended that the Federal Minister for Transport should consider an external consultant to assess whether a high-level intervention is warranted (Barnes, 2007).

The relatives of those killed were not happy and expressed disappointment with the Coroner’s findings (Australian ABC News, 2007).

Shane Urquhart, the father of Constable Sally Urquhart who died in the crash, succeeded, after strong lobbying, in convincing the Australian Senate's Rural and Regional Affairs and Transport Committee to conduct an inquiry into CASA's operations and other matters (Australian ABC News, 2008; The Australian, 2008; Cricky, 2008).

#### 2.9.1.4 Senate's Inquiry into CASA's Operations and Other Matters

In his submission to the inquiry, Mr. Urquhart accused CASA personnel of hiding information and having a "shift-the-information-into-undiscoverable-places" culture. Mr. Urquhart also rejected the results of the Miller Review. The Miller Review was a result of the Coroner's Inquest recommendation to the Federal Minister of Transport to have an external consultant assess the relationship between CASA and the ATSB and whether a high-level intervention was warranted. Mr. Urquhart indicated that the Review was conducted by "a person with strong ties to CASA through their preferred Law firm." Mr. Urquhart called Miller's recommendation that CASA and the ATSB get closer in their roles "absolutely ludicrous." (Urquhart, 2008).

A former senior legal counsel to CASA told the inquiry that the authority (CASA) had been *captured* by the industry, which made it hesitant to deal decisively with non-complying air operators. CASA's decision to move operational staff from Canberra to Brisbane was criticised by Qantas, who explained that it had led to "a growing perception in industry that senior CASA executives have undertaken little direct consultation with industry" (The Canberra Times, 2008).

The Senate inquiry issued the following three recommendations (Sterle, 2008):

1. The committee recommends the Australian Government strengthen CASA's governance framework and administrative capability by:
  - a. introducing a small board of up to five members to provide enhanced oversight and strategic direction for CASA; and
  - b. undertaking a review of CASA's funding arrangements to ensure CASA is equipped to deal with new regulatory challenges.

2. The committee recommends, in accordance with the findings of the Hawke Taskforce, that CASA's Regulatory Reform Programme be brought to a conclusion as quickly as possible to provide certainty to industry and to ensure CASA and industry are ready to address future safety challenges.
3. The committee recommends that the Australian National Audit Office audit CASA's implementation and administration of its Safety Management Systems approach.

The families of the crash victims were satisfied with the outcome of the inquiry and its recommendations. Urquhart stated “we were very happy with the outcome of that inquiry.” He also mentioned that he likes “... the last recommendation about the Australian Audit Bureau having a good hard look at CASA’s operations and how they do business...” (Australian ABC News, 2010).

The effect and benefits of ATSB functional and structural independence from the regulator (CASA) made it possible for the ATSB to freely criticise CASA, which would have been very difficult otherwise.

## **2.9.2 Lessons from the United Kingdom**

### **2.9.2.1 The Ladbroke Grove Rail Accident Inquiry**

Another inquiry into, this time, a rail accident ended with the recommendation of establishing an independent Rail Accident Investigation Branch (RAIB) in the UK to improve railway safety. The Ladbroke Grove or Paddington train accident occurred on 5 October 1999 in London, England. A total of 31 people were killed in the accident and 227 were injured. A public inquiry led by Lord Cullen into the crash has led to the creation of the independent Rail Safety and Standards Board (RSSB) and the above-mentioned RAIB.

The RSSB is an independent company (not for profit) owned by the rail industry stakeholders. Its primary objective is “to facilitate the railway industry’s work to achieve continuous improvement in the health and safety performance of the railways in Great Britain, and thus to facilitate the reduction of risk to passengers, employees and the affected public.” (RSSB, 2010).

The RAIB is a government agency similar to the, already proved to be, successful independent accident investigation branches: the Air Accident Investigation Branch (AAIB) and the Marine Accident Investigation Branch (MAIB). The RAIB is charged with finding the facts of the event under investigation and evaluating causes, but without apportioning blame or establishing liability. In addition, the RAIB does not enforce safety law or conduct prosecutions (RAIB, 2010).

Lord Cullen proposed an independent RAIB that would investigate rail accidents and serious incidents while other incidents would be investigated by the industry. The report considered carrying out accident investigations by the regulator as “inappropriate” because there might be a chance that the safety regulator’s decisions needed to be examined and criticised. In addition, the proposed activities of such an independent investigation body would provide feedback on the safety regulator functions (Lord Cullen, 2001).

The Cullen report stated a number of criticisms of the rail investigation system used by Her Majesty’s Railway Inspectorate (HMRI) before the establishment of the RAIB (Lord Cullen, 2001):

- Low number of investigators
- Unpublished reports
- Lack of transparency
- Unpublished recommendations and progress of their implementation
- Not keeping the families informed throughout the investigation and briefing them about any report before it was published

The report stated a number of benefits of having a separate investigation function from an enforcement one:

- Lessons can be learned without apportioning blame.
- A greater chance to make the investigation process more efficient and improve investigation skills.
- Enhancement in the dissemination of the lessons learned and recommendations.

- Freedom of the independent investigation body to criticise the regulatory decisions and describe their contribution to the accident.

According to the Cullen Report, other countries such as the US, Canada, and New Zealand had positive experiences with independent accident investigation setups. The report also rejects a setup where the investigators and regulators co-exist in a single regulator even if there is an arrangement where a “Chinese wall” between the investigators and the regulators is set, which would not work because it won’t “*inspire confidence among the industry or the public*” (Lord Cullen, 2001).

#### 2.9.2.2 Arguments against an Independent RAIB

As a counter argument to the need for establishing an independent investigation body, the UK Health and Safety Executive (HSE) Counsel argued that (Lord Cullen, 2001):

- There was no evidence of actual conflict between its regulatory and investigatory roles.
- Inspection techniques and investigation techniques benefit from each other.
- There is a danger that investigators get out of touch because of their isolation from “*day to day operations*”.
- There are numerous occasions for “cross-fertilisation of ideas and experiences” when auditors and investigators are in the same organisation.
- Forensic and technical support is readily available for investigators.
- It was possible for the HSE to investigate and prosecute and that the aviation model (AAIB) is not comparable.

Moreover, the Transport Safety Review (TSR) team argued that by setting up a separate investigation body the recruiting process will be fierce and HM Railway Inspectorate (HMRI) experts might be lost in the process. In addition, Mr. Waldram, former President of the Institution of Occupational Safety and Health

(IOSH) argued that good accident investigators are good auditors and therefore they should be in a single organisation.

### 2.9.2.3 Conclusions from the Ladbroke Inquiry

Lord Cullen concluded in his report that (Lord Cullen, 2001):

- HMRI criticisms against establishing an independent investigation body are related to performance which can be corrected.
- The stronger argument is in favour of establishing an investigation body with real and perceived independence.
- The aviation system in the UK and the transportation systems in other countries demonstrated the effectiveness and success of such a setup.
- Having an independent investigation body can bring the benefit of focusing on the lessons learned and recommendations to improve safety.
- As a disadvantage of having an independent investigation body, there might be a danger of losing direct contact between the investigators and the operation.
- Stronger arguments are demonstrated in favour of establishing an independent accident investigation and, therefore, it is recommended by the report.

### 2.9.3 Independent Accident Investigation in Military Aviation

On the 2<sup>nd</sup> of September 2006 a UK Royal Air Force Nimrod XV230 caught fire while airborne over Afghanistan which led to an explosion and total loss of the aircraft and every one of the 14 Service Personnel on board. Because of the location of the crash it was not possible to recover the wreckage. It was, however, possible to identify a fuel leakage as the most probable physical cause of the fire.

Charles Haddon-Cave QC was appointed by the Secretary of State on 13 December, 2007 to conduct a review into the wider issues of the loss of Nimrod XV230.

In his report, Haddon-Cave identified several “missed opportunities” that could have been utilised to prevent the accident (Haddon-Cave, 2009):

- The risk of an airborne fire from misaligned FRS couplings: Harrier XW921 (1988)
- The potential for leaks from fuel couplings to migrate: Nimrod XV249 (1999)
- The risks from split fuel seals: Nimrod XV245 (2000)
- The fire risks from fuel coupling leaking onto a hot duct: Nimrod XV229 (2000)
- The risks of a fuel coupling leak being ignited by a hot duct despite insulation: Tornado ZA599 (2002)
- The risks of the rupture of bleed-air ducting destroying adjacent fuel seals: Nimrod XV227 (2004)
- The potential increase in risk following a second bleed-air duct failure: Nimrod XV229 (2005)

A safety review was carried out by BAE Systems, Ministry of Defence (MoD), and an independent advisor (QinetiQ) between 2001 and 2005. The review did not discover the design problems, and “the best opportunity” to avoid the accident was missed. The review is described as “lamentable job from start to finish” and “... a story of incompetence, complacency and cynicism” (Haddon-Cave, 2009).

Haddon-Cave describes the lack of independence of the regulatory system of the MoD as a “fundamental weakness”. The following two aspects are considered to be the results of the absence of regulatory independence:

- Lack of independent regulatory oversight
- Presence of people that represent two conflicting functions: Airworthiness and Output duties.

The Nimrod report explains in detail the UK’s MoD airworthiness system deficiency. The report attributes this deficiency to many reasons some of which are: the dilution of airworthiness as a discipline, lack of independence and transparency, lack of “ownership” of airworthiness, complex regulations, no training in airworthiness regulations, as well as other reasons. As a result,



Haddon-Cave has identified the following set of key principles necessary for an effective safety and airworthiness system:

- Leadership
- Independence
- People (not just processes and paper)
- Simplicity.

To overcome these deficiencies, Haddon-Cave proposes a “new military airworthiness regime”. In the centre of the specified aims of this proposed new regime is that “accident investigations will be independent, competent and effective.”

Military air accident investigations were formerly based in Boards of Inquiry (BOI) assembled by the Aircraft Operating Authority (AOA). The civil AAIB is usually called to help in an investigation when possible. Haddon-Cave recommends a new and independent Military Air Accident Investigation Branch (MAAIB) to investigate military accidents. The findings for this subject are summarised in five areas:

- The Service Inquiry (SI) is not independent
- There is no joint military accident technical investigation team trained to investigate all military aircraft types
- There is no proper system in place for learning lessons from investigations
- There is a lack of experience on aircraft type
- There is a need for more cooperation between the military and the AAIB

The Haddon-Cave Report is not the first report to criticise MOD air accident investigations. In 1986, the UK’s Chief Air Accident Inspector, Mr William Tench, was commissioned to “review the procedures pertaining to Service Boards of Inquiry”. The Tench Report identified two main problems with the MOD accident investigation system: low standards and lack of independence. Tench emphasised the need for independent military accident investigations

and declared BOI to be obsolete. The recommendations of the Tench Report were not implemented (Haddon-Cave, 2009).

To resolve the deficiencies in the area of military investigations, Haddon-Cave put forward several recommendations:

1. The Military Aviation Authority (MAA) shall be the single convening authority for Service Inquiries (SI) for all aircraft accidents involving military aircraft and/or military personnel.
2. The MAA shall establish a Joint Service MAAIB which shall comprise a permanent team of specialists to carry out investigations into the immediate causes of air accidents.
3. The investigation shall focus on two key areas: first, a technical/operational investigation into the immediate causes of the accident; second, a detailed investigation into the wider aspects and implications of the accident.
4. Presidents and members of SI should have proper administrative, secretarial and legal support.
5. The President and members of SI should retain residual responsibility following the delivery of their Report to confirm to the Head of the MAA in due course whether their Recommendations have been enacted correctly, adequately and in a timely fashion.
6. In any case where an SI has to investigate the decisions or activities of the Regulator itself, the President of the SI shall report directly to the 2<sup>nd</sup> Permanent Under-Secretary.
7. The MAAIB should maintain a close liaison with other international organisations, both military and civil, entrusted with the investigation of air accidents.

#### **2.9.3.1 Organisational Factors**

Personality and “group culture” can affect individuals and their perception of safety and risk taking (Braithwaite, 2001). This effect of group culture was present in the Nimrod accident. According to Haddon-Cave (2009), there was a shift in organisational culture from safety to financial targets within the UK MoD

between 1998 and 2006. Internal promotions were based on budget improvements, not safety improvements. As a result, business became the first priority, not safety.

A similar cultural effect was noticed before in other accident investigations. For example, the Columbia Accident Investigation Board (CAIB) that was formed by NASA to investigate the Space Shuttle Columbia accident that occurred on 1 February 2003, brought attention to what are called “organizational causes” or failures in their final report (CAIB, 2003).

One of the recommendations in the CAIB report that was released on 26 August of the same year was to establish an “Independent Technical Engineering Authority” responsible for technical requirements and waivers of technical requirements amongst other functions. It was also recommended in the report that NASA, should “prepare a detailed plan for defining, establishing, transitioning, and implementing an independent safety program” (CAIB, 2003).

One of the lessons that the Haddon-Cave Report highlighted was that the organisational failures in this accident were similar to those of other accidents and particularly in the Space Shuttles Challenger and Columbia accidents (Haddon-Cave, 2009). In both cases, the independence of the safety programme has been put forward as a solution to mitigate these organisational risk factors.

#### **2.9.4 United States National Transportation Safety Board (NTSB)**

The US National Transportation Safety Board (NTSB) is an independent multi-mode federal agency that is concerned with finding the causes of accidents and promoting safety. Other than accident investigations, the NTSB also “...conducts safety studies, evaluates the effectiveness of other governmental agencies’ programs for preventing transportation accidents, and reviews the appeals of enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and the U.S. Coast Guard (USCG), as well as the appeals of civil penalty actions taken by the FAA” (NTSB, 2010).

The most important product of the NTSB, and any safety board, is its recommendations. They are the vehicle to improve safety. The NTSB's mission as stated on their website is to promote transportation safety by:

- Maintaining our congressionally mandated independence and objectivity;
- Conducting objective, precise accident investigations and safety studies;
- Performing fair and objective airman and mariner certification appeals; and
- Advocating and promoting safety recommendations, and to assist victims of transportation accidents and their families.

In 1929, the Air Commerce Act gave the responsibility of investigating aircraft accidents to the U.S. Department of Commerce. In 1940, this responsibility was transferred to the Civil Aeronautics Board's Bureau of Aviation Safety. In 1967, the U.S. Department of Transportation (DOT) was created and the independent NTSB was established within the Department. In 1974, the NTSB was separated from the Department of Transportation, to ensure the NTSB's independence for proper oversight, after Congress passed the Independent Safety Board Act of 1974 (NTSB, 2010).

What emphasises the NTSB's independence is its total separation from other transportation industry's stakeholders. The travelling public is the most important stakeholder in the NTSB, and "promoting transportation safety for the travelling public" is their only objective (NTSB, 2010).

The first safety board to implement both independence and multi-mode concepts is the NTSB, which was established in 1967 (Stoop and Roed-Larsen, 2009). Terry Baxter, who was working for the American NTSB at the time of publishing his article, states that setting up a council that is responsible for investigating accidents in all modes of transportation is the best way to ensure independent investigation. According to him, the American NTSB reached its current level of effectiveness "not only from its independence, but also from its mandate to investigate accidents in all areas of transportation." Baxter also states that the independence of the safety board was found to be essential in order to stay away from any conflict of interest during any investigation and

such a safety board would have a single mission – to improve public safety (Baxter, 1995).

The American Congress wanted the Government to focus on safety and that is why the NTSB was created with no other function assigned to it. Congress also wanted to form an independent body with no distracting or proprietary influences present, which are often seen when the investigating body is part of the operator or the regulator. By not giving other tasks that demand time and attention to those involved in safety, the NTSB developed a very high degree of expertise amongst its employees. To ensure the independence of the NTSB, the Congress passed the Independent Safety Board Act in 1974 which severed the NTSB ties to the Department of Transportation and gave increased authority to the NTSB in accident investigation (Baxter, 1995).

Pieter van Vollenhoven claims that the NTSB was the only truly independent accident investigation board for many years. It was set up to investigate accidents in all modes of transportation from the beginning. Its independence was planned from start since it was set up as a permanent, autonomous organisation. It is the success of the experience of the NTSB that led to greater development in the field of accident investigation. Because of the NTSB's success in investigating accidents in all modes, that Sweden, Finland, Canada, New Zealand, the Netherlands, Australia, Indonesia and other countries decided to set up multi-modal transport safety boards of their own (van Vollenhoven, 2001). Van Vollenhoven was the chairman of the Dutch Safety Board (DSB) at the time, the only multi-sector investigation body in the world.

Sweedler (1995) claims that the American NTSB achieved a good record as a result of saving “thousands of lives” and preventing “many accidents” because of its independence.

The credibility of the independent NTSB makes the recipients of the recommendations more willing to implement them. The investigators' competency and high technical qualifications add to the credibility of the NTSB and with this growing credibility, the recommendations' acceptance rate also grows (Sweedler, 1995).

### 2.9.5 United Kingdom Air Accidents Investigation Branch (AAIB)

The UK AAIB emerged from military aviation. Air investigation started in the Royal Flying Corps in 1915. In 1920, the Air Navigation Act came out and made it possible to make regulations for investigating air accidents (Stoop and Kahan, 2005).

The second factor, considered by Smart (2004) is the *independence* of the investigation body. Three government aircraft accident investigation reviews in the UK are claimed to have had a major effect on the issue of independence. The three reports are: the “Shelmerdine committee” report in 1945, the “Newton Committee” review, and the “Cairns Report”. All three reviews emphasised the importance of the independence of the accident investigation body.

The Shelmerdine Committee was a departmental committee that was selected in 1943 to consider what amendments were essential to the Accident Regulations to meet post-war circumstances. The report was finished in 1945 but was not published; however, it was referred to by other reports. One of its recommendations was to standardize the Inspector’s Investigation Report format which has since been done (Newton, 1948; Cairns, 1961).

The Newton Committee looked at the history of accident investigation and legislations relevant to it in the UK. In November 1948 the Committee issued its final report and concluded that the fact that the Chief Inspector reports to the Minister of Aviation is not acceptable and recommended complete separation of the accidents investigation branch from the Ministry of Aviation. It also recommended the establishment of an independent Civil Air Accident Board. The Minister, however, did not accept these recommendations and criticised them in his memorandum which is attached to the report (Newton, 1948).

In 1959 a “committee in civil aircraft accident investigation and licence control” was appointed by the Ministry of Aviation “to inquire into the law and practice” of civil aircraft accident investigations and the licensing of civil aviation personnel in the UK. The committee’s report, also known as the Cairns Report, concluded

with important recommendations with regard to the independence of air accident investigations (Cairns, 1961).

The Cairns Report criticised the accident investigation system that was in effect at the time. The Report also criticised several aspects of the regulations some of which are (Cairns, 1961):

- Under the regulations at the time, when it is clear that someone is going to be blamed for the accident, it is the responsibility of the Inspector to notify that person that he may be blamed and give him a chance to make a statement.
- Not all reports are published.
- Although the Chief Inspector can independently decide which accidents to investigate, he is responsible to, and reports to the Minister of Aviation.

The Cairns Committee received strong recommendations to completely separate the Chief Inspector and his branch from the Ministry of Aviation and move them to another Government Department. The main reason why people think the accident investigation branch should be separated from the Ministry of Aviation is that the Ministry both own and staff facilities that directly affect the safe operation of aircraft, such as ATC, landing systems, and telecommunications and radio aids to navigation. The Ministry, because of these activities, is likely to be involved in the accident investigation. Such an arrangement makes it difficult for the Ministry employee, the Inspector investigating the event, to be unbiased in his investigation. Moreover, the Minister may have to answer to Parliament for both his staff that may be investigated and for the Inspector who is investigating.

On the other hand, the Minister of Aviation and other government departments believe that it is not suitable to separate the accident investigation branch from the Ministry of Aviation for several reasons: several other governmental and non-governmental bodies are against this separation and believe it will not help the investigation; the branch would lose contact with the aviation industry and would not be updated on what is going on within the industry; the separation

would not be real because technical advice from the Ministry of Aviation would still be needed (Newton, 1948; Cairns, 1961).

Justice Cairns (1961) studied the possibility of applying the laws and practices of accident investigations used in railway and marine modes (at that time) to the air mode. It was concluded that the railway and marine modes accident investigations would not be sufficient for finding the causes of aircraft accidents and would not be suitable to apply them to the civil aviation for several reasons:

- Aircraft field investigations are usually more complex and longer-lasting
- The number of people that need to be questioned are far greater in air investigations
- More experiments and tests are usually done in air investigations

The Cairns Report made several recommendations to the Ministry of Aviation concerning the independence of aircraft accident investigations (Cairns, 1961):

- The regulations should explicitly state the purpose of aircraft accident investigation and that is; "...to determine the cause, or causes, of an accident so that appropriate action, based on the findings, may be taken to avoid further accidents."
- The branch of accident investigation should not be separated from the Ministry of Aviation because the "real protection for the public lies in the independence of the investigation rather than the formal separation."
- The Directorate of Aviation Safety and the Accident Investigation Branch would work better in disseminating safety information and in the follow-up of the implementation if they report to the same senior officer. Therefore, the Chief Inspector should continue to report to the Minister directly.
- All accident reports should be available to the public.
- Accident reports should be more detailed to deal with immediate causes as well as contributory causes.
- Accident investigations should not attribute blame to anybody.

One more review led to the Council Directive 94/56/EC entitled "Establishing the Fundamental Principles Governing the Investigation of Civil Aviation Accidents



and Incidents” which was introduced in 1994. The review was the result of two reports by Mr. Geoffrey Wilkinson and Professor Lucian Rapp.

Smart (2004), who was the Chief Inspector of the UK AAIB at the time, claims that the public and industry trust in the capability of the AAIB in the UK encouraged other modes of transportation to use this model. The author claims that the public and the industry seem to be confident that the AAIB does a thorough job investigating air accidents and keeping the bereaved families updated while the investigation is ongoing.

Smart (2004) mentioned four factors which he considered necessary to establish “trust”:

- Investigation framework
- Actual and perceived independence
- Safety culture
- Qualities of investigators and their liaison with bereaved families

Several forces, all related to the safety culture, were behind the established trust in the aviation industry in the UK. These “cultural” forces are: the effect of having a “just” culture for reporting; the perception of high risk in the industry; the dynamic nature of the aviation industry; the benefit that major safety developments are done internationally; and the fact that most people in the industry are well paid (Smart, 2004).

### **3 CRIMINALISATION AND JUST CULTURE**

Criminalisation is the main threat to the independence of accident investigations. The improvement of flight safety is hindered when the persons involved in an aviation accident are criminally prosecuted for their mistakes, or when the safety data gathered in safety investigations is used to apportion blame or liability. Flight safety improvement depends highly on the data gathered voluntarily from individuals involved in an aviation accident. However, no one will volunteer to give any information, even if it is vital for aviation safety, knowing that this information might be used in other proceedings to impose judicial or administrative punishment and could lead to self-incrimination

The upgrade of section 5.4.1 in the 10<sup>th</sup> edition of Annex 13 to a standard enhances the independence of safety investigations which in turn improves the protection of safety information and those who provide the safety information. It also obligates States to enhance the regulations safeguarding the independence of the safety investigations, and the coordination between safety investigations and other parallel investigations. This kind of coordination when adopted by an ICAO-Member State would actually enhance the effectiveness of both safety investigations and administrative/judicial proceedings.

Although ICAO Annex 13 standards, such as section 5.4.1, emphasize the independence of safety investigations (which may involve other States) from the local judicial proceedings, it is important to understand that the sovereignty of each State is not degraded.

In addition, the independence of the accident investigation authority from the Regulator allows for impartial judgment of the role of the Regulator in providing a safe operational environment. This independence also helps the quick dissemination of safety lessons learned from independent investigations to the international community.

Usually, there are administrative or judicial investigations going on in parallel with the safety investigations because aviation accidents are high profile accidents and often

get a lot of media attention. ICAO framework gives higher priority to safety investigations to prevent other investigations from interfering.

By ensuring an adequate level of independence and coordination, the accident investigation authority can have immediate and unrestricted access to the accident site, the wreckage, flight recorders, and witnesses without interference from other authorities. The investigation authority can also perform necessary destructive testing on evidence when needed without interference from the judicial authorities.

### **3.1 Protection of Records**

The independence of accident investigations is directly related to the protection of records such as the FDR, CVR, and witness identity. Also, protecting the identity of the witness is necessary to keep the flow of information coming to the accident investigation authority. Otherwise, the authority's integrity and public's trust may be lost. The focus of the investigation authority should be on safety advancement not on apportioning blame or liability.

ICAO Annex 13 10<sup>th</sup> ed. paragraph 5.12 states:

“5.12 The State conducting the investigation of an accident or incident shall not make the following records available for purposes other than accident or incident investigation, unless the appropriate authority for the administration of justice in that State determines that their disclosure outweighs the adverse domestic and international impact such action may have on that or any future investigations:

- a. all statements taken from persons by the investigation authorities in the course of their investigation;
- b. all communications between persons having been involved in the operation of the aircraft;
- c. medical or private information regarding persons involved in the accident or incident;
- d. cockpit voice recordings and transcripts from such recordings;
- e. recordings and transcriptions of recordings from air traffic control units;
- f. cockpit airborne image recordings and any part or transcripts from such recordings; and

- g. opinions expressed in the analysis of information, including flight recorder information.

“5.12.1 These records shall be included in the final report or its appendices only when pertinent to the analysis of the accident or incident. Parts of the records not relevant to the analysis shall not be disclosed.

*“Note 1.— Information contained in the records listed above, which includes information given voluntarily by persons interviewed during the investigation of an accident or incident, could be utilized inappropriately for subsequent disciplinary, civil, administrative and criminal proceedings. If such information is distributed, it may, in the future, no longer be openly disclosed to investigators. Lack of access to such information would impede the investigation process and seriously affect flight safety.*

*“Note 2.— Attachment E contains legal guidance for the protection of information from safety data collection and processing systems.*

“5.12.2 The names of the persons involved in the accident or incident shall not be disclosed to the public by the accident investigation authority.”

However, complying with paragraph 5.12 has proved to be difficult in some countries. A paper presented by the Secretariat of the ICAO Accident Investigation Group (AIG) during the AIG divisional meeting in October 2008 in Montreal, Canada revealed that there are problems in some countries’ legal systems with regard to the protection of safety information (AIG Secretariat, 2008c).

The ICAO 35<sup>th</sup> Assembly acknowledged the necessity and need for protecting safety information from inappropriate use, which might prevent the availability of this information in the future. The Assembly noted that “existing national laws and regulations in many States may not adequately address the manner in which safety information is protected from inappropriate use.” Due to the importance of the issue and the need to have a balance between the “proper administration of justice” and the protection of safety information, the 35<sup>th</sup> Assembly instructed the Council to develop guidance for this issue. A legal guidance for the protection of information from Safety Data Collection and Processing Systems (SDCPS) was developed to assist States to enact laws and regulations to protect this information and at the

same time allow for proper administration of justice. The guidance was added as Attachment E to Annex 13 (AIG Secretariat, 2008c; ICAO Assembly, 2004).

The Secretariat sent out a State letter requesting States to comment on the “level of implementation” of Attachment E. A total of 53 States replied. Many ICAO-States benefited from the guidance of Attachment E. Some of them mentioned that Attachment E was or will be “used as the basis from which relevant legislation was drafted.” There were 12 States, however, that mentioned that they did not benefit from the guidance in Attachment E. Analysis of these 12 States showed that five of the State’s laws and regulations in force did not allow for the implementation of the guidance material in Attachment E, and two of the 12 States had no provision in their legislation to protect accident and incident records. The Secretariat concluded that Attachment E is reaching its goal and that there was no need for its reassessment at this point in time (AIG Secretariat, 2008c).

According to the Flight Safety Foundation (FSF) website, there was a listening session held by the ICAO Safety Information Protection Task Force (SIP TF) in Washington DC, USA on the 5<sup>th</sup> of December, 2012. The SIP TF aims to “understand the needs and perspectives of interested groups and individuals,” and to “identify a sound basis on which to consider approaches to balancing the protection of safety information with the administration of justice, safety-related regulatory action, and the public’s right to know.” (FSF, 2012)

### **3.2 Just Culture**

On April 27, 2010 a conference was held by the Air Law Group of the Royal Aeronautical Society (RAeS) in London, UK to discuss the proposed EU regulation on Air Accident Investigation. The conference was titled; “The Criminalisation of Air Accidents and the Just Culture”.

The speakers emphasised the importance of the safety investigation’s independence and that such investigations must not be concerned with apportioning blame or liability.

Conference attendees were from different organisations within the Aviation and related industries, including EASA, AAIB, IATA, Law firms, Insurance, Department of

Transportation, European Commission, EUROCONTROL, Swiss Air Navigation Services, CAA, Airlines, Universities, and others. The diversity presented within the background of the attendees gives a good indication of how important this subject is and how many industries it touches directly and indirectly.

Haddon-Cave in his keynote speech to the conference identified several dangers associated with the “Criminalisation of the investigation”: people will refuse to come forward; self-preservation within management; engineers will be scared to take decisions; delegation will be blurred; and the danger of promiscuous procedures (Haddon-Cave, 2010).

The speaker also emphasised that there should be protection for data/evidence, protection for witnesses, and assurance that published safety reports can only be used for their purpose. All speeches revolved around the concept of “Just Culture”.

Just Culture aims to achieve a delicate balance between encouraging crucial safety information flow for the purpose of improving aviation safety, and acknowledging the judicial system and the need to prosecute criminal acts (Troger, 2011).

There are several attempts to define Just Culture. For example, Eurocontrol defines it as “...culture where 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”(EUROCONTROL, 2008).

Also, James Reason provides the following definition:

“... atmosphere of trust in which people are encouraged for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour” (Reason, 1997).

The USA based Joint Planning and Development Office (JPDO) of the Next Generation Air Transportation System called Just Culture a “healthy alternative” to blaming culture, and defines it as “... Just Culture is one in which employees are held accountable for deliberate violations of the rules but are encouraged and

rewarded for providing essential safety-related information. A Just Culture does not tolerate reckless behaviour or deliberate malfeasance” (JPDO, 2010).

Correct implementation of Just Culture is not an easy task because of the various stakeholders involved in the implementation of this concept.

The JPDO (2010) listed three core principles in Just culture, which need to be incorporated in regulatory framework to provide legal certainty:

1. Identification of appropriate safeguards to ensure witnesses participation in safety investigations will not be punished
2. This protection shall not be granted to those who conduct gross negligence or wilful misconduct
3. To improve aviation safety, full contribution to aviation safety should be encouraged.

Learning from mistakes can be attained when a Just Culture is implemented. In general, there are three main benefits of having a Just Culture (GAIN, 2004):

- Increased reporting
- Trust building
- More effective safety management.

Various groups, within a state or an organisation, with different, sometimes conflicting, goals can work together to improve safety if the concept of Just Culture is implemented correctly because of the trust it brings with its implementation. This would improve the effectiveness of safety management and improve the sharing of safety information.

Just Culture encourages speaking out, is based on trust, and is not blame free. Neither a blame culture nor blame-free culture should be favoured. Balance in accident investigation between the two cultures should be promoted.

### **3.3 Blame and Blame-Free Culture**

The purpose of accident investigations is to find and document all relevant facts, establish their relationship to the accident and identify their causes in order to

prevent a similar accident from happening again. The purpose is not to find the person or persons responsible for causing the accident (Tench, 1985).

When the purpose of the accident investigation is to allocate accountability for the sake of taking disciplinary action, the search for the real causes will be influenced. Investigations with such a purpose will also restrict “the range of viable remedial actions.” Because of the blame feeling, involved personnel will try to protect themselves and may hide or alter information. In addition, people will be reluctant to report accidents or near-accidents to avoid guilt and blame. Accident investigations with legal or disciplinary agenda should be avoided if possible or at least be clearly separated from safety investigations (Kjellén, 2000).

The independence of accident investigations is an essential prerequisite to reach the desired transparent, blame-free safety culture. It must be noted that a blame-free safety culture does not mean ignorant management or that personnel can get away with their “crimes”. The promoted blame-free culture is all about the people who tried hard to do their job correctly, but things went wrong. This culture is promoted to encourage people to come forward and tell their story to help safety investigators understand what exactly happened and why. It is crucial to learn every possible lesson from an accident to prevent similar accidents from happening in the future (Haddon-Cave, 2010).

Lord Cullen (2001) referred to a report by the National Economic Research Associates (NERA) on Safety Regulations and Standards for European Railways. The NERA report identified that in order for an investigation board to focus on finding systemic safety shortcomings without apportioning blame, several requirements must be satisfied: the board must be independent; the board must be able to call on expertise as needed; and there must be protection from court proceedings against blame and punishment.

### **3.4 Criminalisation in Aviation and Healthcare**

The EUROCONTROL’s Performance Review Unit (PRU) conducted a safety survey in 2001-2002 on penalty-free ATM safety occurrence reporting in Europe. They found out that many States had legal obstacles that prevented the correct



implementation of non-punitive ATM safety occurrence reporting. Because of these constraints, and especially in States that have “Freedom of Information” legislation in effect and where safety reports are not protected from the application of this legislation, many staff felt restrained from reporting. The survey analysis noted that there was poor communication between Air Navigation Service Providers and the “people on the ground”. Safety regulators were regarded in many States as being weak and without a defined role (EUROCONTROL, 2002).

The report points out that Directive 94/56 (Article 8) protects only the names of persons involved in incidents. There is no protection for persons involved in accidents (EUROCONTROL, 2002). Directive 94/56 was later cancelled and replaced with EU Regulation 996/2010 in 2010.

EUROCONTROL (2002) reported that most of the time, national laws are not clear about the protection of the names of those who report safety occurrences. Moreover, in most of the States, the judicial or administrative authorities have access to ATM-related accident or serious incident information gathered during a technical investigation. When it comes to complying with international requirements, the survey showed that “*the majority of States has not formally adopted Annex 13, but apply it in practice.*” Also, many States do not have paragraph 5.12 of Annex 13, regarding disclosure of flight recorder information, as part of their national law and, despite Article 38 of the Chicago Convention, half of them did not file difference with ICAO.

Criminal prosecution is seen as a threat to employees’ safety and to safety-critical systems in many industries such as aviation and the healthcare industry. The issue of criminal prosecution has seen recent increases; however, no effective programmes exist to stop this increase (Dekker, 2011; Michaelides-Mateou and Mateou, 2010).

Aviation professionals have been prosecuted in the Netherlands, England, Spain, France, Italy, Greece, Cyprus, USA, Taiwan, and other countries (Brothers and Maynard, 2008; Dekker, 2011; Esler, 2009; Learmount and Modola, 2004; Michaelides-Mateou and Mateou, 2010; PSEKA, 2009).

*“Under the Swiss law the CAA is obliged to report any occurrence considered as a concrete endangerment of life in public transport to the prosecutor. ATCOs in that State feel that they are therefore under constant threat of criminal proceedings if they report an occurrence. Consequently, there is a strong reluctance to report safety occurrences; this results in a lack of visibility of potential problems.”*  
(EUROCONTROL, 2002)

Dekker (2011) claims that healthcare, shipping, construction, and chemical processing industries have also seen an increase in criminalisation recently. There is a specific criminal category of causing air disasters in some countries, such as Italy. The author discussed the social causes and organisational consequences of this phenomenon.

Criminalising professional mistakes is a concern for several reasons (Dekker, 2011); first, it interferes with independent safety investigations and with safety reporting and disclosure of errors (Berlinger, 2005; Brous, 2008).

The second reason is the inevitability of mistakes. Professional mistakes in aviation or healthcare cannot be prevented through sanctions. Chapman (2009) explained, when describing mistakes in the drug industry *“dispensing mistakes happen. And even with the introduction of robots and Standard Operating Procedures, the Utopian ideal of a world without errors is closer to fantasy than reality.”*

The third reason is that prosecuting individuals is taking precedent over pursuing system improvements. Bodies such as accident investigation authorities in aviation and medical discipline committees in medicine are in a better place to deal with the failures of their safety-critical systems (FSF, 2006).

The fourth reason for concern is the thin line between acceptable and unacceptable behaviour (Morrill et al., 1997). Who draws the line? This line is not an agreed upon and clearly defined line. It is a *“judgement that could be influenced by politics, power, and populism”* (ibid.)

This is another reason why the *independence* of accident investigations must be ensured to prevent the influence of politics, power and other factors.

An example from aviation that shows the negative effect of criminalisation on “safety culture” is the Ansett de Havilland Dash 8 crash in June 1995 in New Zealand. Four people died in the aircraft accident, but the pilots survived. The cockpit voice recorder (CVR) was turned over to criminal prosecutors, who charged the pilots with manslaughter. In order to stop the police from using the CVR in court, pilots in New Zealand sued the police claiming that recorders should only be used for safety and educational purposes. However, the prosecutors succeeded and regained access to the CVR. Soon after that, pilots started disabling CVRs on their flights. Finally, officials agreed that police would be permitted to use CVR in future cases only when New Zealand’s High Court believed it to be necessary (McKenna, 1999).

Another problem concern is that professionals will start hiding errors because they are afraid of prosecution (Chapman, 2009). Another issue is the practice of “defensive medicine,” which requires unnecessary tests that will increase the cost of healthcare (Sharpe, 2004).

In addition, there is a worry that employees could incriminate themselves by disclosing information about violations or incidents, which could be used later in a criminal prosecution. All of these issues could reduce or even destroy the balance between accountability and learning, and affect the openness in safety cultures (Dekker, 2007; FSF, 2006; ISMP, 2007; Michaels, 2008).

There is a lack of research into the social causes leading to the increase in criminalisation. The biggest concern with judicial investigations, which are designed to apportion blame, following aviation or healthcare accidents and incidents, is that they demolish people’s trust in the system and cause them to stop voluntarily reporting mistakes, and this interferes with independent safety investigations (Berlinger, 2005; Brous, 2008; Chapman, 2009; Dekker, 2007; 2011; FSF, 2006).

Tunisian charter pilots crash-landed off the coast of Sicily, Italy in 2005. As a result of the crash, 16 people died and the pilots were later sentenced to 10 years in prison. An investigation showed that a fuel gauge that was designed for an older and smaller version of the aircraft malfunctioned on the ATR 72 turbo prop aircraft. Because of the fuel gauge reading the pilots believed they had enough fuel for their trip, which they did not. Although the pilots requested emergency services from the

ATC, they decided to crash-land the plane instead of attempting to reach Palermo airport. The prosecution also included the Director-General of the company and the company's Technical Director in addition to three other people. They were sentenced to between eight and nine years in jail by the court (RTE, 2009).

In October 2006, the Flight Safety Foundation (FSF), the Royal Aeronautical Society in England (RAeS), the Civil Air Navigation Services Organisation (CANSO), and the *Academie Nationale de L'Air et de L'Espace* (ANAE) issued a resolution condemning the increasing attempts of judicial authorities and law enforcement to criminalise human errors in aviation accidents, despite its adverse effect on aviation safety (FSF, 2006).

Voss, FSF President and CEO, stated that governments are increasingly focusing on conducting criminal investigations in the wake of accidents. Governments should ensure the safe and free flow of information, instead of punishment, to allow the understanding of what exactly happened and why, and to stop similar accidents from happening again.

Alexander ter Kuile, Secretary General of CANSO called the prosecution of basic human error a "grave mistake". According to him, the aviation industry is the most labour-intensive safety operation in the world and, therefore, human error is inevitable. Punishment is for those who break the law not for honest mistakes.

Mans, RAeS President explained that pilots, mechanics, ATC, engineers, safety regulatory officials, and others should be encouraged by authorities to speak up and admit any mistakes without fear of punishment. The focus should be on "gathering all the facts and evidence from those involved."

Several high profile examples of criminalisation of human error have been referred to by safety organisations, such as; the Embraer-Gol mid-air collision in Brazil; the French Supreme Court's decision rejecting the dismissal of criminal charges growing from the Air France Concorde crash in 2000; the criminal trial in the wake of the Air Inter crash in Strasbourg, France in 1992; and the pursuit of criminal manslaughter charges against managers of Skyguide and air traffic controllers in Switzerland related to the mid-air collision of DHL-Bashkirian in 2002 over Germany.

Moreover, in France, an Air France (Air Inter at the time) Airbus A320 crashed on its landing approach killing 87 people in 1992. In 2006, six French aviation officials were acquitted on manslaughter charges. In Japan, two Japan Airlines planes almost collided because of the confusion from the ATCs. The controllers were sentenced to prison terms on charges of negligence, with suspension, in 2008. In Indonesia, a Garuda Boeing 737 crashed on landing killing 21 people in 2007. Prosecutors charged the pilot with manslaughter (Michaels, 2008).

Five main points were made by Michaels (2008). The author:

1. Declares that the paramount consideration in an investigation should be to determine the probable cause of the accident and contributing factors, not to criminally punish individuals.
2. Declares that, in absent acts of sabotage and wilful or particularly egregious reckless conduct, criminalisation of an accident is not an effective deterrent or in the public's best interest.
3. Urges States to exercise far greater restraint and adopt stricter guidelines before officials initiate investigations or bring criminal prosecutions in the wake of aviation disasters.
4. Urges States to safeguard the safety investigation report and probable cause/contributing factors conclusions from premature disclosure and direct use in civil and criminal proceedings. It also criticised prosecutorial use of relatively untrained and inexperienced "experts," which can lead to "technically flawed analyses, a miscarriage of justice, and interference with official accident inquiries."
5. Urges accident investigating authorities to assert strong control over the investigation, free from undue interference from law enforcement, invite international cooperation in the investigation, conduct investigations deliberately and avoid a "rush to judgment," ensure the free flow of essential safety information, and address swiftly any acts or omissions in violation of aviation standards.

## **3.5 Case Studies**

### **3.5.1 The French Criminal Law and the Napoleonic Code**

In France, criminal investigations have supremacy over safety investigations because of the French criminal law system. In the event of an aircraft accident, French law gives the right to the judicial authority to seize the evidence including the FDR and CVR. The French BEA can make a copy of the FDR and CVR but only under the supervision of the police. Moreover, the BEA needs judicial consent to remove any evidence from the wreckage for examination, provided that this should not lead to the alteration or destruction of the evidence. The French criminal procedure law also applies the Napoleonic Code, which specifies that fatal accidents must be investigated with the intention of establishing blame (Trogeler, 2011).

French judicial investigations did not always have supremacy over aircraft accident investigations. There was close cooperation between the judicial investigators and the BEA investigators. The joint ministerial instructions of 3 January 1953 laid down the aspects for the cooperation and coordination of both authorities. However, on 26 June 1988 an Airbus A320 crashed during a demonstration flight at an air show near Mulhouse when the pilot flew at a low speed below 100 feet and crashed in the forest at the end of the runway. The crash killed three passengers. The BEA seized the flight recorders. However, the recorders were missing the few seconds prior to the aircraft crash when they were returned to the judicial authorities. The BEA was accused of allegedly tampering with the recorders to conceal problems with the aircraft. This event was discussed for years and led to public mistrust, which led to BEA losing the status of taking precedence over criminal proceedings related to aircraft accidents (Trogeler, 2011).

### **3.5.2 The Concorde Case**

Air France flight 4590 was destined for New York's JFK airport from Charles de Gaulle Airport on 25 July 2000. The aircraft ran over a metal strip that had fallen from a Continental Airlines aircraft that had departed a few minutes earlier. The metal strip caused one of the Concorde's tires to burst and chunks of the burst tyre impacted the aircraft's wing resulting in a rupture in tank 5 and major fuel leak. The leaking fuel

was ignited causing a huge fire under the left wing. The aircraft took off from the runway, however, the crew shut down engine 2 after the engine fire alarm sound. After about one minute of flight the landing gear could not be retracted and the aircraft was unable to gain speed or height. Then, engine 1 lost thrust and the aircraft crashed onto a hotel killing all 109 passengers and crew, and 4 people on the ground (BEA, 2004).

The French civil aviation accident and incidents investigation authority (Le Bureau d'Enquêtes et d'Analyses - BEA) investigated the accident and published the final report on January 2002. The investigators reached the following conclusions:

1. The crew were qualified and the aircraft was airworthy.
2. There was no plan for dealing with the simultaneous failure of two engines on the runway because it was considered highly unlikely.
3. The aircraft was 810 kg above the maximum takeoff weight; however the effect on takeoff performance from this excess weight was negligible.
4. The metal strip that cut the Concorde's tyre was not manufactured, and was not installed in accordance with the manufacturer procedures.
5. A high-speed runway excursion and landing gear collapse would have occurred if the pilot had attempted to abort the takeoff.
6. Even if the engines were operating normally, the aircraft would still crash because of the severe structural damage.

The final report listed the following as probable causes for the Concorde's crash (BEA, 2004):

- High-speed passage of a tyre over a part lost by an aircraft that had taken off five minutes earlier and the destruction of the tyre.
- The ripping out of a large piece of tank in a complex process of transmission of the energy produced by the impact of a piece of tyre at another point on the tank, this transmission associating deformation of the tank skin and the movement of the fuel, with perhaps the contributory effect of other more minor shocks and /or a hydrodynamic pressure surge.
- Ignition of the leaking fuel by an electric arc in the landing gear bay or through contact with the hot parts of the engine with forward propagation of the flame

causing a very large fire under the aircraft's wing and severe loss of thrust on engine 2 then engine 1.

- The impossibility of retracting the landing gear probably contributed to the retention and stabilisation of the flame throughout the flight.

The UK is the joint State of Design and Manufacture of the Concorde aircraft and had the right to participate in the investigation according to ICAO Annex 13.

The UK complained about the French approach to the investigation of aircraft accidents by involving the judiciary from the beginning of any French accident inquiry. Because of the involvement of the French judicial authorities, the UK AAIB was only allowed to examine crash evidence briefly. In addition, some evidence were withheld from the AAIB (Flightglobal, 2002).

Comments from the UK Accredited Representative are attached to the final report. In these comments, the UK Accredited Representative pointed out that the AAIB was able to make an effective contribution to the investigation because of the cooperation between the AAIB and the French BEA. However, the separate inquiry into the accident that was conducted in parallel by the French judicial authorities presented "major impediments to the AAIB's participation in the technical investigation." The UK listed the following difficulties the AAIB faced because of the French judicial inquiry:

- The French judicial authorities did not allow the AAIB Investigators to examine all items of the wreckage or to participate in component examinations
- The French judicial authorities did not allow the AAIB Investigators full access to all relevant evidence as soon as possible.
- The French judicial authorities specifically prohibited Advisors to the UK Accredited Representative from participating in the examination of major components for which the United Kingdom had primary airworthiness responsibility.

### **3.5.2.1 Criminal Investigation of the Concorde Accident**

The French authorities initiated a criminal investigation of Continental Airlines, whose plane dropped the metal strip on the runway in March 2005. In addition, the former



head of the Concorde division at Aerospatiale and the Concorde chief engineer came under investigation for negligence.

On 12 March 2008, judges brought manslaughter charges against Continental Airlines, an American Continental mechanic, an American Continental maintenance manager, a former head of Concorde division at Aerospatiale, a former employee of the French airline regulator, and the Concorde chief engineer (Michaelides-Mateou and Mateou, 2010).

As a result of the trial that was started in February 2010:

- Continental Airlines was found criminally responsible for the disaster by a Parisian court in December 2010.
- A Continental mechanic was given a 15-month suspended sentence,
- Another airline operative and three French officials were cleared of all charges.
- Another Continental employee was found not guilty.

On 29 November 2012, a French appeals court cleared Continental Airlines of manslaughter conviction. The Parisian court also ruled that Continental would have to pay 70% of any compensation claims. The French appeals court, while overturning the criminal rulings by the Parisian court, affirmed the civil ruling and left Continental liable for the compensation claims

Flight Safety Foundation (FSF) general counsel Quinn stated that “We are very pleased that courts are recognizing that professional human error does not amount to criminal conduct, even where it can lead to catastrophic consequences.” He also commented that the effort should have been towards training, human factors and technology to prevent similar tragedies from occurring again (Mark, December 2012).

This case shows that the involvement of the judicial process makes the investigation slow and cumbersome and may cause witnesses to withhold information, thus compromising the prompt dissemination of safety information. Moreover, such involvement did not allow investigations to be carried out in the shortest possible time, as required by the European Council Directive 94/56/EC, which was later

replaced by EU Regulation 996/2010 (European Union, October, 2010), nor did it allow the AAIB to conduct in-depth technical investigations to the level they feel comfortable with.

### **3.5.3 The Brazilian Aviation Case**

On September 29, 2006, Gol Boeing 737 was on scheduled passenger flight 1907 from Manaus, Brazil to Rio de Janeiro. The Gol B737 collided with an Embraer 135 Legacy aircraft that was in its way to the USA. The Gol B737 was a new aircraft that was delivered to Gol for operation on September 12, 2006 (17 days before the accident). The aircraft crashed into a rainforest after the collision. All 154 passengers and crew were killed. The Embraer Legacy also was a new aircraft that was in its delivery flight from the factory to the owner in the USA. The Embraer sustained damages on the left wing and the tail section after the mid-air collision; however, it landed safely. There were seven people on the Legacy none of whom died or were injured (CENIPA, 2008).

The accident was investigated by CENIPA (the Brazilian Air Force) and the NTSB (USA). CENIPA's final report was released on December 10, 2008. The NTSB issued their report which was attached to the final accident investigation report. In its final report, CENIPA concluded that errors from both the air traffic controllers and the Embraer Legacy's pilots caused the accident. The NTSB, however, concluded that all pilots acted properly and that the accident was a result of "individual and institutional" ATC errors. The NTSB strongly disagreed with CENIPA's conclusion about the Embraer's pilots and stated that "the crew flew the route precisely as cleared and complied with all ATC instructions." (CENIPA, 2008).

CENIPA controlled and operated Brazil's airways at the time. In this investigation CENIPA was investigating itself and cannot be considered an independent investigation body. On the other hand, the NTSB can be considered independent investigation body that had no apparent ties to either of the two aircraft or the ATC involved in the accident.

The Legacy aircraft landed at the Cachimbo's base where the officials from ANAC (Agência Nacional de Aviação Civil – the National Agency of Civil Aviation) took

possession of the Legacy's Cockpit Voice Recorder (CVR) and the Flight Data Recorder (FDR). The recorders were sent to Sao Paulo (Sao Jose dos Campos) for further analysis. Moreover, the passengers and crew were interrogated. In October 1<sup>st</sup>, a recovery process started to recover bodies and evidence, including the GOL Boeing's CVR and FDR, from the rainforest, where the aircraft crashed. The operation lasted for about seven weeks. The CVR was found 20 centimetres under the ground, and was sent to Transport Safety Board of Canada (TSB) for further analysis. The Federal Police detained both of the Legacy's pilots in Brazil. In November 16 2006, CENIPA released the preliminary investigation report, which revealed the multiple communication attempts between the Legacy Jet and the Brazilian ATC. It also reported that the Transponder in the Legacy Jet was not in operation. The report also showed that the GOL Boeing was, in accordance with its flight plan, flying at 37000 feet (de Souza, 2008).

Transponders are used to inform ATC about the altitude, coordinates, and speed of an aircraft. The transponder is also responsible for activating the anti-collision system on the aircraft. However, no information was released in this report to indicate whether the Legacy crew was following their flight plan or not, which caused the media to speculate that the Legacy Jet was not following its flight plan.

The International Federation of Air Traffic Controllers' Association (IFATCA), a worldwide organisation representing more than fifty thousand air traffic controllers in 134 countries, issued a statement criticizing CENIPA's report and indicating the need of neutrality in the investigation. The Federation indicated that the final report did not offer "clear conclusions" with regard to known problems in the Brazilian ATC system and how it contributed to the accident. IFATCA stated that "Whereas the inquiries in regard to the events in the cockpit of the Legacy private jet seem to have received a lot of attention and were done with rather detailed care by CENIPA, the same cannot be said for investigations on the ATC side," (Lacagnina, Feb 2009; IFATCA, 14 Jan 2009; IFATCA, 12 Jan 2009).

IFATCA did not believe the investigation was independent or impartial and presented its opinion in a strong statement that the Federation "... *thinks that identified shortcomings in the CENIPA report are a missed opportunity for the Brazilian*

*aviation authorities to restore trust and safety in the national aviation system. This final accident report could have served as a starting point for an extensive and desperately needed healing process.*

*...This has unfortunately not occurred, as CENIPA-an integral part of the same Brazilian Air Force that is responsible for the provision of air traffic control- has chosen to put the main responsibility for the midair collision of 2006 on the front-line operator only. This CENIPA decision appears driven by a reluctance to expose staff and departments situated in its own organization.” (IFATCA, 12 Jan 2009).*

The pilots were detained and later charged with the offence of “exposing to danger a ship or aircraft (...)”. The pilots were finally released and were allowed to leave the country around mid of December in 2006. Also, four air traffic controllers charged with criminal charges. Two ATC operators had the charges against them dismissed in 2008. In 2010, however, the Appeals Court overturned the ruling indicating that the two ATC operators should face charges (de Souza, 2008; Michaelides-Mateou and Mateou, 2010).

CENIPA denied the Brazilian Federal Police the access to the data inserted in the Boeing equipment arguing that the investigation were proceeding under the provision and protection of ICAO Annex 13. Moreover, CENIPA indicated that the investigation was under military surveillance, and that the data would be available after Canada’s Transport Safety Board (TSB) finishes their analysis. The media accused the Brazilian government of hiding information (de Souza, 2008). This came as a result of the lost trust in CENIPA’s investigation process mainly because it was not perceived as an independent investigation body.

It is clear in this case that the lack of CENIPA’s independence led to criminalizing pilots and ATC errors, which did not serve any positive purpose for this investigation. It is also noted that the lack of independence of CENIPA, and the perception of its lack of independence, had led the media and public to lose trust on the accident investigation process and on CENIPA in general.

Furthermore, in 2007, an Airbus-320 belonging to the Brazilian company TAM skidded off the runway after landing at Sao Paulo’s domestic airport in rainy

conditions, smashed into a warehouse and exploded. The Brazilian Government were blamed for not closing the runway when they knew about the potential problems that it could cause. The director of the Sao Paulo-based airline industry magazine *Asas* (*Wings*) clarified that because of its shortness and poor drainage, the runway was known as the “aircraft carrier.” Moreover, two jets had slipped off the runway without injuries in rainy weather only a day earlier. Although the runway had unfinished repair work on it, the Brazilian Government did not close it (Al Jazeera English, 2007; Reuters, 2007b; Guardian, 2007; The New York Times, 2007).

The Minister of Defence was fired on 25 July 2007 by President Luiz da Silva as a result of this crisis. The final report, published by CENIPA in September 2009, showed that one of the thrust levers was in a position to accelerate when it should have been in idle; it did not identify if the problem was mechanical or human failure. Also, CENIPA identified several contributing factors such as the high volume of rain on the day, the unfinished grooving of the runway, and the positions of the thrust levers. However, the length of the runway was not pointed out as a contributing factor (CENIPA, 2009; Reuters, 2007a; FOLHA online, 2009).

The above event of the mid-air collision, and other subsequent events, such as the air controllers’ strikes and the Airbus-320 aircraft disaster, caused what the media called the “Brazilian aviation crisis.”



## 4 EXISTING TOOLS FOR MEASURING INDEPENDENCE

This research focuses on air accident investigations and therefore the meaning of independence in this context should be explained. In chapter 2 of this thesis several definitions were presented from the existing literature. The definition that will be used for the purposes of this study is the one proposed by the ROSAT: ***“the structural (separation from authorities and clear legal status) and financial (yearly stability of funds) ability to decide what and how to investigate, and to publish the results of the investigations.”***

There are many factors involved in ensuring the proper independence of an investigation body from within the body itself and even from outside the body, especially from the judicial, legal, and political systems of that State. Having a dedicated accident investigation body that is separate from the Regulator is an essential step; however, it is not enough by itself to achieve the desired, and required, independence of investigation or the perception of being independent. An example of this is the Singapore Airlines B747 flight SQ006 accident in Taiwan in 2000.

On 31 October 2000, Singapore Airlines flight SQ006 departing to Los Angeles USA crashed on a partially closed runway in Taiwan Taoyuan International Airport during takeoff. 83 people were killed and 71 were injured. The aircraft was destroyed as a result of a collision with construction equipment and by post crash fire.

Weather conditions were poor, heavy rain and strong winds, at the time of the accident. The aircraft was cleared to depart from runway 05L, however, the pilots entered the wrong runway, 05R, which was closed for repairs at the time. Because of the poor visibility caused by weather conditions, the construction equipment parked on the runway were not visible to the flight crew (ASC, 2002).

The Aviation Safety Council (ASC) investigated the accident. The ASC, which was established as an independent agency in 1998 in New Taipei, Taiwan, is responsible for aviation accident investigations in the Free Area of the Republic of China. Although the ASC was an accident investigation body separated from the regulator at the time and indeed still is, Singapore Airlines did not believe that they are

independent. This might be due to the fact that Singapore Airlines pilots were arrested after the crash. The NTSB of the USA and ATSB of Australia were involved in the investigation to provide a “non-biased” view of the accident and contributing factors (Michaelides-Mateou and Mateou, 2010; Hannon, 2002; Gittings, 2000; BBC, 2000)

When the Justice Minister of Taiwan Chen Ting-nan announced that Taiwan will have judicial sovereignty over the investigation in SQ006 crash, the head of Taiwan's Aviation Safety Council (ASC), Jung Kai, warned against prosecuting the three SIA pilots and indicated that there was not such a precedent in the international aviation community. (Airline Industry Information, November 9, 2000)

IFALPA issued a statement protesting against the arrest of the SQ006 flight crew stating that *“in the strongest possible terms, the growing and extremely disturbing trend of apportioning ‘blame’ following aircraft accidents...the threat of civil or criminal proceedings for violations of aviation safety laws and regulations is having a profound and damaging effect on the flow of precious aviation safety information which is essential if lessons are to be learned from accident investigations.”* IFALPA cautioned that its pilots would refuse to fly to Taiwan if the SQ006 flight crew is convicted on manslaughter charges (Airline Industry Information, November 9, 2000).

In the section titled *“Findings Related to Probable Causes”*, the final report listed several factors which investigators believe played a major role in the conditions leading to the accident. The section stated that pilots failed to notice that the aircraft entered the wrong runway because they did not review the taxi route. Also, the report indicates that the flight crew did not check the paravisual display (PVD) and the primary flight display (PFD), which would have told them they are on the wrong runway (ASC, 2002).

The Accredited Representatives from Singapore did not like how the findings were presented in the report. They felt that the report concentrated on blaming the flight crew of SQ006 and “played down” the contributing factors from the closed runway. The runway did not have barriers or markings at the beginning to indicate that it is closed. Also, the runway had some lighting missing or not working at the time.



Singapore Ministry of Transport (MOT) disputed almost every single finding in the final report. The MOT wrote its own report and asked the ASC to attach it to the final published report, which they did. In addition, the NTSB's comments are also attached to the final report. The NTSB stated that they "...wish to congratulate the ASC for an excellent job in conducting the investigation". Moreover, the Australian ATSB's comments were also attached to final report. The ATSB indicated that they believe that "...the report is thorough and the conclusions fully supported." (ASC, 2002; Hannon, 2002)

Taiwanese prosecutors investigated the three pilots for possible negligence but did not pursue any criminal charges against them. The prosecutors recommended that two of the pilots have their licensed suspended and not allowed to fly in Taipei for one year (Nisha, 2011).

It is important to understand that the ultimate goal of all air accident investigations is to improve safety. This is why commercial pilots should not be prosecuted. Otherwise, some facts, which might be crucial to the improvement of flight safety, will be held up by the lawyers if pilots to be prosecuted. By ensuring a "just culture", the flight crew, maintenance, and witnesses, can share all information including the details of their mistakes during the accident which will eventually lead to better procedures or trainings.

#### **4.1 Analysing ICAO Annex 13**

ICAO Annex 13 is based on the concept of independent investigations. A huge amount of work has been put into ICAO Annex 13 since its first edition, to ensure the independence of air accident investigations, which in turn helps to realise the full benefits of learning from accidents and incidents. Analysing the ICAO Annex 13 Standards and Recommended Practices (SARPs) revealed 12 elements that are aimed to ensure the independence of the air accident investigation when implemented correctly.

Table A-1 in Appendix A shows the analysis of ICAO Annex 13 SARPs to produce these elements. The results that analysis produced are the elements shown in Table

4-1. These elements can be considered as “indicators” of the level of independence of accident investigation authorities.

**Table 4-1 ICAO Annex 13 elements for investigation independence**

<b>Not to Apportion Blame</b>	<b>Conduct of Investigation</b>	<b>Access &amp; Control (Site/evidence/witnesses)</b>	<b>Delegation</b>
<b>Legal Framework</b>	<b>Evidence</b>	<b>Separation of investigation</b>	<b>Participation</b>
<b>Transparency</b>	<b>Consultation</b>	<b>Cooperation</b>	<b>Coordination</b>

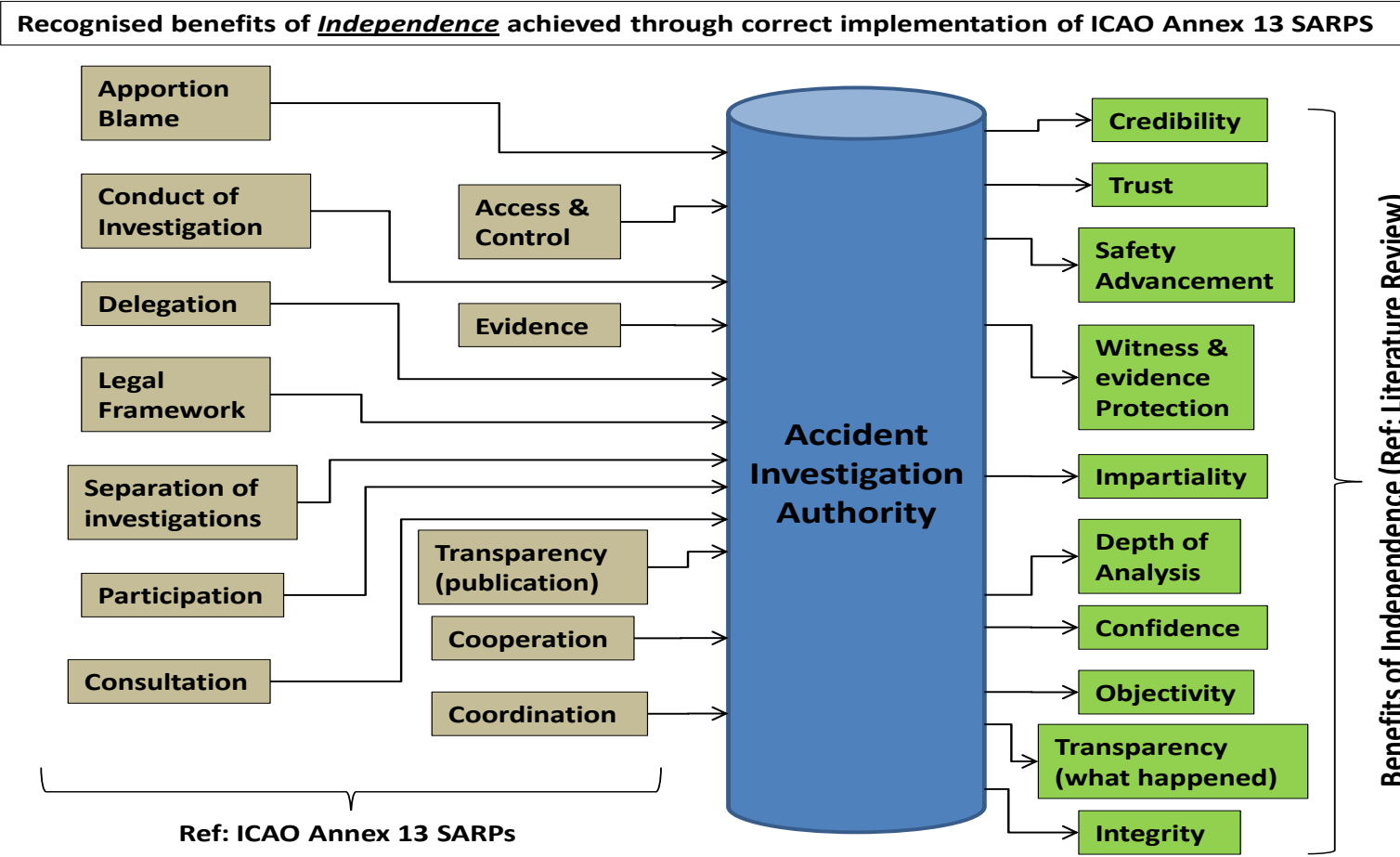


Figure 4-1 Recognised benefits of independence achieved through correct implementation of ICAO Annex 13 SARPs

Figure 4-1 shows the most important benefits related to air accident investigations that can be achieved by the correct implementation of ICAO Annex 13 SARPs. The elements shown on the left side of the figure represent investigation elements that are embedded within ICAO Annex 13 SARPs. The “benefits” shown to the right of the figure are the benefits that are mentioned in the literature as expected benefits from having an independent accident investigation authority.

The “separation of investigations” element includes both functional and structural (as required by the 10<sup>th</sup> edition of Annex 13) separation from judicial and other investigations.

“Confidentiality” and protection of Flight Data Recorders (FDRs) are regulated under the “evidence” element mentioned above.

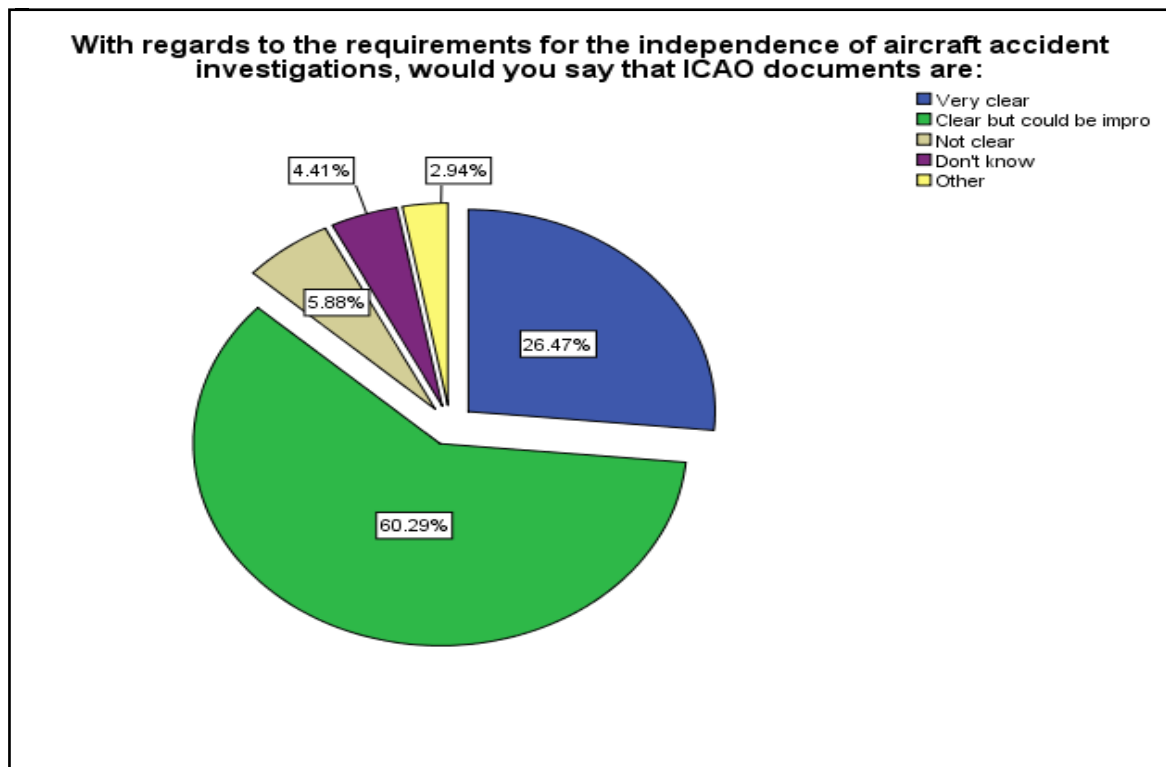
Also, the “cooperation” and “coordination” elements are about regulating the relationship with judicial authorities, legal authorities, and other civil aviation authorities from other countries. These two elements also “regulate” the relationship within the industry by, for example, sharing findings with the industry so that they can take safety actions before the final report is published.

The 12 elements are indicators of the Annex 13 SARPs “spirit” and their benefits can be achieved by any aircraft accident investigation authority if they are understood and implemented correctly. ICAO provides guidance on how to implement Annex 13 correctly. However, 60% of the participants in this research survey, coming from 45 different countries, indicated that ICAO guidance “could be improved.”

Table 4-2 and Figure 4-2 show the distribution of what participants think about the clarity of ICAO documents when it comes to the requirements for the independence of accident investigation authorities, which will be discussed later in greater detail.

**Table 4-2 Clarity of ICAO documents with regard to the requirements of independence**

	Frequency	Percent	Cumulative Percent
Very clear	18	26.5	26.5
Clear but could be improved	41	60.3	86.8
Not clear	4	5.9	92.6
Don't know	3	4.4	97.1
Other	2	2.9	100.0
Total	68	100.0	



**Figure 4-2 Clarity of ICAO documents with regard to the requirements of independence**

## 4.2 Measuring Tools

Many have discussed the benefits and necessity of the independence of air accident investigation; however, no measure has been introduced to evaluate it. This study proposes a methodology to measure that independence. The proposed method brings together valuable insights from different disciplines about the meaning of independence and how to measure it. These insights are scattered throughout the literature of Economic, Legal, Political Science, and other disciplines.

### 4.2.1 Measuring the “Independence” of Central Banks and Independent Regulatory Agencies (IRAs)

Examining the literature revealed that a method to measure the independence of central banks has been developed many years back (Cukierman and Webb, 1995; Cukierman et al., 1992; Elgie, 1998; Grilli et al., 1991).

In 1992, there was an attempt to measure “Central Banks’ legal independence” as an essential component of actual independence (Cukierman et al., 1992).

Cukierman et al. (1992) used formal indicators based on legal issues, such as: head of central bank term in office, the process of appointing the head of central bank, and central bank objectives. Because of the lack of precise policies on central bank function, the authors also used informal indicators based on a questionnaire, such as: price stability priority, and central bank governor turnover. The questionnaire, which was used to measure the central bank independence (CBI), was sent to specialist on monetary in 72 countries. The study also identified the importance of central bank practice for price stability. Central bank independence (CBI) in this study refers to the formal and informal control of central bank over the levers of monetary policy, and its freedom to set monetary targets such as price stability.

The questionnaire variables were divided into several possible responses, and given different “weights” and “numerical codes”. For example, the variable “limitations on lending in practice” was given the weight of (0.20) and each of its possible responses was given a “numerical code” as follows: Tight (1.0), Moderately tight (0.66), Moderately loose (0.33), and Loose or nonexistent (0.00).

Cukierman et al. (1992) studied the link between CBI and inflation performance in more depth than any related study before by examining a group of countries much bigger than any group examined before. The legal dimension of the CBI was analyzed and found to reveal a negative correlation, in general, between CBI and inflation.

Six years later, Elgie indicated that “Cukierman’s” measure is by far the most sophisticated to date. Elgie added more indicators (from 16 to 37) and two dimensions; political independence and economic independence. The new index attempted to measure the formal and actual (*de jure* and *de facto*) independence of central banks (Elgie, 1998).

Forder (2001) criticised the above measures and questioned whether they do their intended job. However, he did not suggest any different measures. Forder believes that Elgie’s argument is deficient in three ways: the methodology used to measure independence is “inappropriate”; the measure of accountability is not reliable because the argument about the nature of accountability is not convincing; and finally, Elgie’s conclusion is not derived from his argument.

In 2002, Gilardi (2002) changed the “Cukierman” measure of independence to fit his purposes to measure the (formal) independence of the Independent Regulatory Agency (IRA) from the government. Gilardi greatly changed the measures and divided them into five dimensions:

- The agency head status
- The management board members’ status
- The general frame of the relationship with government and the parliament
- Financial and organisational autonomy
- Extent of delegated regulatory competencies

It should be noted that Gilardi made it clear that the concept of “independence” is most controversial and that the index he developed “...should not be evaluated against any possible conception of ‘independence’, but, rather, against the specific definition that is used here.”

In 2007, Maggetti developed a framework for “informal” independence of agencies. This measuring index (with its many different versions and developments) was used in the Economy and Banking field as well as in the Political Science field.

Because Gilardi’s work is the most complete and relevant to this study, it will be discussed in more detail.

Gilardi assumes all dimensions have the same effect on the independence of the IRAs, therefore, each of the five dimensions is given the same weight (0.20) or (1/5) of the overall scale. Moreover, each indicator in any category has the same weight (Gilardi, 2002; Gilardi, 2005).

Table 4-3 shows the independence index used to measure the formal independence of IRAs.

**Table 4-3 measuring IRA’s formal independence (adapted from (Gilardi, 2002))**

Dimension	Category	Indicators	Coding
Status of the agency head (Weight = 0.20)	Term of office	Over 8 years	1.00
		6 to 8 years	0.80
		5 years	0.60
		4 years	0.40
		Fixed term under 4 yrs or at the discretion of the appointer	0.20
		No fixed term	0.00
	Who appoints the agency head?	The members of the management board	1.00
		A complex mix of the parliament and the government	0.75
		The parliament	0.50
		The government collectively	0.25
		One or two ministers	0.00
	Dismissal	Dismissal is impossible	1.00
		Dismissal is possible, but only for reasons not related to policy	0.67
		There are no specific provisions for dismissal	0.33



Dimension	Category	Indicators	Coding
		Dismissal is possible at the appointer's discretion	0.00
	May the agency head hold other offices in government?	No Only with permission of the government Yes/ no specific provisions	1.00 0.50 0.00
	Is the appointment renewable?	No Yes, once Yes, more than once	1.00 0.50 0.00
	Is independence a formal requirement for the appointment	Yes No	1.00 0.00
Status of the members of the management board (Weight = 0.20)	Term of office	Over 8 years 6 to 8 years 5 years 4 years Fixed term under 4 yrs or at the discretion of the appointer No fixed term	1.00 0.80 0.60 0.40 0.20 0.00
	Who appoints the members of the management board?	The head of the agency A complex mix of the parliament and the government The parliament The government collectively One or two ministers	1.00 0.75 0.50 0.25 0.00
	Dismissal	Dismissal is impossible Dismissal is possible, but only for reasons not related to policy There are no specific provisions for dismissal Dismissal is possible at the appointer's discretion	1.00 0.67 0.33 0.00
	May the members of the management board hold other offices in government?	No Only with permission of the government Yes/ no specific provisions	1.00 0.50 0.00
	Is the appointment	No	1.00

Dimension	Category	Indicators	Coding
	renewable?	Yes, once Yes, more than once	0.50 0.00
	Is independence a formal requirement for the appointment	Yes No	1.00 0.00
Relationship with government and parliament (Weight = 0.20)	Is the independence of the agency formally stated?	Yes No	1.00 0.00
	What are the formal obligations of the agency vis-a-vis the government?	There are no formal obligations Presentation of an annual report for information only Presentation of an annual report that must be approved The agency is fully accountable to the government	1.00 0.67 0.33 0.00
	What are the formal obligations of the agency vis-a-vis the parliament?	There are no formal obligations Presentation of an annual report for information only Presentation of an annual report that must be approved The agency is fully accountable to the parliament	1.00 0.67 0.33 0.00
	Which body, other than a court, can overturn the decisions of the agency where the latter has exclusive competence?	No body A specialised body The government, with qualifications The government, unconditionally	1.00 0.67 0.33 0.00
Financial and organisational autonomy (Weight = 0.20)	What is the source of the agency's budget?	Fees levied on the regulated industry Both the government and fees levied on the regulated industry The government	1.00 0.50 0.00
	How is the budget controlled?	By the agency By the accounting office or court By both the agency and the	1.00 0.67 0.33

Dimension	Category	Indicators	Coding
		government By the government only	0.00
	Which body decides on the agency's internal organisation?	The agency Both the agency and the government The government	1.00 0.50 0.00
	Which body is in charge of the agency's personnel policy (hiring and firing staff, deciding on its allocation and composition)?	The agency Both the agency and the government The government	1.00 0.50 0.00
Regulatory competencies (Weight = 0.20)	Who is competent for regulation in the sector?	The agency only The agency and another independent authority The agency and the parliament The agency and the government The agency has only consultative competencies	1.00 0.75 0.50 0.25 0.00

#### 4.2.1.1 Issues to Consider about Gilardi's Index

Gilardi's index will not work if applied directly to measure the independence of the air accident investigations for several reasons:

- The air accident investigation body is not a regulator. In fact, it has no power at all to regulate or enforce anything. It can only recommend.
- Even though Gilardi's index is considered to be the most comprehensive in its field, it has been criticised for being underdeveloped.
- Gilardi gave the same "weight" to all of the five dimensions. In other words, every dimension measured has the same effect on the independence of the regulatory agency.
- Gilardi measured the formal (*de jure*) independence only. Actual or informal (*de facto*) is not measured. This suits his purpose for "institutional design" research but may not be enough for measuring the air accident investigation.

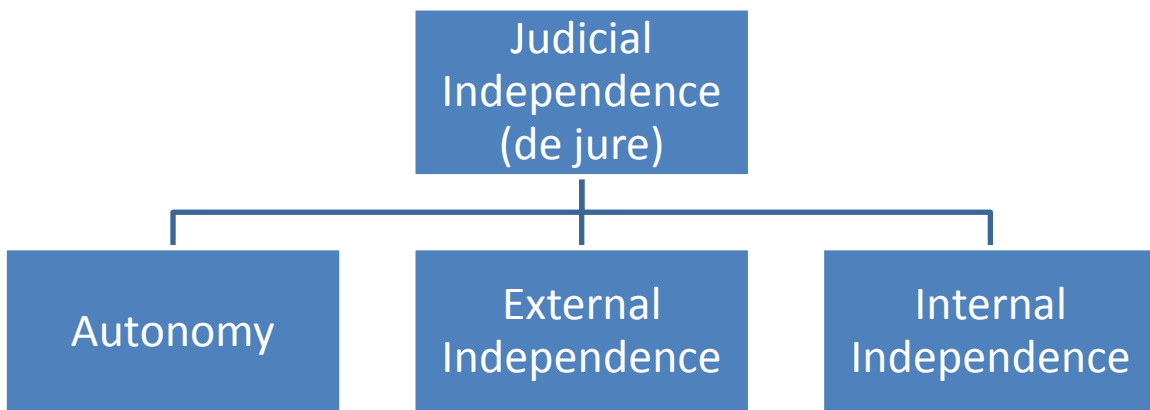
### 4.2.2 Measuring Judicial Independence

Many authors have written about judicial independence (Dubois, 1986; Feld and Voigt, 2003; Ferejohn et al., 2004; Geyh, 2003; Hayo and Voigt, 2007). Some have introduced ways to measure this independence. Much of this work discusses the independence of judges to freely do their work or what is called the “judicial behaviour”. Others look at what is called the “institutional framework” or the independence of the judiciary from other institutions and from politicians.

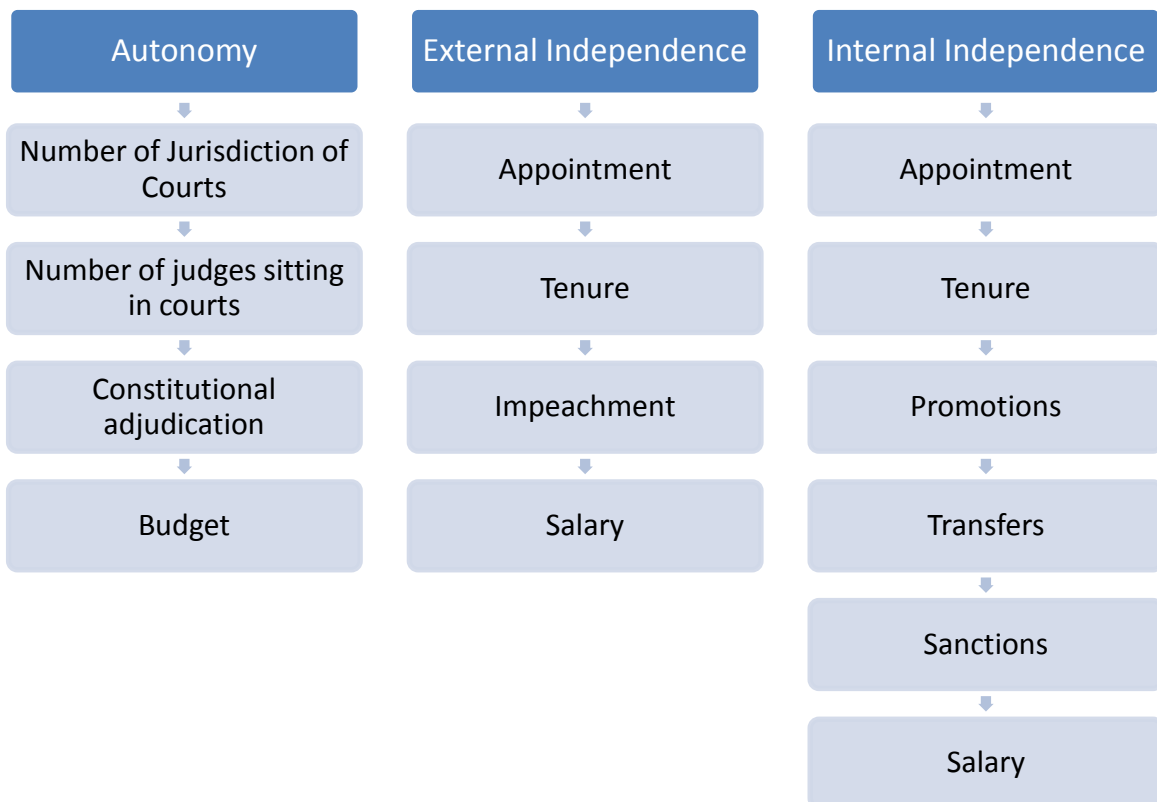
In the judicial system the judges are considered independent if they are free to decide on government violations. In this type of judicial independence, whether judges’ decisions are independent is used as the measuring criteria. The institutional framework describes the limits and incentives that judges have compared to other governmental agents. The criteria to check if judicial independence from other governmental agencies exists can be found from the laws defining relationships with other governmental agencies. Another condition is that these laws must also be followed.

One study, for example, divided judicial independence into three different components to be able to measure the *de jure* independence. Figure 4-3 and Figure 4-4 are summaries of the components of the judicial independence and the variables used to measure them (Rios-Figueroa, 2006).

*De jure* independence refers to the official or legal independence which could be stated in a constitution or a decree but may not be actually practised. It is the opposite of *de facto* independence which refers to the actual or practised independence.



**Figure 4-3 Components of judicial independence (*de jure*) as described by Rios-Figueroa (2006)**



**Figure 4-4 Variables to measure each component of *de jure* judicial independence adapted from Rios-Figueroa (2006)**

In Figure 4-4, *Autonomy* refers to the ability of the judiciary to decide its own basic institutional structure; *External Independence* to the relationship between Supreme Court Judges and the elected organs of Government; and *internal independence* to lower court Judges' relationship with their superiors (Rios-Figueroa, 2006).

#### 4.2.3 Indicators Defined by SafetyNet in Transportation

SafetyNet Integrated Working Package 4 "Independent Accident Investigation" introduced a framework to measure the independence of accident investigations including air accident investigations. The working group used the framework to evaluate accident investigation setups in France, Germany, the United Kingdom, Italy, and Finland (Jähi et al., 2005).

**Table 4-4 indicators used by SafetyNet to measure the independence of air accident investigations in European Countries: the case of the UK AAIB (Jähi et al., 2005)**

Established	1915
Legal form of the body	Public authority, state body (Department for Transport)
Current status	Annex13; Directive 94/56/EC; Civil Aviation Regulation 1996
Relation to the public powers	The secretary of State for Transport appoints the Chief Inspector
Budget	nav
Personnel	52
Events notified	nav
Events investigated	nav
Reports published	nav
<b>Structural independence:</b>	
Separate from the market authority	yes
Separate from the operations authority	yes
Separate from the safety authority	yes
Permanence of the investigating body	yes
Safety investigation's legal status	yes
Safety investigator's legal status	yes
Liability issues excluded	yes
Findings cannot be used for the purposes of the judicial	yes

enquiry	
<b>Financial independence:</b>	
Financial autonomy of the investigating body	yes
Financial autonomy to carry out investigations	yes
Relations to the industry (constructors, operators, or others)	yes
<b>Functional independence:</b>	
Obligation to investigate	yes
Liberty to investigate	yes
Autonomous determination of the scope of the investigation	yes
Autonomous determination of the methods of the investigation	yes
Access to the evidence	yes
Access to the witnesses	yes
Investigation accessible to observers of the state of design of the vehicle	yes
Investigation accessible to observers of the state of manufacture	yes
Investigation accessible to observers of the state of occurrence	yes
Investigation accessible to observers of the state of operator	nap
Investigation accessible to observers of the state of registry	yes
Investigation accessible to observers of other substantially interested state	yes
Investigation accessible to observers of other interested organisations	yes
Diverging comments of the observers published	yes
Findings are public	yes
Reports published without further scrutiny	yes
Respect of the anonymity	yes

**Table 4-5 indicators used by SafetyNet to measure the independence of air accident investigations in European Countries: the case of the French BEA (Jähi et al., 2005).**

Established	1946
Legal form of the body	Public authority, attached to the Ministry of Transport
Current status	2001; Annex13; Directive 94/56/EC; Loi No. 99-234 of 29/3/1999; Decret No 2001-1043 of 8/11/2001
Relation to the public powers	The Minister of Transport appoints the Director for a renewable 7 years term
Budget	(2004) 3,4 M€
Personnel	(2004) 110 of which 30 investigators and 10 investigative assistants
Events notified	750 (average per year)
Events investigated	300-350 (per year)
Reports published	100-130 (per year)
<b>Structural independence:</b>	
Separate from the market authority	yes
Separate from the operations authority	yes
Separate from the safety authority	yes
Permanence of the investigating body	yes
Safety investigation's legal status	yes
Safety investigator's legal status	yes
Liability issues excluded	yes
Findings cannot be used for the purposes of the judicial enquiry	yes
<b>Financial independence:</b>	
Financial autonomy of the investigating body	yes
Financial autonomy to carry out investigations	yes
Relations to the industry (constructors, operators, or others)	yes
<b>Functional independence:</b>	
Obligation to investigate	yes
Liberty to investigate	yes
Autonomous determination of the scope of the investigation	yes
Autonomous determination of the methods of the	yes



investigation	
Access to the evidence	yes
Access to the witnesses	yes
Investigation accessible to observers of the state of design of the vehicle	yes
Investigation accessible to observers of the state of manufacture	yes
Investigation accessible to observers of the state of occurrence	yes
Investigation accessible to observers of the state of operator	Yes
Investigation accessible to observers of the state of registry	Yes
Investigation accessible to observers of other substantially interested state	Yes
Investigation accessible to observers of other interested organisations	No
Diverging comments of the observers published	Yes
Findings are public	yes
Reports published without further scrutiny	yes
Respect of the anonymity	yes

**Table 4-6 indicators used by SafetyNet to measure the independence of air accident investigations in European Countries: the case of the German BFU (Jähi et al., 2005)**

Established	1998
Legal form of the body	Federal authority
Current status	1998; Annex13; Directive 94/56/EC; Flugunfall-Untersuchungs- Gesetz FIUUG, August 26 <sup>th</sup> , 1998
Relation to the public powers	nav
Budget	2,4 M€
Personnel	35
Events notified	(2003) 44
Events investigated	(2003) 44
Reports published	(2003) 44
<b>Structural independence:</b>	
Separate from the market authority	yes
Separate from the operations authority	yes
Separate from the safety authority	yes
Permanence of the investigating body	yes
Safety investigation's legal status	yes
Safety investigator's legal status	yes
Liability issues excluded	yes
Findings cannot be used for the purposes of the judicial enquiry	yes
<b>Financial independence:</b>	
Financial autonomy of the investigating body	yes
Financial autonomy to carry out investigations	yes
Relations to the industry (constructors, operators, or others)	yes
<b>Functional independence:</b>	
Obligation to investigate	yes
Liberty to investigate	yes
Autonomous determination of the scope of the investigation	yes
Autonomous determination of the methods of the investigation	yes
Access to the evidence	yes
Access to the witnesses	yes
Investigation accessible to observers of the state of design of	yes

the vehicle	
Investigation accessible to observers of the state of manufacture	yes
Investigation accessible to observers of the state of occurrence	yes
Investigation accessible to observers of the state of operator	Yes
Investigation accessible to observers of the state of registry	Yes
Investigation accessible to observers of other substantially interested state	Yes
Investigation accessible to observers of other interested organisations	No
Diverging comments of the observers published	Yes
Findings are public	Yes
Reports published without further scrutiny	yes
Respect of the anonymity	yes

The above examples in tables 4-2, 4-3, and 4-4 show the results of applying this model for the case of the UK AAIB, the case of the French BEA, and the case of the German BFU respectively. The measured independence in these cases is the formal or *de jure* independence. The indicators have one of two values; yes or no. Unavailable data and “not applicable” questions are indicated by “nav” and “nap” respectively.

It is very difficult to differentiate between the capabilities of these three examples. This is because the indicators used in this model do not go deep enough to show the real differences between the mentioned accident investigation agencies with regard to their independence.

Moreover, the indicators used by SafetyNet are not specific to aviation. The same indicators are also used for evaluating other modes of transportation namely marine, rail and road.



## **5 METHODOLOGY**

Because the concept of accident investigation independence is not clearly defined in the literature, this study was started as an exploratory type of research to help define the data collection method, best research design, and suitable selection of population and sample. The exploratory method applied thus far is not used to define any conclusions in this research. It is only used to help understand the best way to approach a vague concept, such as the concept of accident investigation independence.

In order to improve something it needs to be measured first. Such a measuring tool for the independence of accident investigation does not exist today. This research proposes to fill this gap and develop such a tool.

### **5.1 Research Strategy**

According to Robson (2002) the purpose of the investigation will dictate the research strategy: case studies for exploratory research; surveys for descriptive studies; and experiments for explanatory research. Although this is true for most of the researches, it is not always the case.

Experiments can be used in social science to prove or disprove a theory. Experiments are due to lack of research in this area.

Case studies are ideally the best strategy for exploratory work; however, for the purpose of this research case studies are also rejected because of the difficulty in obtaining sensitive information, attending meetings, and obtaining copies of communications, letters, etc. which are important for a case study strategy. In addition, it is not clear which cases (ICAO Member States) should be studied because it is not proven which States have the best independence, or the worst.

For the purpose of this research, a literature review, surveys and interviews are the most appropriate strategies, given the requirement of the other strategies. The Methodology for this research is described in Figure 5-1.

## **5.2 Selecting a Philosophical Approach for the Research**

To the researcher's knowledge there has not been a study in this area before. Therefore, there are no theories to test. Moreover, this research is more *exploratory* in nature and should have a wide scope initially. Hence, a phenomenological approach seems the most appropriate for this research.

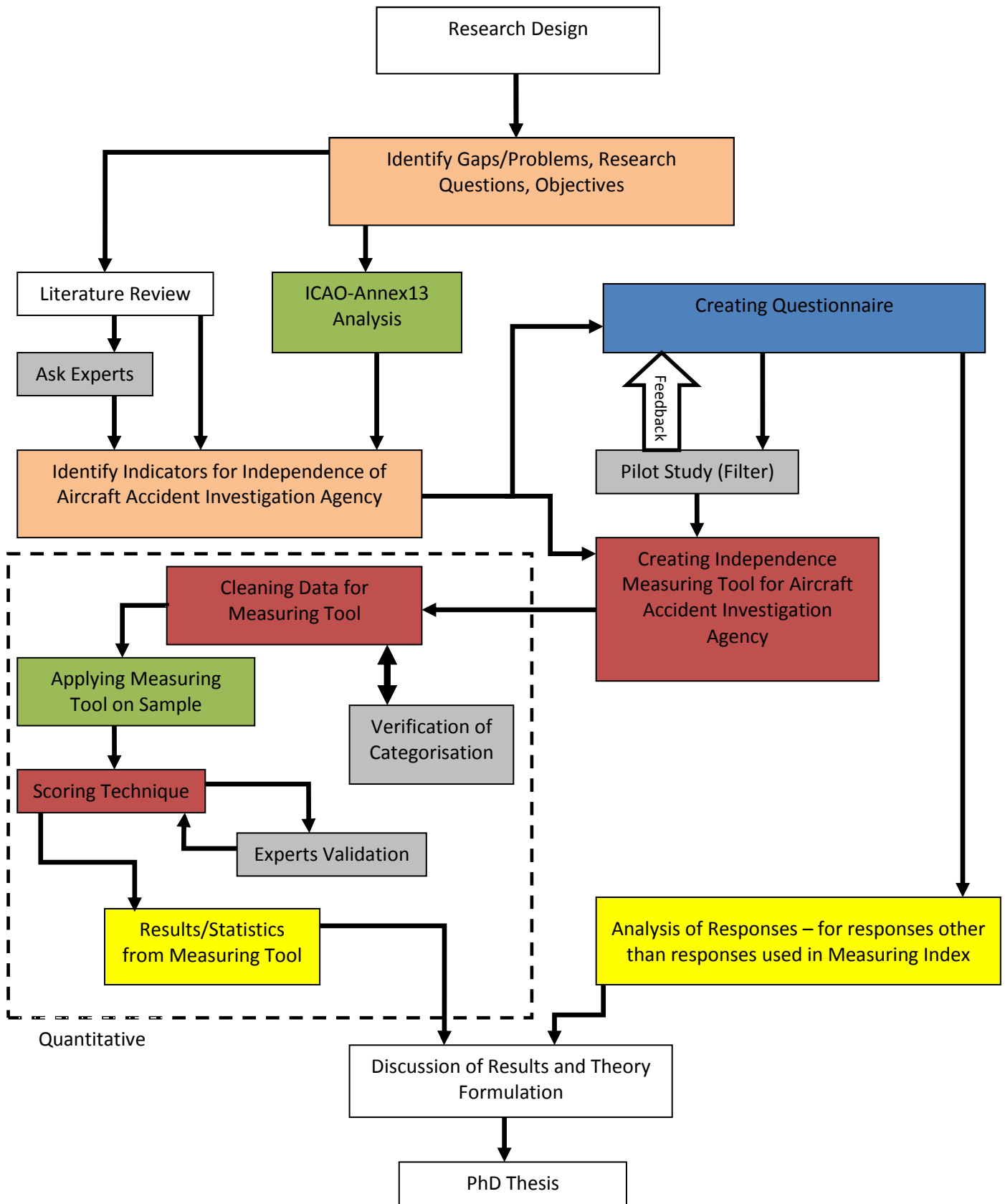


Figure 5-1 Research Methodology Diagram

### 5.3 Theory

As the phenomenological approach is selected for this research it implies that the data collected will be used to form the theory, rather than using data to test existing theory. Robson (2002) suggests that researches that are classified as exploratory are used to find out what is happening, to seek new insights, to ask questions, to assess phenomena in a new light, and are usually qualitative.

Method is defined as “a set of procedures and a goal” (Kitchener, 1999). The goal or aim of this thesis therefore can be achieved by utilising scientific techniques or strategies. The study of scientific methods is called *epistemology* or theory of knowledge. The author makes a distinction between method and methodology. He describes method as the practices or steps taken or actions performed, whereas, methodology is the theory of these methods.

The research design is a plan that “guides the investigator in the process of collecting, analysing and interpreting observations. It is a logical model of proof that allows the researcher to draw inferences concerning causal relationships among the variables under investigation. The research design also defines the domain of generality, i.e. whether the obtained interpretations can be generalised to a larger population or to different situations” (Nachmias and Nachmias, 1976). In an academic environment, the purpose of the research plan is to document the approach taken by the researcher and make it possible to repeat the same process.

Different levels of scales are described in measurement theory literature. The needed level of measurement depends on the research question and the desired application of the indicator. Depending on the complexity of the information needed to be described, four different scale levels can be used; nominal, ordinal, interval, and ratio scale (Bowling, 2004).

A *nominal* scale is used to describe basic relationships or for classification of data in a very simple way (for example, ‘independent’ or ‘dependent’).



Contingency coefficient is usually used as a measure of correlation for this level of data.

The *ordinal* scale, also called the ranking scale, is more descriptive than the nominal scale in that it describes the “relationship” of one object to another (for example, “more effective”, “less effective”). Usually the median is used in statistics to describe the “central tendency of scores”.

The *interval* scale is essentially an ordinal scale with known distances between any two numbers on the scale. Thus, this scale is categorised by a constant unit of measurement. With this quantitative scale, all common parametric statistics apply, such as standard deviations, means, etc. The interval scale is suitable if the research question is something like “How different is X to Y?”

The *ratio* scale is an interval scale with a true zero defined. The ratio is independent of the unit of measurement.

After selecting a philosophical approach for this research, a methodology was designed to answer the research question:

***Is it possible to measure the independence of air accident investigation in ICAO Member States?***

The research methodology is shown in Figure 5-1 above.

## **5.4 Details of Data Collection**

### **5.4.1 Consulting the Literature**

The study started by looking to understand the independence concept in the literature. The literature is very vague about it and did not give any agreed definition that can be used in the context of aircraft accident investigations. The literature, however, spoke of different attributes or indicators that suggest the existence of independence in an organisation or the perception of its existence. As discussed in Chapter 3, there are several attempts to measure the independence of different organisations in several disciplines. The most notable attempts to measure independence are those to measure the independence of

Central Banks, Regulated Agencies, and the shy attempt to measure the independence of transport accident investigation agencies in Europe.

Because this research focuses on the independence of aircraft accident investigation agencies in ICAO Member States, ICAO Annex 13, *Aircraft Accident and Incident Investigation*, the standard for aircraft accident investigations for these States, was consulted since it is the agreed upon standard and the ultimate reference in this subject. Surprisingly and unfortunately, Annex 13 does not include a clear definition of independence of investigations.

#### **5.4.2 Asking ICAO**

ICAO was approached to understand what they mean by independence of investigation since it was a recommendation in their ICAO Annex 13, which has recently been upgraded to a Standard in the 10<sup>th</sup> edition of Annex 13. The Accident Investigation Group (AIG) was contacted directly via email to ask them about the definition of investigation independence. They replied that what ICAO is looking for is the functional independence as described in *Part I* in ICAO *Manual of Aircraft Accident and Incident Investigation (ICAO Doc 9756)* but no clear definition was given. This reply was an unofficial one and does not represent the ICAO's position, as stated in the email. ICAO answers officially to Member States not to individuals. Note that this answer was before the publication of the latest edition of Annex 13 (10<sup>th</sup> edition), which requires the structural separation of the investigation agency in addition to the functional separation. The details of this are explained in Chapter 2 of this thesis.

#### **5.4.3 Interviews**

Several professionals were interviewed informally and were asked about the meaning of investigation independence. Almost every one of them had a different opinion on what it means. These are working or retired professionals that spent many years of their lives working for accident investigation agencies in different countries and yet they could not agree on its meaning.

In addition, Captain Barayan, the head of the Saudi Arabian investigation team that was sent to participate in the investigation of the Saudi Airlines mid-air accident over India in 1996, was interviewed via email. Captain Barayan's interview and his opinion in this regard can be found in Chapter 1 of this thesis.

#### **5.4.4 ICAO Annex 13 Analysis**

Analysing ICAO Annex 13 to understand the requirements pertaining to the vague concept of independence of accident investigations was a logical step. The result of analysing ICAO Annex 13 is shown in Table A-1 in Appendix A. Elements of the independence of aircraft accident investigation found to be impeded in ICAO Annex 13 Standards and Recommended Practices (SARPs) are discussed in greater detail in Chapter 6 of this thesis.

The results shown in the tables (in Chapter 6 and Appendix A) and the data gathered from the literature at this stage are used to build the survey questionnaire to collect data from ICAO Member States about their aircraft accidents and incidents investigation capabilities.

#### **5.4.5 The Survey**

The results of the exploratory approach explained above showed that there are indicators that can be used to measure the concept of independence in the context of aircraft accident investigation.

Ideally, structured and semi-structured interviews with Chief Inspectors or heads of accident investigation agencies in ICAO Member States would have been the best way to gather the needed data. However, because of time constraints, busy schedules of targeted heads of investigation agencies and Chief Inspectors, and the prohibitive cost of travel around the world, the interview method was quickly disqualified. The most suitable method to collect data for the purposes of this study is by sending questionnaires (surveys) out to each of the Member States' accident investigation authorities, if they exist, or the bodies that are responsible for accidents and incidents investigations in that State.

A questionnaire was prepared using the data gathered from the literature review, informal interviews of aviation professionals, and from the analysis of ICAO Annex 13. The questionnaire goal is to gather enough data about aircraft accident investigations and investigation agencies in ICAO Member States to understand their practices with regards to accident investigation independence.

An online survey has been chosen over a paper survey for several reasons; it is faster, easier to complete, easier to send out to participants, and the results are faster and easier to download and analyse. A customised version of the Bristol Online Survey (BOS) tool was used for the preparation and dissemination of the questionnaire. The customised version looks very professional and personalised for Cranfield University as shown in the snapshot in Figure B-1 in Appendix B.

#### **5.4.5.1 Advantages and disadvantages of using questionnaire in research**

There are several advantages and disadvantages of using questionnaire as a data collection method in research

In general, using questionnaire is relatively easy to administer and analyze. Questionnaires can be used to collect information about sensitive topics which participants may feel uncomfortable speaking to an interviewer about. Also, questionnaires cost less in comparison with other methods. Moreover, several other advantages are mentioned in the literature such as (Key, 1997; Brace, 2008; Ong'anya and Dr Ododa, Feb 2009):

- Questionnaires remove the likelihood of interviewer bias
- Geographically distant participants can easily take part in answering the questionnaire.
- Uniformity of questions. Each participant receives the exact set of questions which yield data more comparable than data gathered from interviews.
- It is possible for highly structured questions to be standardized.

- Questionnaires are a useful method in investigating patterns and frequencies.
- Questionnaire format is familiar to most respondents.
- Gives plenty of time for the respondents usually to think about their answers.
- Questionnaires are relatively a fast way to collect data.
- Results can be quickly quantified.
- Data analysis can be more objectively than other forms of research.

Moreover, there are some specific advantages of using online questionnaires such as:

- Responses can be pre-coded eliminating transcript errors
- Data is already in electronic format making analysis easier
- Guidance and/or software is widely available.

There are also some disadvantages of using questionnaire such as:

- Some people are not honest with their answers.
- Some people may not fully understand some of the questions.
- Some people may leave blank spaces or write down silly answers.
- People can choose not to fill in the questionnaire.
- Relies on the subject to be honest
- Response rate is usually low
- There is no follow-up mechanism
- Timing of sending out the questionnaire, length of the questionnaire, and complexity of the questions can affect the response rate
- Obtaining sufficient number of responses can be difficult sometimes.
- Questions in questionnaires can be misinterpreted
- Open-ended questions can generate large amount of data which makes it difficult to interpret.

Disadvantages of using online questionnaires:

- Technical problems can occur.
- people may respond more than once
- some types of surveys may not be deliverable online

#### 5.4.6 Pilot Study

*Valid question* means it should measure the concept it is intended to measure and *reliable question* means that it should be answered the same way every time it is asked (Weisberg et al., 1996).

The questionnaire was sent to different countries with different languages. The English language was used because it is the aviation language. Also, the standardized answers (answer options) used for questions were based on the literature review and the pilot study.

An indicator is considered a valid measure if it actually measures what it says it measures. Terminology is one well known problem affecting the validity of the measurements. The literature talks about different types of validity such as:

- Content validity: shows the extent to which the measure represents all aspects of a given construct. It is also referred to as logical validity.
- Face validity: shows if it measures the concept that it is supposed to measure.
- Criterion validity: shows how close a variable can predict the result based on input from other variables.
- Concurrent validity: used to show correlation of a test with a previously validated measure.
- Predictive validity: shows how well a score from a scale can predict other scores on some measured criterion.
- Construct validity: shows the validity of inferences that a measuring tool actually measures the investigated construct.
- Convergent and Discriminant validity: shows the extent to which two measures of constructs are related. They are considered as subtypes of

construct validity. The convergent validity is established when two similar constructs correspond with each others, however, discriminant validity is established when the constructs are easily distinguished.

In order to eliminate the risk of misunderstanding questions in the questionnaire, and to test the validity and reliability of the questions used in the questionnaire, a pilot study was conducted. The pilot study was split into two parts; one for the paper version and the other for the electronic version.

The paper survey was given to five different aviation safety professionals, who are not part of the final sample, to complete and comment upon it.

Difficulties encountered with some questions were reported in separate debriefings. There were not, however, any substantial changes to the questionnaire to mandate another pre-test.

One problem was pointed out – the length of the questionnaire. Several attempts have since been taken to shorten the questionnaire but it was very difficult to remove any questions without compromising the results. After careful consideration, very few questions were removed from the questionnaire; however, the resultant questionnaire is still considered to be long. Since there was only a single chance to obtain reliable information from very busy professionals, the researcher decided that shortening the questionnaire any more would jeopardise missing important information.

Other problems pointed out and suggestions from the pilot study were:

- The choice of the words “Agency”, “Authority”, “Body” or “Office” when referring to the entity responsible for aircraft accident investigations.
- Adding the choices of “Other” and “Don’t Know” to every question.
- One question split into two questions, so that each question represents one idea only.
- Add a note at the beginning of the questionnaire to indicate that this questionnaire is about the participant’s country.
- Lightly rephrasing some questions.

- Change the order of some questions.
- Replace some words with less ambiguous ones.

#### **5.4.7 Treatment of Data**

Many participants used the “Other” options to express their opinion which meant that most of the data had to be treated and cleaned to make it usable. The answers given under “Other” option were analysed, classified and matched with the available options where possible. Otherwise, it is left ‘as is’ if it does not match any option.

Because the practice above depends on the researcher’s opinion, an independent opinion was needed to verify the process. A sample of the questions and answers from participants were given to another, independent researcher to classify them into available categories or in a category on their own. After the independent researcher put answers into available options for that question it was compared with the original classification. The answers matched more than 86% of the time for the sample questions and, therefore, the original classifications for the whole questionnaire were accepted and considered valid.

Also, the answers to narrative questions (two questions) were classified into categories to make them usable for statistical analysis. There was no validation needed for this process because the created categories were created from the data available and did not have to match any prescribed options or categories.

#### **5.4.8 Coding the Answers**

The data had to be coded in order to quantify the qualitative inputs and be able to use software packages such as SPSS. By using an electronic survey, many of the inherent problems with coding the paper survey questions disappeared. For example, problems such as: unclear marking on paper, misreading the participant’s answer in the data entry phase, interviewer checking the wrong box, or interviewer check mark may be unclear so that it leads to wrong code.



All these problems were overcome by the use of an advanced electronic survey tool.

#### **5.4.9 Ethics Committee Approval**

Cranfield Science and Engineering Research Ethics Committee (SEREC) is the committee responsible for evaluating researchers' fieldwork proposals, providing feedback on adequate ethical research practices, and approving acceptable proposals. Their primary function, as stated in their website, "*... is to safeguard the rights, safety, physical and mental well-being of direct and indirect participants, stakeholders and researchers in studies carried out by staff and students. This involves determining that research processes and methods address relevant ethical concerns and meet applicable professional and University requirements.*" (Cranfield University, 2012)

A research proposal was submitted to the SEREC for review. It reviewed the ethics proposal and asked for some required changes before they approved the proposal. The changes were incorporated in accordance with SEREC's feedback and the corrected proposal was approved by the Committee. The approved ethical proposal is shown in Appendix C.

#### **5.4.10 Population and Research Sample**

There were a total of **68** responses covering **45** different countries. The countries are shown in Table 5-1.

The 45 countries, as the research sample, represent less than **24%** of the total number of ICAO Member States (more than 192 States), which is the research population. However, the assumption that all of these countries have accident investigation capabilities to do their own investigations is an incorrect assumption.

ICAO USOAP audit results indicate that a number of ICAO Member States have not been able to implement an effective accident and incident investigation system (Costa, 2011). However, it can be seen from Costa's keynote speech

that there are “a number of states” in “many regions” that do not do their own investigations. Also, the two examples of Regional Accident Investigation Organisations (RAIOs) that Costa talks about have 19 States within them that do not do their own investigations. Therefore, although 45 different States have participated in this research, the percentage of the sample from the population is actually unknown.

The researcher contacted Costa to obtain a fixed number or a percentage of the number of States that do not do their own investigations but could not get a clear answer.

Instead, the aircraft traffic around the world was used to understand how representative the sample is in this research. The world’s aircraft traffic data are available from the ICAO website. Table 5-2 shows the Global traffic for 2009-2010 as published by ICAO.

**Table 5-1 countries responded to survey**

ANTIGUA & DEPS	AUSTRALIA	AUSTRIA	BELGIUM	BOLIVIA
CZECH REPUBLIC	DENMARK	FINLAND	FRANCE	GERMANY
ITALY	LATVIA	LIBYA	LITHUANIA	LUXEMBOURG
PAKISTAN	POLAND	PORTUGAL	ROMANIA	RUSSIAN FEDERATION
SUDAN	SWEDEN	SWITZERLAND	TUNISIA	TURKEY
BULGARIA	CANADA	CROATIA	ESTONIA	UGANDA
GREECE	HUNGARY	ICELAND	IRELAND (REPUBLIC)	UNITED ARAB EMIRATES
MACEDONIA	MALAYSIA	MOROCCO	NETHERLANDS	UNITED KINGDOM
HONG KONG SAR	SERBIA	SINGAPORE	SLOVAKIA	UNITED STATES

According to ICAO’s statistics shown in Table 5-2 and Table 5-3, the 45 countries covered represent more than **66%** of the estimated world traffic for 2010, and more than **68%** of actual world traffic for 2009.

**Table 5-2 Global Traffic by Country 2009-2010 (Source: ICAOdata website)**

**Table 5. Tonne-kilometres and passenger-kilometres performed on scheduled services**  
(countries and groups of countries whose airlines performed more than 100 million total tonne-kilometres in 2010<sup>1</sup>)

Country or group of countries	TONNE-KILOMETRES PERFORMED (millions) (passengers, freight and mail)								PASSENGER-KILOMETRES PERFORMED (millions)							
	Total operations (international and domestic)				International operations				Total operations (international and domestic)				International operations			
	Rank number in 2010	2010	2009	Increase or decrease (%)	Rank number in 2010	2010	2009	Increase or decrease (%)	Rank number in 2010	2010	2009	Increase or decrease (%)	Rank number in 2010	2010	2009	Increase or decrease (%)
United States	1	156,286	147,819	6	1	59,641	54,372	10	1	1,299,874	1,256,996	3	1	394,281	372,738	6
China <sup>2</sup>	2	53,302	42,155	26	6	18,871	12,618	50	2	400,610	334,762	20	10	73,488	55,348	33
Hong Kong SAR <sup>3</sup>		16,189	16,966	-5		16,189	16,966	-5		85,811	89,019	-4		85,811	89,019	-4
Macao SAR <sup>4</sup>		246	240	3		246	240	3		2,106	2,078	1		2,106	2,078	1
Germany	3	29,518	26,796	10	2	28,489	25,818	10	4	202,047	202,681	0	3	191,037	192,489	-1
United Arab Emirates	4	28,347	23,126	23	3	28,347	23,126	23	5	186,821	154,561	21	4	186,821	154,561	21
United Kingdom	5	23,650	23,453	1	4	23,053	22,785	1	3	229,649	230,644	0	2	221,953	222,319	0
Republic of Korea	6	21,175	16,166	31	5	20,724	15,696	32	13	91,759	83,459	10	9	87,121	78,470	11
Japan	7	20,401	18,170	12	9	14,470	12,665	14	7	138,079	127,859	8	11	72,212	66,575	8
France	8	19,543	19,150	2	7	17,837	17,370	3	6	154,761	154,407	0	5	136,493	135,601	1
Singapore	9	14,788	13,997	6	8	14,788	13,997	6	17	87,674	84,514	4	8	87,674	84,514	4
Netherlands	10	13,845	12,500	11	10	13,845	12,500	11	16	87,696	84,575	4	7	87,695	84,575	4
Russian Federation	11	13,474	9,918	36	14	7,614	5,168	47	9	109,435	83,828	31	16	52,616	37,143	42
Canada	12	13,144	11,904	10	12	8,017	6,942	15	8	115,793	107,371	8	12	68,167	60,979	12
Australia	13	11,388	11,652	-2	17	6,721	6,923	-3	12	96,579	100,515	-4	19	46,902	50,061	-6
India	14	10,578	8,944	18	20	5,990	5,086	18	11	99,692	85,788	16	18	49,885	43,773	14
Brazil	15	10,451	7,364	42	25	3,377	2,464	37	14	90,846	74,049	23	25	22,777	20,649	10
Spain	16	9,367	8,276	13	15	7,424	6,369	17	15	88,300	80,094	10	13	68,079	59,782	14
Ireland	17	9,229	7,370	25	11	9,225	7,366	25	10	100,664	80,502	25	6	100,633	80,462	25
Thailand	18	7,844	6,964	13	16	7,359	6,590	19	19	57,201	54,106	6	14	53,257	49,337	8
Qatar	19	7,723	5,621	37	13	7,723	5,621	37	20	52,733	40,408	31	15	52,733	40,408	31
Turkey	20	7,351	6,420	14	18	6,139	5,230	17	18	64,800	57,488	13	17	51,475	44,717	15
Malaysia	21	7,140	6,207	15	19	6,137	5,251	17	21	51,564	45,532	13	20	40,719	35,020	16
Italy	22	5,645	5,151	10	23	4,383	4,187	5	22	50,446	43,951	15	23	37,341	34,084	10
Switzerland	23	5,314	4,371	22	21	5,299	4,358	22	25	40,564	33,698	20	21	40,408	33,552	20
Luxembourg	24	5,234	4,696	11	22	5,234	4,696	11	111	529	483	10	110	529	483	10
Scandinavia <sup>5</sup>	25	4,761	4,303	11	24	4,150	3,729	11	24	43,748	41,449	6	22	37,387	35,447	5
Indonesia	26	4,370	3,836	14	45	1,329	1,097	21	23	46,974	37,675	25	38	12,660	9,443	34
Saudi Arabia	27	4,102	3,746	9	26	3,224	2,902	11	27	30,758	28,891	6	27	21,842	20,248	8
South Africa	28	3,554	3,379	5	28	2,676	2,501	7	26	31,012	29,700	4	26	22,101	20,804	6

Philippines	29	3,438	2,684	28	30	2,590	1,899	36	28	28,084	25,364	11	29	20,196	16,910	19
Chile	30	3,140	2,769	13	33	2,495	2,204	13	33	19,200	17,523	10	39	12,628	11,822	7
Colombia	31	3,097	2,499	24	32	2,495	1,977	26	42	14,760	13,983	6	44	9,596	9,005	7
New Zealand	32	3,083	3,249	-5	27	2,804	2,922	-4	30	25,512	25,358	1	28	21,809	21,736	0
Portugal	33	2,728	2,367	15	31	2,509	2,144	17	29	25,918	22,656	14	24	23,735	20,448	16
Israel	34	2,680	2,375	13	29	2,610	2,348	11	36	18,369	16,757	10	32	17,477	16,454	6
Finland	35	2,456	2,159	14	34	2,361	2,056	15	34	18,947	18,374	3	31	17,883	17,233	4
Austria	36	2,358	2,210	7	35	2,337	2,191	7	32	19,293	17,965	7	30	19,077	17,776	7
Viet Nam	37	2,344	1,797	30	42	1,439	1,065	35	31	21,095	16,531	28	37	12,721	9,530	33
Mexico	38	2,306	2,404	-4	39	1,680	1,715	-2	35	18,546	20,831	-11	41	12,079	13,616	-11
Belgium	39	2,221	1,843	21	36	2,221	1,843	21	48	8,609	7,079	22	47	8,609	7,079	22
Egypt	39	2,186	1,820	20	37	2,074	1,776	17	37	18,217	16,326	12	34	17,123	15,845	8
Bahrain	41	1,773	1,893	-6	38	1,773	1,893	-6	44	12,753	13,950	-9	36	12,753	13,949	-9
Iran (Islamic Republic of Of)	42	1,683	1,373	23	49	943	635	49	39	16,322	14,487	13	51	7,770	6,333	23
Ethiopia	43	1,671	1,478	13	40	1,653	1,460	13	45	10,875	9,746	12	42	10,681	9,562	12
Morocco	44	1,652	1,501	10	41	1,614	1,471	10	38	17,557	15,797	11	33	17,141	15,474	11
Pakistan	45	1,554	1,515	3	44	1,374	1,331	3	43	14,326	13,779	4	40	12,581	12,047	4
Argentina	46	1,501	1,225	23	50	932	716	30	41	15,158	11,997	26	46	8,808	6,418	37
Hungary	47	1,421	1,204	18	43	1,421	1,204	18	40	15,512	13,115	18	35	15,512	13,115	18
Sri Lanka	48	1,180	988	19	46	1,180	988	19	47	9,338	7,750	20	45	9,338	7,750	20
Kuwait	49	1,003	1,004	0	47	1,003	1,004	0	52	7,886	7,962	-1	49	7,886	7,962	-1
Peru	50	992	909	9	53	762	646	18	50	8,458	8,765	-4	56	6,056	5,911	2
Kenya	51	986	987	0	48	967	965	0	51	8,257	7,925	4	48	8,026	7,695	4
Greece	52	921	917	0	55	725	734	-1	49	8,563	8,900	-4	53	6,557	7,083	-7
Panama	53	912	916	0	51	912	916	0	46	10,138	10,175	0	43	10,138	10,175	0
Jordan	54	877	747	17	52	875	746	17	53	7,805	6,734	16	50	7,789	6,721	16
Mauritius	55	762	668	14	54	756	663	14	56	6,320	5,605	13	55	6,257	5,551	13
Poland	56	736	700	5	56	715	681	5	54	7,710	7,169	8	52	7,453	6,939	7
Ukraine	57	707	588	20	57	659	536	23	55	6,980	5,880	19	54	6,454	5,311	22
Uzbekistan	58	657	507	29	58	627	482	30	58	5,567	4,775	17	59	5,249	4,505	17
Brunei Darussalam	59	603	454	33	59	603	454	33	59	5,260	3,885	35	58	5,260	3,885	35
Czech Republic	60	564	601	-6	60	562	598	-6	57	6,014	6,350	-5	57	5,994	6,324	-5
Oman	61	530	431	23	62	496	404	23	60	5,129	4,308	19	61	4,763	4,016	19
Bangladesh	62	521	623	-16	61	517	620	-17	62	4,905	4,953	-1	60	4,872	4,927	-1
Kazakhstan	63	495	455	9	70	308	283	9	61	4,905	4,529	8	72	2,987	2,760	8
Fiji	64	428	368	17	63	424	363	17	66	3,855	3,230	19	64	3,802	3,182	19
Romania	65	421	377	12	65	402	359	12	64	4,438	3,960	12	62	4,218	3,762	12
Algeria	66	406	365	11	68	347	299	16	63	4,554	4,033	13	65	3,762	3,302	14
Cyprus	67	403	412	-2	64	403	412	-2	65	4,070	4,163	-2	63	4,070	4,163	-2

Iceland	68	398	424	-6	66	398	424	-6	72	3,180	3,445	-8	70	3,180	3,445	-8
Lebanon	69	377	366	3	67	377	366	3	71	3,182	3,075	3	69	3,182	3,075	3
Ecuador	70	340	476	-29	75	228	360	-37	74	2,837	4,248	-33	80	1,473	2,954	-50
Latvia	71	311	283	10	69	311	283	10	67	3,591	2,993	20	66	3,591	2,993	20
Libyan Arab Jamahiriya	72	308	309	0	73	280	277	1	69	3,384	3,293	3	71	3,111	2,920	7
El Salvador	73	299	332	-10	71	299	331	-10	70	3,223	3,516	-8	68	3,219	3,511	-8
Tunisia	74	295	330	-11	72	295	330	-11	68	3,510	3,252	8	67	3,510	3,252	8
Trinidad and Tobago	75	256	279	-8	73	241	255	-5	76	2,718	2,879	-6	74	2,675	2,828	-5
Venezuela	76	249	230	8	91	99	91	8	75	2,765	2,551	8	90	1,069	987	8
Malta	76	249	230	8	74	249	230	8	73	2,949	2,529	17	73	2,949	2,529	17
Yemen	78	237	218	9	76	228	210	9	78	2,448	2,258	8	76	2,357	2,175	8
Costa Rica	79	228	215	6	78	225	213	6	77	2,582	2,877	-10	75	2,555	2,854	-10
Tajikistan	80	205	189	8	80	192	182	6	80	2,166	2,005	8	78	2,084	1,928	8
Jamaica	81	202	206	-2	79	201	206	-2	79	2,187	2,241	-2	77	2,187	2,241	-2
Cuba	82	199	184	8	81	189	175	8	84	1,538	1,427	8	81	1,462	1,357	8
Nigeria	83	183	169	8	97	90	80	12	81	2,121	1,873	13	97	879	870	1
Syrian Arab Republic	84	162	132	23	82	159	129	23	87	1,468	1,415	4	82	1,437	1,385	4
Bolivia	85	153	132	16	90	106	95	12	83	1,570	1,519	3	91	1,050	1,021	3
Angola	86	147	126	16	84	137	119	15	100	760	680	12	101	671	605	11
Suriname	87	146	136	8	83	146	136	8	92	1,121	1,131	-1	87	1,121	1,131	-1
Myanmar	88	145	134	9	89	108	98	11	82	1,611	1,470	10	85	1,200	1,093	10
Namibia	89	139	171	-19	85	137	168	-18	85	1,498	1,668	-10	79	1,473	1,640	-10
Azerbaijan	90	136	122	12	86	135	110	23	89	1,428	1,274	12	84	1,416	1,148	23
Seychelles	91	134	182	-26	87	134	181	-26	88	1,431	1,452	-1	83	1,425	1,446	-1
Turkmenistan	92	132	185	-29	91	102	126	-19	86	1,475	1,955	-25	88	1,088	1,310	-17
Armenia	93	114	103	11	88	114	103	11	90	1,194	1,074	11	86	1,194	1,074	11
Papua New Guinea	94	112	94	20	102	68	56	21	95	997	728	37	108	544	386	41
Madagascar	95	109	88	24	94	99	79	25	96	983	819	20	98	872	719	21
Bulgaria	96	104	115	-9	92	100	111	-10	91	1,126	1,248	-10	89	1,083	1,202	-10
Total for above countries (98) <sup>6</sup>		601,419	538,201	12		414,536	365,157	14		4,668,771	4,324,648	8		2,859,370	2,635,036	9
Total for other countries		1,611	1,455			1,449	1,315			16,131	15,070			14,436	13,505	
Total for 190 ICAO Member States		603,031	539,655	12		415,985	366,472	14		4,684,902	4,339,719	8		2,873,806	2,648,541	9

1. Most 2010 data are estimates, thus the ranking and the rate of increase or decrease may change when final data become available.

2. For statistical purposes, the data for China excludes the traffic for the Hong Kong and Macao Special Administrative Regions (Hong Kong SAR and Macao SAR), and that of the Taiwan province of China.

3. Traffic for the Hong Kong Special Administrative Region (SAR).

4. Traffic for the Macao Special Administrative Region (SAR).

5. Three States – Denmark, Norway and Sweden.

6. Includes the States listed in note 5.

Source.— ICAO Air Transport Reporting Form A plus ICAO estimates for non-reporting States.

**Table 5-3 Traffic data for the 34 States that participated in this research's survey  
(extracted from Table 5-2)**

<b>Country</b>	<b>2010 (Estimated)</b>	<b>2009</b>
United States	156,286	147,819
Hong Kong SAR <sup>3</sup>	16,189	16,966
Germany	29,518	26,796
United Arab Emirates	28,347	23,126
United Kingdom	23,650	23,453
France	19,543	19,150
Singapore	14,788	13,997
Netherlands	13,845	12,500
Russian Federation	13,474	9,918
Canada	13,144	11,904
Australia	11,388	11,652
Ireland	9,229	7,370
Turkey	7,351	6,420
Malaysia	7,140	6,207
Italy	5,645	5,151
Switzerland	5,314	4,371
Luxembourg	5,234	4,696
Portugal	2,728	2,367
Finland	2,456	2,159
Austria	2,358	2,210
Belgium	2,221	1,843
Morocco	1,652	1,501
Pakistan	1,554	1,515
Hungary	1,421	1,204
Greece	921	917
Poland	736	700
Czech Republic	564	601
Romania	421	377

Country	2010 (Estimated)	2009
Iceland	398	424
Latvia	311	283
Libyan Arab Jamahiriya	308	309
Tunisia	295	330
Bolivia	153	132
Bulgaria	104	115
<b>Total for 190 ICAO Member States</b>	603,031	539,655
<b>Total for survey sample (34 States)</b>	398,686	368,483
<b>Sample's Traffic percentage of the Total Global Traffic</b>	<b>66.11%</b>	<b>68.28%</b>

Note that only 34 countries out of the participating 45 countries are listed in Table 5-2. The traffic data were extracted for the 34 ICAO Member States and the percentage of this traffic out of the total global traffic was calculated as shown in Table 5-3. Even without taking into account the missing data for 11 States out of the 45 total States represented in the survey, the total aircraft traffic in the 34 States represents more than **66%** of the total global traffic in 2010 (estimated), and more than **68%** of the total global traffic in 2009. Also note that out of the total sample's traffic percentage, the US alone represents 39.2% of the 2010 (estimated) global traffic, and 40.11% of the 2009 Global traffic. However, this should not be a problem because the US covers a huge area and has a huge aviation industry.

ICAO Accident/Incident Data Reporting (ADREP) system was used to collect data about number of accident (commercial and non-commercial) per each participating State. The results are shown in Table 5-4. ICAO-ADREP website explains that the database "...contains all official accident and incidents which were officially notified to ICAO by the States as per ICAO Annex 13 since 1st of January 2000. The list also contains unofficial reports, collected by ICAO through other sources."

Table 5-4 shows that the states participating in this research represent about 63% of the accidents in the world.

**Table 5-4 Number of Accidents by Country Since 2000 ( Source: ICAO ADREP Database – last access in December 2013)**

ICAO-State	Total Number of Accidents (Commercial and Non-Commercial)	Total Number of Fatalities (Commercial and Non-Commercial)
WORLD (general)	8877	16964
Australia	184	118
Germany	184	224
UK	140	107
Poland	17	6
Finland	3	0
UAE	15	65
Portugal	23	17
Lithuania	2	0
Serbia	0	0
Ireland	22	8
Switzerland	62	68
USA	3675	2361
Greece	9	130
Hungary	16	4
Singapore	7	0
Denmark	13	3
Italy	120	315
Romania	14	7
Austria	17	28
Sweden	33	7
Russia	163	960
Netherlands	16	19
Czech R.	8	0
Estonia	6	18



ICAO-State	Total Number of Accidents	Total Number of Fatalities
Iceland	4	3
Bulgaria	24	3
Latvia	1	1
Canada	476	198
Croatia	2	0
Pakistan	10	217
France	192	367
Luxembourg	3	20
Hong Kong	No Data	No Data
Slovakia	4	5
Bolivia	15	19
Belgium	6	11
Antigua	2	0
Sudan	40	108
Turkey	23	211
Morocco	9	13
Macedonia	No Data	No Data
Malaysia	15	5
Libya	6	231
Tunisia	5	16
Uganda	5	16
Sum of accidents in all States		5591
Percentage of all accident in all participating States to the total number of accidents in the world		<b>62.983%</b>

In conclusion and based on the above analysis, this sample is found to be representative of the whole population.

#### 5.4.11 Difficulties of Data Collection

Collecting data from qualified personnel has proved to be a very difficult task in this research. Because the research is about ICAO Member States, the logical

place to find contact details is from the ICAO website. The website was consulted first for a list of contact details but the list found was to be out-of-date. The researcher contacted ICAO directly asking for an updated list. The researcher was directed to another list and was told that it is the latest and most up-to-date list.

However, even this “latest and most up-to-date” list has many problems. An email with a link to the electronic survey was sent to all emails shown on the list. There were many “wrong email address” automatic replies, and those emails that were apparently working emails did not reply. The researcher managed to send to the few working faxes on the list; however, very few replied.

The link to the electronic survey was posted on several aviation safety related groups in LinkedIn; however, the response rate did not improve.

After that, the researcher contacted former UK Chief Inspector, and asked for his help for a valid contact list and to write a letter of introduction so that people could trust giving information for purposes of the research. The letter was used to invite experts from different countries to participate in the survey. This actually worked to a certain extent. Although the link to the survey was sent to many more emails and faxes, only 68 persons participated in the survey representing 45 different countries.

It is not clear why the majority of the invited recipients did not participate. One reason could be the length of the questionnaire. Another could be the sensitivity of the information given. It could also be that these professionals are very busy and cannot spare time to reply to surveys.

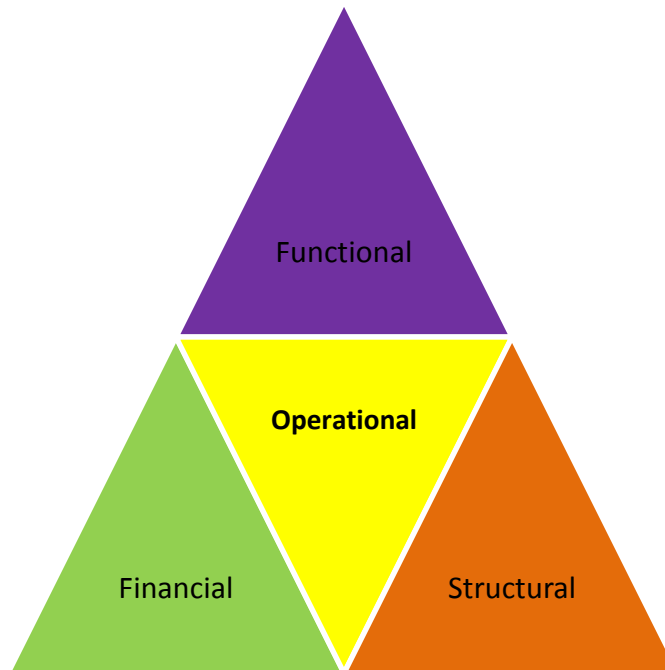
## 6 DEVELOPMENT OF A MEASURING TOOL FOR THE INDEPENDENCE OF AIR ACCIDENT INVESTIGATION

Although ICAO imposes requirements to ensure investigation independence, it does not specify a definition for this independence. The requirements for independence have been emphasised even more in the new 10th edition of ICAO Annex 13, published in July 2010. In order to elicit reasonable measures, a definition to clarify the meaning of independence in the context of accident investigation must be either introduced by this research or selected from the different definitions in the existing literature.

As mentioned earlier in this thesis, there have been several attempts to define 'independence of accident investigation'. The definition that will be used for the purposes of this study is the one proposed by the Road Strategy for Accident in Transport (ROSAT).

Therefore, this study will look at the three different dimensions mentioned in the ROSAT definition; *structural* independence, *financial* independence, and *functional* independence.

Moreover, because the aim is to measure the independence of air accident investigation in ICAO Member States, this research proposes a fourth dimension which will be referred to as '*operational*' independence (see Figure 6-1). The "*operational dimension*" encompasses the two sides of the independence of investigation authorities; legal or regulatory and political.



**Figure 6-1 Four Dimensions Measuring Index (4DMI) model for measuring the independence of aircraft accident investigation**

Each of the four ‘dimensions’ shown in the model in Figure 6-1 will be measured using different ‘variables’ or ‘indicators’ that can estimate the level of independence of the specified dimension. The model will be referred to as 4DMI throughout this research. The proposed model is not a measure of “compliance” with ICAO Annex 13; therefore, it is not a replacement for the ICAO USOAP Audit, which is a measure of compliance.

### **6.1 4DMI Model Development**

Figure 6-1 above shows the 4DMI model. At first, the researcher look at ICAO’s accident investigation model to understand the dimension it considers. ICAO’s focus found to be on the functional dimension only. However, it is understood that this is the “minimum” compliance needed from each ICAO-Member States. ICAO also considers that some States do not have the capability or the resources to comply with an accident investigation model that considers different dimensions, at least for the time being. But this should not stop this research from exploring a wider understanding of this vague concept.

Next, the research analyzed ICAO-Annex 13, which encompasses the Standards and Recommended Practices (SARPs) that ICAO believes will lead to good and impartial accident investigations results when correctly implemented by Member States. The analysis showed that there are 12 different “elements” impeded within the SARPs that are related to the independence of accident investigation as shown in Table 4-1. These elements can be attributed to different dimensions, however, not all of the SARPs emphasising these elements are obligatory. Only the ones concerned with the functional dimension of the independence of aircraft accident investigations are obligatory.

Next, looking back at the adopted definition of independence in this research, the Structural Dimension was considered and related indicators were added to the measuring index. Also, Financial dimension’s indicators were considered and added to the measuring index. The financial capability of the accident investigations authority has a clear effect on how the authority ensures its independence and the independence of its investigations. Therefore, this effect needs to be measured to correctly consider the big picture of investigation independence.

Then, the idea was developed to include the legality that is needed to ensure that the functional independence is respected within a Member State. Therefore, related indicators were added to the measuring index. Later on, related legal dimension’s indicators for the Structural and Financial dimensions were added.

After that, the political dimension came into the picture because it has the power to interfere with, or support the independence of aircraft accident investigations regardless if there were regulations/legislations already in place to support the investigations independence or not. The combination of both Legal and Political Dimensions are referred to as Operational Dimension in this research.

The concept of independence must be taken as a “whole”. It cannot be successful if parts only are favoured and the rest is ignored. By looking at the

model in Figure 6-1, it can be seen that the “Operational Dimension” (both Political and Legal) is in the heart of the model. Each of the other dimensions in the 4DMI has one of its sides in touch with the Operational Dimension which is in the centre. This is to say that each of the dimensions (Structural, Financial, and Functional) should have solid Legal and/or Political support. The stronger the support (in the form of Regulations/Legislations, international agreements, memorandum of understandings (MoU), ...etc), the stronger the independence of the setup of the accident investigation body.

The process of building a new independent body should start at the centre of the model by establishing the necessary regulations/legislations, with enough political support. Starting with the Operational dimension, good independence practices related to each of the Functional, Structural, and Financial dimensions should be documented formally when possible, and encouraged in case of informal practices.

It should be noted that each dimension has elements from other dimensions. Structural practices, for example, can have some elements of Financial and/or Functional dimensions. However, in this case, the elements of Structural dimension would be dominant in these particular practices. This again suggests that successful setup should consider the model as a whole.

Usually the independence of the three dimensions (Functional, Structural, and Financial) can be controlled and ensured by the accident investigation body itself. However, the Operational Dimension usual necessitates the coordination with other bodies such as the Judicial and Political systems in that State. It is crucially important that other bodies (judicial/police/legal/political) understand the importance of ensuring the independence of the air accident investigations, and the independence of the investigating agency itself, in order to ensure the highest level of aviation safety.

The judicial authorities specifically have the ability to hamper the independence of the air accident investigations and, therefore, must be fully informed of the massive consequences of their cooperation, or failure of cooperation. It is

equally crucial that the independent accident investigation body shows their understanding of the needs for the judicial system to investigate with the intention to blame and punish when necessary.

The political system's power must also be respected and acknowledged by the independent investigation body and an understanding must be reached to keep this power from affecting the independence of the accident investigation body. All these understandings must be documented in some way or another to give them some power and engrave them in the heart of all practices in the independent accident investigation body. This is the only way that can ensure a functional "just culture" within an ICAO-Member State.

Proper regulations/legislations must be in place to ensure the benefits of independent investigations. For example, without the proper regulations in place, witnesses could be blamed for self-incriminating information they provided in an accident investigation if this information was used in judicial proceeding even if it had been years after the conclusion of the safety investigation.

Table 6-1 shows the questions used in the 4DMI and their dimensions colour-coded for easy reference. The table also shows the location of each question in the original questionnaire and its location in the 4DMI tool after being rearranged.

**Table 6-1 Identifying Dimensions of each question in 4DMI**

		Colour Codes	<b>Structural</b> <b>Functional</b> <b>Financial</b> <b>Operational (Legal)</b> <b>Operational (Political)</b>
Q # in questionnaire	Q # in 4DMI Tool	Question	Dimension
3	1	<i>State has permanent accident Investigation agency?</i>	Structural
6	2	<i>Agency (physically) separate from regulator</i>	Structural
7	3	<i>Agency (generally) separated from operation authorities</i>	Structural
		<i>Specific separations from Operation authorities</i>	
9	4	<i>Internal organisation decided by:</i>	Operational (Political)
10	5	<i>Personnel policy (hire, fire, etc) decided by:</i>	Operational (Political)
12	6	<i>Is there a Law or Reg to prevent use of safety findings in judicial inquiry?</i>	Operational (Legal)
14	7	<i>Who appoints head of Agency?</i>	Operational (Political)
15	8	<i>Whom he reports to?</i>	Structural
16	9	<i>Independence of Agency formally stated?</i>	Operational (Legal)
18	10	<i>Can politicians decide which accident to investigate?</i>	Operational (Political)
19	11	<i>Can politicians stop ongoing investigation?</i>	Operational (Political)
24	12	<i>Does the Agency require approval to release report?</i>	Operational (Legal)
25	13	<i>Can Agency launch investigation without prior permission?</i>	Operational (Legal)
27	14	<i>Investigators have immediate/unrestricted access to evidence WITHOUT prior consent?</i>	Operational (Legal)
28	15	<i>Agency's investigation procedures</i>	Operational (Legal)



		<i>specified in:</i>	
34	16	<i>Agency has ready access to sufficient funds for proper investigations (within responsibilities of agency)?</i>	Financial
		<i>Funding for Agency's investigation is:</i>	
34	17	<i>Independent of political pressure?</i>	Financial
34	18	<i>Independent of other influences?</i>	Financial
36	19	<i>Law in place forcing Agency to release documents to public?</i>	Operational (Legal)
37	20	<i>Regulations specify types of accidents &amp; incidents that must be investigated?</i>	Operational (Legal)
38	21	<i>Can Agency decide to investigate occurrences outside its mandate?</i>	Operational (Legal)
39	22	<i>Who determines the scope of investigation?</i>	Functional
40	23	<i>Who determines the method of investigation</i>	Functional
41	24	<i>Who has 1<sup>st</sup> access to witnesses?</i>	Operational (Legal)
42	25	<i>State has regulations to protect witnesses' confidentiality?</i>	Operational (Legal)
43	26	<i>Who speaks to media on behalf of Agency?</i>	Structural
44	27	<i>Who controls/reviews Agency's budget?</i>	Financial
46	28	<i>Agency is dependent on outside support to conduct its investigations?</i>	Financial
47	29	<i>Budgetary resources of Agency considered:</i>	Financial
8	30	<i>Are there employees (from industry) on loan or working part-time for the agency?</i>	Structural
13	31	<i>Head of Agency term in office?</i>	Operational (Political)
		<i>If not permanent, is appointment renewable?</i>	
17	32	<i>Does the agency have a Board?</i>	Structural
		<i>Board Members:</i>	

<i>Does Agency have:</i>			
20	33	<i>Flight Recorder readout facilities?</i>	Functional
21	34	<i>Material failure analysis facilities?</i>	Functional
22	35	<i>Voluntary incident reporting system?</i>	Functional
23	36	<i>Safety Database?</i>	Functional
23	37	<i>Is data in this Database available to others?</i>	Functional
23	38	<i>Who pays for data collection for Database?</i>	Financial
26	39	<i>How do you know if Agency's investigations are perceived by public as credible and partial?</i>	Operational (Legal)
29	40	<i>Salaries of investigators are:</i>	Financial
30	41	<i>According to regulations in your State, determination of causation is:</i>	Operational (Legal)
32	42	<i>Regulations clearly state that investigators are not to testify in courts...?</i>	Operational (Legal)
33	43	<i>Agency recommendations acceptance rate measured?</i>	Functional

The four dimensions of the 4DMI are defined as follows:

- **Structural** Dimension: where the answers show how the structure or setup of the investigation agency supports, or not, the independence of the investigation.
- **Financial** Dimension: where the answers are related to financial independence of the investigation authority.
- **Functional** Dimension: where the answers show how independent the investigation body is in performing its primary function: investigation.
- **Operational** Dimension: is about legal (or regulatory) and political issues.

There are 43 questions in total used in the measuring tool but the total number of points is 47 points because the first question is given five points. The reason

for giving five points to the first question regarding “permanent accident investigation agency” is because it is the most fundamental feature of an independent accident investigation authority, and to put a clear gap between the States that have it and those who do not. This question is very important to this research and also an important indicator of the independence of the accident investigation agency in a State. To learn more about accident investigation independence from the States that rank high in the 4DMI tool, this important question was given five times the score to make sure the high ranking states are actually those that have dedicated accident investigation authorities, and to reduce the chances that a State could rank higher because of the way the participants answered other questions.

### 6.1.1 Weight of Dimensions in the 4DMI Tool

The questions are divided into four dimensions as shown below:

- **Functional = 8 questions**      **(8 points / 47 = 17.02%)**
- **Structural = 7 questions**      **(11 points / 47 = 23.40%)**
- **Financial = 8 questions**      **(8 points / 47 = 17.02%)**
- **Operational = 20 questions**      **(20 points / 47 = 42.55%)**

Operational dimension was further divided into legal (regulatory) and political dimensions.

- **Operational-Legal (or regulatory):** if the question is about the legality of an issue or to check if it is protected by regulation.
- **Operational-Political:** to measure the influence of politicians.

There are six questions within the Operational dimension classified as indicators for political related issues, and 14 classified as legal or regulatory related. Therefore, the new classification for the questions used in the measuring tool becomes as follows:

• <b>Functional =</b>	<b>8 points/ 47 =</b>	<b>17.02%</b>
• <b>Structural =</b>	<b>11 points/ 47 =</b>	<b>23.40%</b>
• <b>Financial =</b>	<b>8 points /47 =</b>	<b>17.02%</b>
• <b>Operational-Political =</b>	<b>6 points /47 =</b>	<b>12.76%</b>
• <b>Operational-Legal =</b>	<b>14 points /47 =</b>	<b>29.79%</b>
-----		
<b>Total =</b>		<b>99.99%</b>

Just by inspecting the number of questions in each dimension it can be seen that there is more emphasis on the Operational dimension (42.55%), and especially on the Operational-Legal (regulatory) part of it (29.79%).

## 7 RESULTS AND DISCUSSION

### 7.1 Results from the 4DMI

Appendix D. Figure D-1 shows the 4DMI indicators (questions) and their answers and scores in a single Microsoft Excel datasheet. The scores for each indicator, based on survey answers from all of the 68 participation, are shown in the datasheet. Answers for all dimensions (Structural, Functional, Financial, and Operational) are shown in the datasheet along with the participants' random ID numbers, percentage of Total Score, and RANKs.

The following steps are taken to apply the 4DMI measuring technique and examine the survey data:

- 1- The results from each dimension alone will be analyzed.
- 2- Unique participation per each ICAO-Member State (45 States) will be identified and the rest of the participation will be filtered.
- 3- The 4DMI is divided into three categories of independence: High, Average, and Low independence. Based on their 4DMI "Total Score", States within each category will be identified.
- 4- States' scores within each category are analysed.
- 5- States' practices within each category are analysed to identify common practices of these States.
- 6- The differences between the High Independence category and the Low Independence Category are also examined.
- 7- The effects of the scores from each dimension are examined in two ways:
  - a) By removing the scores of a single dimension at a time, and keeping the rest of scores.
  - b) By examining the scores from a single dimension alone.

The conclusions and key finding will be identified at the end.

### 7.1.1 Structural Dimension Results

**Structural** Dimension: where the answers show how the structure of the investigation agency/setup supports, or hampers, the independence of the investigation authority.

**Table 7-1 Questions related to Structural Dimension**

Original #	# in 4DMI Tool	Question	Dimension
3	1	<i>Does your State have a permanent accident investigation authority/body/agency?</i>	Structural
6	2	<i>Is the accident investigation authority physically separate from the Civil Aviation Authority (Regulator)?</i>	Structural
7	3	<i>Is the accident investigation authority separate from the operation authority/authorities (airport, air navigation, air traffic controller)?</i>	Structural
		<i>Separation details of Investigation Authorities from Operation Authorities</i>	
15	8	<i>To whom does the head of the accident investigation agency report?</i>	Structural
43	26	<i>In the event of an accident, who speaks to the media on behalf of the accident investigation agency?</i>	Structural
8	1	<i>Are there any employees from the industry (e.g. manufacturers, operators, or others) on loan or working part-time for the accident investigation authority?</i>	Structural
17	3	<i>Does the agency have a Board?</i>	Structural
		<i>Board Members: (details)</i>	

The issue of having a permanent authority to deal with accident investigations has been discussed in chapter 2. The USOAP results mentioned in chapter 2 discussed some ICAO Member States having trouble with this issue. Some States have not established any permanent authority or office to be in charge of accident and incident investigations. The USOAP audit also noted that there are several States that do not have the capability to establish an investigation

system on their own, and do not have guidance on how to cooperate with other States in this matter.

Moreover, articles 3 and 4 of the EU Regulation 996/2010 require each EU Member State to have a permanent, functionally independent body to investigate accidents and serious incidents in civil aviation.

To explore this issue, this survey asks the following questions:

- Does your State have a permanent accident investigation authority/body/agency?
- Is the accident investigation authority physically separate from the Civil Aviation Authority (Regulator)?
- Is the accident investigation authority separate from the operation authority/authorities (airport, air navigation, air traffic controller)?
- What are the separation details of Investigation Authorities from Operation Authorities

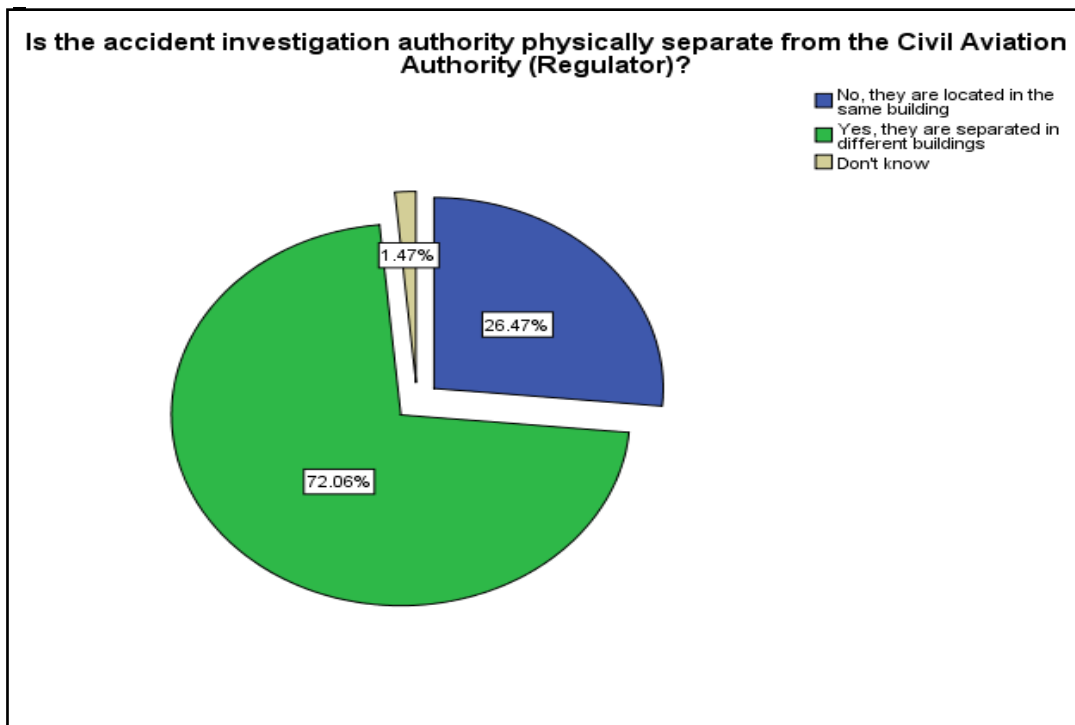
**Table 7-2 Does your State have a permanent accident investigation authority/body/agency?**

	Frequency	Percent	Cumulative Percent
Valid Yes	62	91.2	91.2
No	6	8.8	100.0
Total	68	100.0	

As shown in Table 7-2, more than 91% of the respondents indicated that their countries have a permanent accident investigation authority. However, when asked if the accident investigation authority is physically separate from the regulator, 72% out of the whole sample (100% of the respondents) answered yes (see Table 7-3 and Figure 7-1).

**Table 7-3 Is the accident investigation authority physically separate from the Civil Aviation Authority (Regulator)?**

	Frequency	Percent	Cumulative Percent
No, they are located in the same building	18	26.5	26.5
Valid Yes, they are separated in different buildings	49	72.1	98.5
Don't know	1	1.5	100.0
Total	68	100.0	



**Figure 7-1 Is the accident investigation authority physically separate from the Civil Aviation Authority (Regulator)?**

When the respondents were asked if the accident investigation authority in their State is separate from the operation authorities (airlines, ground support, traffic control, etc.), 82.4% (out of 100% of the respondents) said “Yes” and 13% said “No” (see Table 7-4).



The respondents to this question were then asked (if they answered yes) about the details of this separation. Note that the respondents were allowed to choose from the following options:

*(select all that apply)*

- Functionally separated (the accident investigation authority doing its own function only)
- Structurally separated (they are not in the same organisational structure)
- Physically separated (located in separate buildings)
- Physically separated (located in the same building but on different floors)

**Table 7-4 Separation from the operation authority/**

		Frequency	Percent	Cumulative Percent
Valid	No, they are not separated	9	13.2	13.2
	Yes, they are separated	56	82.4	95.6
	Don't know	3	4.4	100.0
	Total	68	100.0	

The answers were rearranged for the purpose of SPSS analysis and the results are as shown in Table 7-5 and Figure 7-2.

Out of the 82.4% that said yes in Table 7-4;

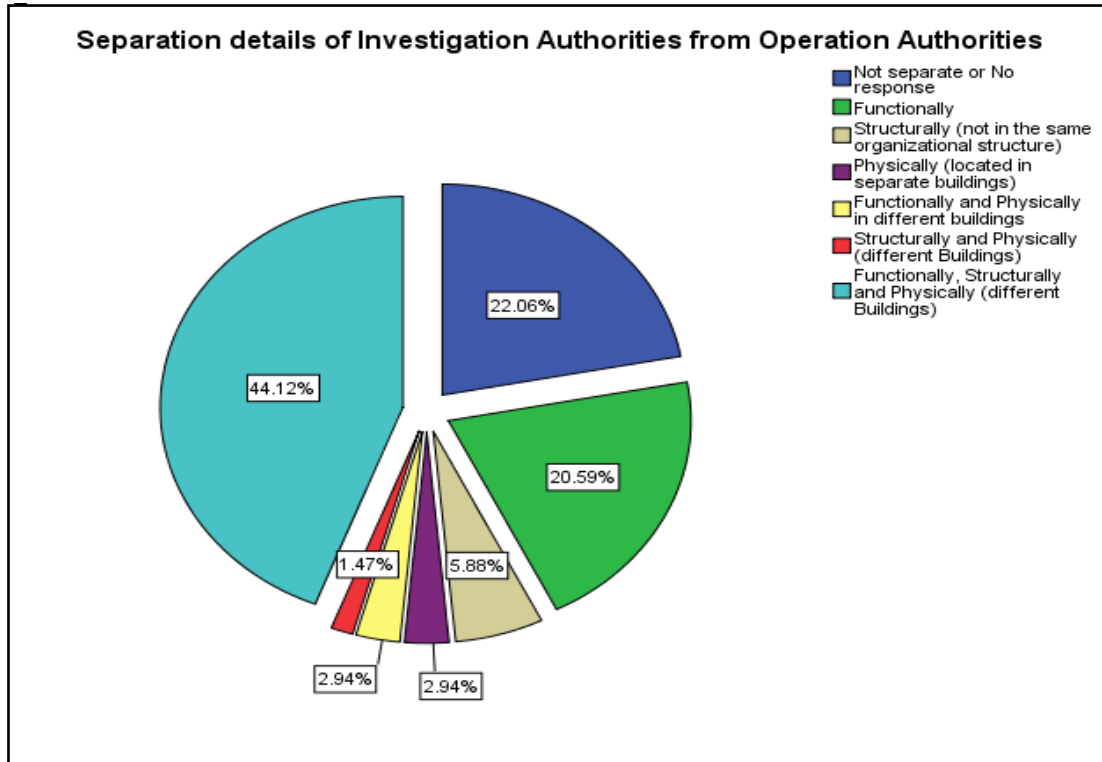
- 22.1% (No response)
- 20.6% said (functionally) separated
- 5.9% said (structurally) separated
- 2.9% said (physically) separated
- 2.9% said (functionally and physically (in different buildings)) separated
- 44.1% said (functionally, structurally and physically) separated

The results suggest that the focus in many ICAO Member States is on the separation from the CAA. Moreover, this separation from the CAA is focused on “functional” and “structural” separation; however, less emphasis is given to physical separation.

It should be noted that these results do not take into account the repeated entries for the same country (e.g. US seven entries, UK six entries). The results give the perception of the participants and, therefore, it is important to keep all the entries to measure the perception of the people individually as their understanding and experience is what this research aims to document.

**Table 7-5 Separation details of Investigation Authorities from Operation Authorities**

		Frequency	Percent	Cumulative Percent
Valid	Not separate or No response	15	22.1	22.1
	Functionally	14	20.6	42.6
	Structurally (not in the same organisational structure)	4	5.9	48.5
	Physically (located in separate buildings)	2	2.9	51.5
	Functionally and Physically in different buildings	2	2.9	54.4
	Structurally and Physically (different Buildings)	1	1.5	55.9
	Functionally, Structurally and Physically (different Buildings)	30	44.1	100.0
	Total	68	100.0	

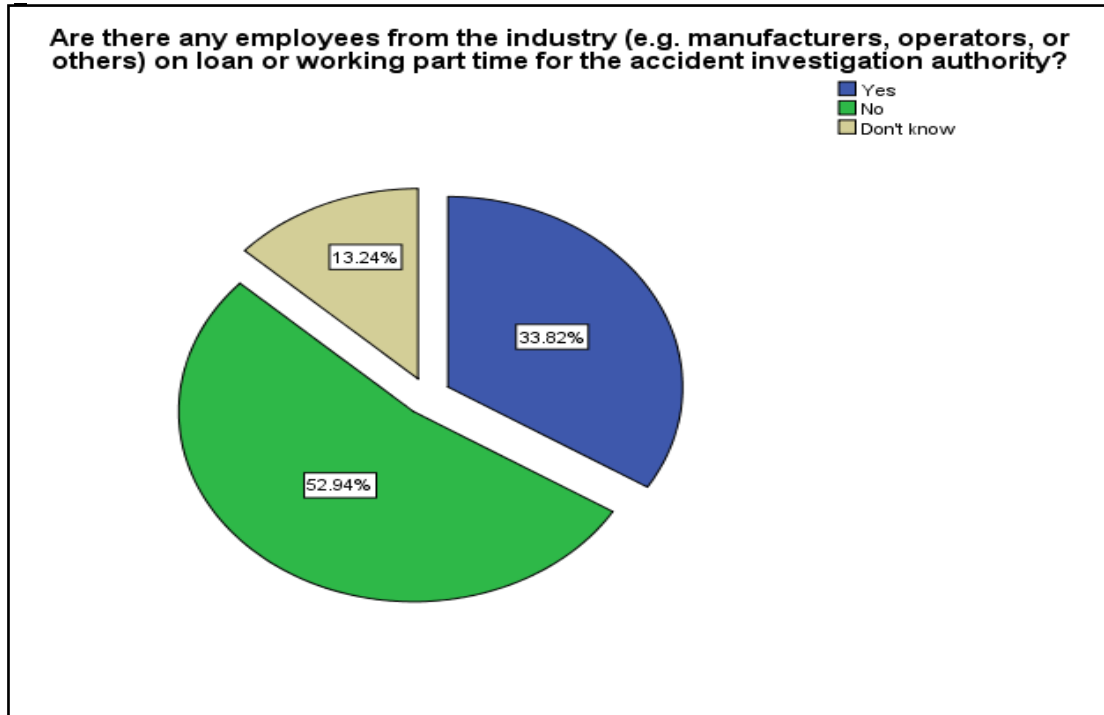


**Figure 7-2 Separation details of Investigation Authorities from Operation Authorities**

About 53% of the participants indicated that the accident investigation authorities in their States do not have employees from the industry that are “on loan” or working “part-time”, which may suggest that these authorities are structured in a way that makes them less dependent on (higher independence from) the industry to fulfil their intended function (see Table 7-6 and Figure 7-3).

**Table 7-6 On loan or part-time employees**

		Frequency	Percent	Cumulative Percent
Valid	Yes	23	33.8	33.8
	No	36	52.9	86.8
	Don't know	9	13.2	100.0
	Total	68	100.0	

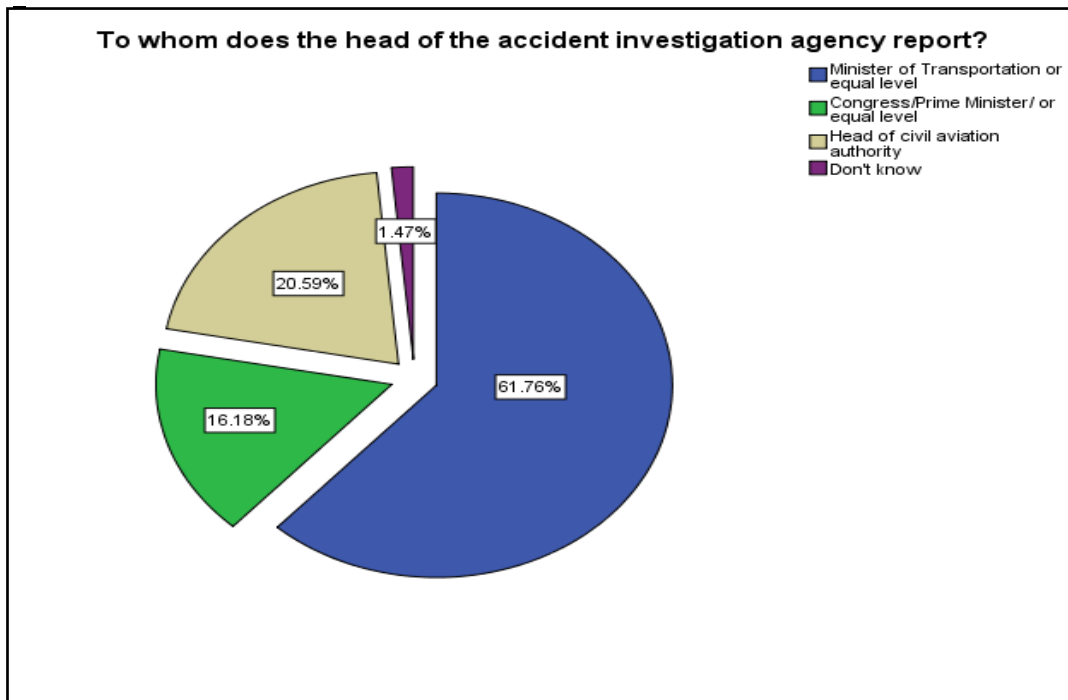


**Figure 7-3 On loan or part-time employees**

When asked “to whom does the head of the agency report”, 61.76% said “to Minister of Transport or equal level”, 16.18% said “Congress/Prime Minister or equal level”; however, 20.59% said “Head of civil aviation authority” (see Table 7-7 and Figure 7-4).

**Table 7-7 To whom does the head of the accident investigation agency report?**

		Frequency	Percent	Cumulative Percent
Valid	Minister of Transportation or equal level	42	61.8	61.8
	Congress/Prime Minister/ or equal level	11	16.2	77.9
	Head of civil aviation authority	14	20.6	98.5
	Don't know	1	1.5	100.0
	Total	68	100.0	



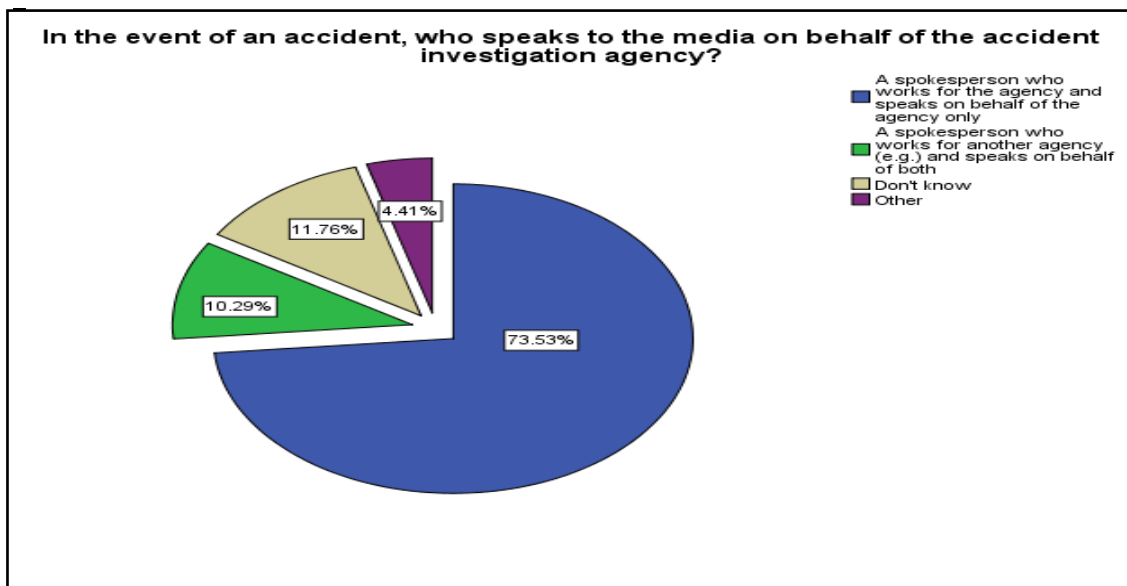
**Figure 7-4 To whom does the head of the accident investigation agency report?**

Based on this sample, the findings show that about 62% of the accident investigation authorities report to the Minister of Transport or equal level and about 16% report to a higher level (Prime Minister/Congress/ or equivalent). There are, however, about 20% of the investigation authorities that report to the Head of the national aviation authority, which may indicate a problem in the structure of how these authorities are setup. Clearly there is the potential to hamper their independence from the regulator. But if the 8.8% who said they do not have a permanent accident investigation agency in their States are removed from the equation, the percentage goes down to about 10% or less of the permanent accident investigation agencies that report to the head of the civil aviation authority. This might be an indication that some States work harder to achieve compliance than to achieve the benefits of having an independent investigation authority. Or it might be an indication that some States do not fully understand that having a permanent investigation authority is not enough, if that authority reports to the regulator at the end.

**Table 7-8 In the event of an accident, who speaks to the media on behalf of the accident investigation agency?**

		Frequency	Percent	Cumulative Percent
Valid	A spokesperson who works for the agency and speaks on behalf of the agency only	50	73.5	73.5
	A spokesperson who works for another agency (e.g.) and speaks on behalf of both	7	10.3	83.8
	Don't know	8	11.8	95.6
	Other	3	4.4	100.0
	Total	68	100.0	

The purpose of this question (in the event of an accident, who speaks to the media on behalf of the accident investigation agency?) is to try to understand if the accident investigation authority in a State is structured in a way that allows it to speak freely to the media through their own spokesperson in the event of an accident. The results suggest that this is actually the case in most of the countries (73.53% out of 68 replies). However, there are countries which have this problem (10.29%) and there are participants who are not sure about this point (11.8%) as shown in Table 7-8 and Figure 7-5.



**Figure 7-5 In the event of an accident, who speaks to the media on behalf of the accident investigation agency?**

## 7.1.2 Financial Dimension Results

**Financial** Dimension: where the answers are related to financial independence of the investigation agency/setup. Table 7-9 shows the questions that are related to the Financial dimension in the survey.

**Table 7-9 Questions related to the Financial Dimension**

Original #	# in 4DMI Tool	Question	Dimension
34	16	<i>Agency has ready access to sufficient funds for proper investigations (within responsibilities of agency)?</i>	Financial
<i>Funding for Agency's investigation is:</i>			
34	17	<i>Independent of political pressure?</i>	Financial
34	18	<i>Independent of other influences?</i>	Financial
44	27	<i>Who controls/reviews Agency's budget?</i>	Financial
46	28	<i>Agency is dependent on outside support to conduct its investigations?</i>	Financial
47	29	<i>Budgetary resources of Agency considered?</i>	Financial
23	9	<i>Who pays for data collection for Database?</i>	Financial
29	11	<i>Salaries of investigators are?</i>	Financial

The respondents were asked if the agency has ready access to sufficient funds to investigate the accidents and incidents that fall within its responsibility. The results are as follows:

- 50% said they agree (26.5%) or strongly agree (23.5%)
- 31% said they disagree (22.1%) or strongly disagree (8.8%)

The results suggest that there are States that do not have access to sufficient funds to investigate the accidents and incidents they are required to investigate. This result agrees in part with what Costa, Chief of Accident Investigation and Prevention Section in ICAO, reported, i.e. that the USOAP audits found a lack of the implementation of effective accident investigation authorities in several States in many regions, which was linked to insufficient human and financial

resources (Costa, 2011). This research cannot confirm that this lack of sufficient resources is the reason for an ineffective accident investigation system as the efficiency of the investigation authority is outside the scope of this research.

Participants have different opinions about political and other influences that might affect the accident investigation authorities in their States. More than 51% of the respondents either agree (32.4%) or strongly agree (19.1%) that the funding of the accident investigation authorities in their countries is free from political pressure (see Table 7-10). About 33% of the respondents either disagree (23.5%) or strongly disagree (8.8%) that the funding of the accident investigation authorities in their countries is free from political pressure.

Moreover, when asked if the funding is independent of “other” influences, 54.5% said they either strongly agree (22.1%) or agree (32.4%), and 30.9% said they either strongly disagree (10.3%) or disagree (20.6%).

**Table 7-10 Funding for the agency's investigations is independent of political pressure**

		Frequency	Percent	Cumulative Percent
Valid	Strongly disagree	6	8.8	8.8
	Disagree	16	23.5	32.4
	Neutral	9	13.2	45.6
	Agree	22	32.4	77.9
	Strongly agree	13	19.1	97.1
	Don't know	2	2.9	100.0
	Total	68	100.0	

In another question, the respondents were asked if the investigation agencies in their States are dependent on financial support from outside the agency to conduct their investigation; the results were as follows (see Table 7-11 and Figure 7-6):

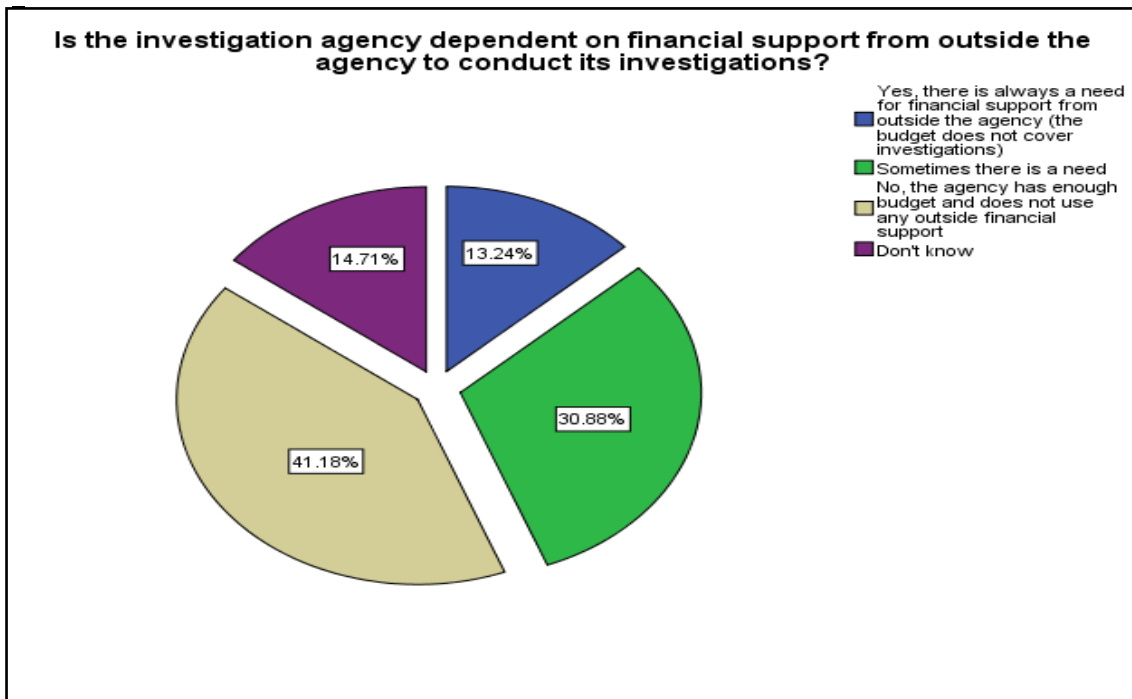
- 13.2% said yes there is a need, (the budget does not cover investigation)
- 30.9% said there is a need sometimes



- 41.2% said no there is no need, there is enough budget
- 14.7% said they do not know.

**Table 7-11 Is the investigation agency dependent on financial support from outside the agency to conduct its investigations?**

		Frequency	Percent	Cumulative Percent
Valid	Yes, there is always a need for financial support from outside the agency (the budget does not cover investigations)	9	13.2	13.2
	Sometimes there is a need	21	30.9	44.1
	No, the agency has enough budget and does not use any outside financial support	28	41.2	85.3
	Don't know	10	14.7	100.0
	Total	68	100.0	



**Figure 7-6 Is the investigation agency dependent on financial support from outside the agency to conduct its investigations?**

In a related question, the respondents were asked to give their opinion (by choosing from the list) on whether they think the accident investigation agency's budget is sufficient or not. The results were as follows (see Table 7-12):

- About 45% said it is sufficient
- About 39% said it is insufficient
- 13% said they do not know

Chapter 2 of this thesis discussed the consequences of not having sufficient funding to be able to perform the job. One of the recommendations from the Senate inquiry with regard to the Australian CASA was to review CASA's funding arrangements to ensure it is equipped to deal with the new regulatory challenges without being "captured" by the industry (Sterle, 2008). A parallel can be drawn here to apply the same recommendation to ICAO Member States, and that is to ensure that the accident investigation authorities in their States have enough funding to be independent from the regulator or other interested organisations.

**Table 7-12 Do you consider budgetary resources of the agency as sufficient**

		Frequency	Percent	Cumulative Percent
Valid	Sufficient	30	44.1	45.5
	Insufficient	26	38.2	84.8
	Don't know	9	13.2	98.5
	Other	1	1.5	100.0
	Total	66	97.1	
Missing	System	2	2.9	
Total		68	100.0	

Moreover, the respondents were asked a question about the salaries offered by the accident investigation authority in their States to try to measure if the agency has enough budget to hire highly qualified and experienced people from the industry. The question also aims to give an indication of how financially independent the investigators themselves are. The results suggest that most of the investigation authorities pay their investigators "around the average"

(26.5%) or “below” (44.1%) as shown in Table 7-13 and Figure 7-7. However, when the researcher consulted experts who work in this field they commented that the salaries are actually higher than average if not the best in the industry. So, why are there discrepancies?

Kovach (1987) claims that there are different levels of employees’ motivators. He suggests that money becomes less of a motivator for employees as their income increases and that as employees become older, interesting work becomes their biggest motivator.

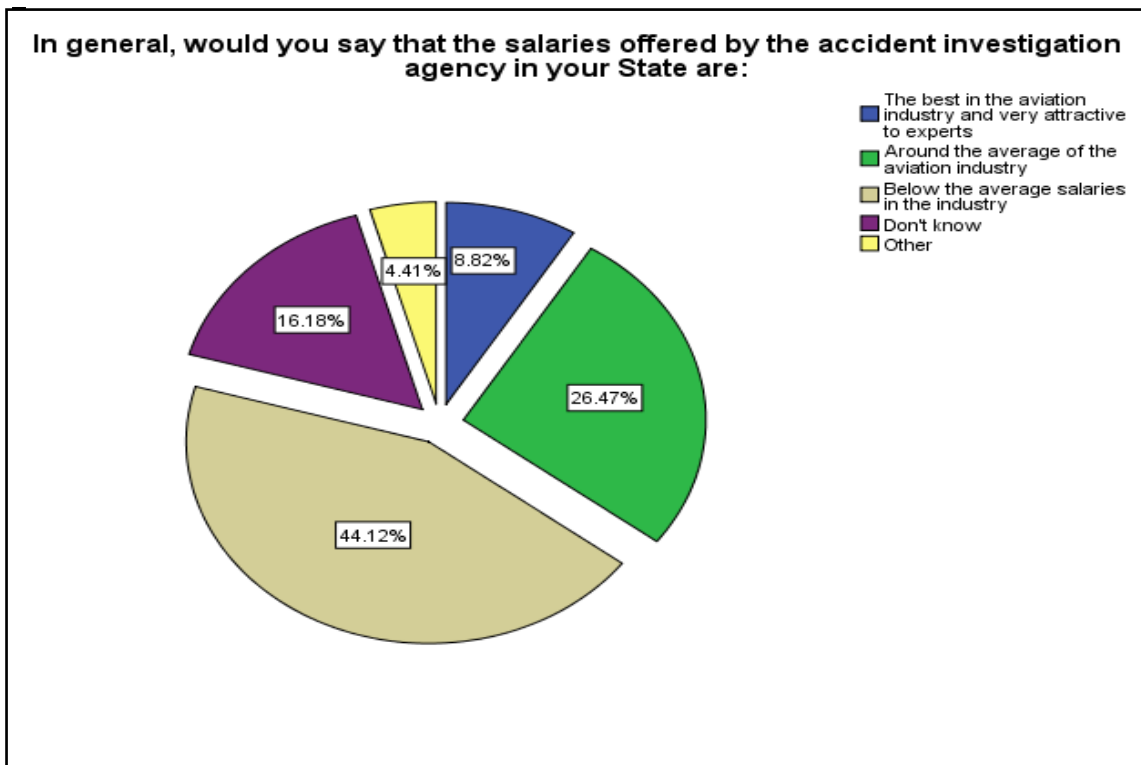
However, Rynes et al. (2004) suggest that the effect of employees’ pay is underestimated in many researches. They claim that pay is an important and powerful general motivator, especially when it is tied to the employee’s performance, despite not being equally important in all situations or to all individuals.

From the discipline of Psychological theory, Nunnally and Bernstein (1994) give an explanation for this behaviour. They indicate that “the tendency to choose items that reflect societally approved behaviours” are called *socially desirable responding*. Rynes et al. (2004) explain that “people are likely to understate importance in the case of salaries because either they misjudge how they might react to an offer of a higher paying job, or due to social norms that view money as a less noble source of motivation than factors such as challenging work or work that makes a contribution to society.”

In this research, the aim is to present the importance of good compensation to attract experienced professionals and keep them in the job, which enhances the independence of the accident investigation authority in such a way that it is not dependent on other organisations’ employees to perform its intended work.

**Table 7-13 Salaries offered by the accident investigation agencies**

		Frequency	Percent	Cumulative Percent
Valid	The best in the aviation industry and very attractive to experts	6	8.8	8.8
	Around the average of the aviation industry	18	26.5	35.3
	Below the average salaries in the industry	30	44.1	79.4
	Don't know	11	16.2	95.6
	Other	3	4.4	100.0
	Total	68	100.0	



**Figure 7-7 Salaries offered by the accident investigation agencies**

### 7.1.3 Functional Dimension Results

**Functional** Dimension: where the answers show how independent the investigation body is in performing its primary function – investigation.

**Table 7-14 Questions related to the Functional Dimension**

Original #	# in 4DMI Tool	Question	Dimension
39	22	<i>Who determines the scope of investigation?</i>	Functional
40	23	<i>Who determines the method of investigation?</i>	Functional
		<i>Does the Agency have:</i>	
20	4	<i>Flight Recorder readout facilities?</i>	Functional
21	5	<i>Material failure analysis facilities?</i>	Functional
22	6	<i>Voluntary incident reporting system?</i>	Functional
23	7	<i>Safety Database?</i>	Functional
23	8	<i>Are data in this Database available to others?</i>	Functional
33	14	<i>Agency recommendations acceptance rate measured?</i>	Functional

Two open-ended questions were asked in the survey: Who determines the scope of the investigation? and Who determines the method of investigation?

The answers were as follows:

- Almost 90% said one of the following “Agency, IIC, Head of investigation office, Board members, or commissioner”
- Only 4.4% said CAA or Minister of Transport.

For the second question about who determines the method of investigation:

- 100% said one of the following “Agency, IIC, Head of investigation office, Board members, or commissioner”.

These answers suggest that almost all ICAO Member States are aware of, and in compliance with the requirements for functional independence when it comes to determining the scope and method of investigation.

The respondents were asked if the accident investigation agencies in their States have flight data recorder (FDR) readout facilities. 48.5% of the participants said their accident investigation authorities in their States do have FDR readout facilities. 51.5% said “No”.

The flight recorder readout facilities are very important to have under the control of the investigation authorities because it also involves evidence that must be protected and must not be made public or made available to the judicial proceedings unless it is deemed to be required. Although accident investigation authorities can have access to FDR readout facilities outside their control, this situation suggests dependency on these facilities, their integrity, and the integrity of their employees, and therefore may suggest a lack of functional independence of the accident investigation authorities.

The frequency analysis was regenerated for 45 cases, where each State has one entry only. The results shown in Table 7-15 indicate that only 33% (15 States) of the respondents have FDR readout facilities. 66% (30 States) do not have these facilities.

**Table 7-15 Does the accident investigation authority have flight recorder readout facilities?**

		Frequency	Percent	Cumulative Percent
Valid	No	30	66.7	66.7
	Yes	15	33.3	100.0
	Total	45	100.0	

When asked if the accident investigation agencies in their States have material failure analysis facilities, out of the 68 replies, 68% said “No” and 32% said “Yes”. This facility is less sensitive than the FDR readout facility. Having a material failure analysis facility is important and enhances the independence of the investigation body; however, it is difficult to find trained and experienced personnel to do the work, and its overhead costs make it a lower priority for many States. Such facilities are not expected in all ICAO Member States.

If the repeated participations are taken into consideration (for example, USA 7 times, and UK 6 times), then it can be seen that the percentage of participants who said they have a material failure analysis facility would drop dramatically. Table 7-16 shows the frequency analysis for 45 States only, where each case represents a State. The number of States that have this facility dropped to 22.2% and those that do not have it rose to 77.8% Therefore, the answers are as expected.

**Table 7-16 Does the accident investigation authority have material failure analysis facilities?**

	Frequency	Percent	Cumulative Percent
No	35	77.8	77.8
Valid Yes	10	22.2	100.0
Total	45	100.0	

When the participants were asked if the accident investigation authority has a “voluntary accident reporting system”, the respondents replied as follows:

- 42.6% said “Yes”
- 33.8% said “No”
- 17.6” said “Other”

It is interesting to learn what some of the participants said under “Other”. One participant indicated that there is a regulation for it but there is no system in place to report accidents. Another participant indicated that there is a “poorly managed system” in place. Others indicated that there is a voluntary reporting system but it is located within the CAA. Although having a voluntary reporting system within the accident investigation authority is not a requirement, it can highly enhance the independence and the perception of independence of the accident investigation authority.

When asked if the investigation authority has a safety database, the respondents answered with the following (see Table 7-17):

- 79.4% said “Yes”

- 17.6% said “No”

And when asked if the database is available to others, the participants answered with the following (out of the 79.4% who said “Yes” above):

- 55.8% said “Yes”
- 23.5% said “No”

**Table 7-17 Does the accident investigation authority have a safety database (reports, safety studies, recommendations, etc)?**

	Frequency	Percent	Cumulative Percent
Valid Yes	54	79.4	79.4
No	12	17.6	97.1
Don't know	2	2.9	100.0
Total	68	100.0	

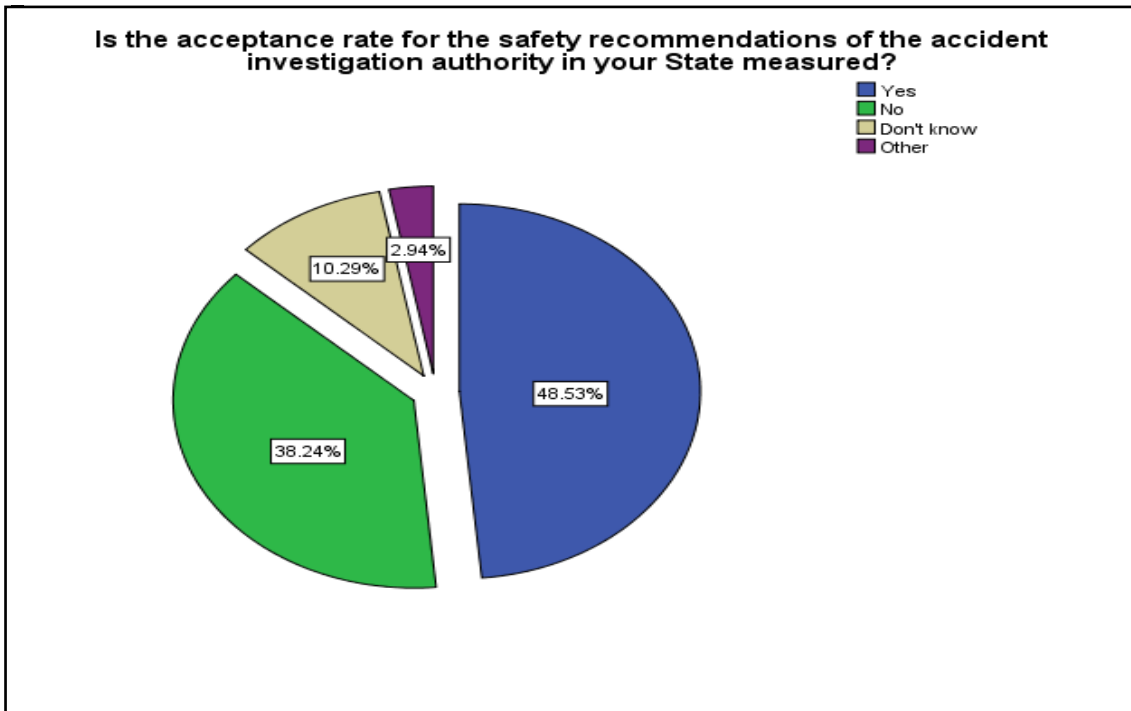
The survey asks if the acceptance rate for the safety recommendations of the accident investigation authority in the participants’ States is measured. The answers are as follows (see Table 7-18 and Figure 7-8):

- 48.5% said “Yes”
- 38.2% said “No”

**Table 7-18 Is the acceptance rate for the safety recommendations of the accident investigation authority in your State measured?**

	Frequency	Percent	Cumulative Percent
Valid Yes	33	48.5	48.5
No	26	38.2	86.8
Don't know	7	10.3	97.1
Other	2	2.9	100.0
Total	68	100.0	





**Figure 7-8 Is the acceptance rate for the safety recommendations of the accident investigation authority in your State measured?**

### 7.1.4 Operational-Political Dimension Results

The **Operational** Dimension is about Legal (or Regulatory) and Political issues.

**Operational-Political:** to measure the influence of politicians.

**Table 7-19 Questions related to the Operational-Political Dimension**

Original #	# in 4DMI Tool	Question	Dimension
9	4	<i>Internal organisation decided by:</i>	Operational (Political)
10	5	<i>Personnel policy (hire, fire, etc) decided by:</i>	Operational (Political)
14	7	<i>Who appoints the Head of Agency?</i>	Operational (Political)
18	10	<i>Can politicians decide which accident to investigate?</i>	Operational (Political)
19	11	<i>Can politicians stop ongoing investigations?</i>	Operational (Political)
13	2	<i>Head of Agency term in office?</i>	Operational (Political)
		<i>If not permanent, is appointment renewable?</i>	

When the participants were asked who decides on the agency's internal organisation, out of 45 participants:

- 20% said the government only
- 17.8 said the agency only
- 53.3% said both

When the respondents were asked who is responsible for the agency's personnel policy, out of 45 replies:

- 15.6% said the government only
- 35.6% said the agency only
- 44.4% said both

The respondents were asked who appoints the head of the agency. Out of 45 replies:

- 13.3% said Head of State

- 44.4% said one or two ministers
- 11.1% said members of safety board
- 15.6% said mix of parliament and government

The respondents were asked if politicians can decide which accidents are investigated by the accident investigation authority in their States. Out of 45 replies, the answers are as follows:

- 82.2% said no
- 8.9% said yes

When the respondents were asked if the politicians can stop an ongoing investigation, they answered the following (out of 45 replies):

- 84.4% said no
- 8.9% said yes

The results may suggest that in most of the countries the politicians do not, or cannot, directly influence the accident investigation authorities' decisions with regard to starting or stopping an investigation.

When asked about the head of investigation agency's term in office, out of 45 replies, they gave different answers but the most notable is that 57.8% said "permanent or unspecified term".

### 7.1.5 Operational-Legal (Regulatory) Dimension Results

**Operational-Legal (regulatory):** the question is about the legality of an issue or to check if it is protected by regulation.

**Table 7-20 Questions related to Operational-Legal Dimension**

Original #	# in 4DMI Tool	Question	Dimension
12	6	<i>Is there a Law or Reg to prevent use of safety findings in a judicial inquiry?</i>	Operational-Legal
16	9	<i>Independence of Agency formally stated?</i>	Operational-Legal
24	12	<i>Does the Agency require approval to release report?</i>	Operational-Legal
25	13	<i>Can Agency launch investigation without prior permission?</i>	Operational-Legal
27	14	<i>Investigators have immediate/unrestricted access to evidence WITHOUT prior consent?</i>	Operational-Legal
28	15	<i>Agency's investigation procedures specified in:</i>	Operational-Legal
36	19	<i>Law in place forcing Agency to release documents to public?</i>	Operational-Legal
37	20	<i>Regulations specify types of accidents &amp; incidents that must be investigated?</i>	Operational-Legal
38	21	<i>Can Agency decide to investigate occurrences outside its mandate?</i>	Operational-Legal
41	24	<i>Who has 1<sup>st</sup> access to witnesses?</i>	Operational-Legal
42	25	<i>State has regulations to protect witnesses' confidentiality?</i>	Operational-Legal
26	10	<i>How do you know if Agency's investigations are perceived by public as credible and partial?</i>	Operational-Legal
30	12	<i>According to regulations in your State, determination of causation is:</i>	Operational-Legal
32	13	<i>Regulations clearly state that investigators are not to testify in courts...?</i>	Operational-Legal

Most of the questions in this dimension are related to the legal framework within which the accident and incident investigation authority works.

The questionnaire asks if the ICAO Member State has a law or regulation to prevent the use of safety findings in a judicial inquiry. Since this is an ICAO requirement, and these are ICAO Member States that are signatories to the Chicago Convention, it was expected to see a very high percentage of the answers indicating that their State does have such a law or regulation. However, the answers were as follows:

- 58.82% said yes, there is
- 33.82% said no, there isn't

In addition, the survey asks if the independence of the accident investigation agency is formally stated in the State's regulation or legislation. The answers were as follows:

- 83.8% said yes
- 13.2% said no

#### **7.1.5.1 ICAO Annex 13 SARPs are not Regulations**

The Chicago Convention is subject to the general international law of treaties; however, the annexes to the Convention are not an integral part of the Convention. Therefore, the signatory States to the Chicago Convention must implement the Convention's provisions into their domestic legislations. On the other hand, ICAO SARPs do not have the same legal status as the provisions of the Chicago Convention. Therefore, with the exception of a few standards such as the recognition of licences issued by other States, each ICAO Member State has the power to decide which of the standards of the annexes are "practicable" to comply with, as stated in Article 37 of the Chicago Convention: "...to collaborate in securing the highest practicable degree of uniformity in regulations, standards". ICAO does not have the legal power to enforce these SARPs (Trogeler, 2011).

The survey in this research asked the following related question:

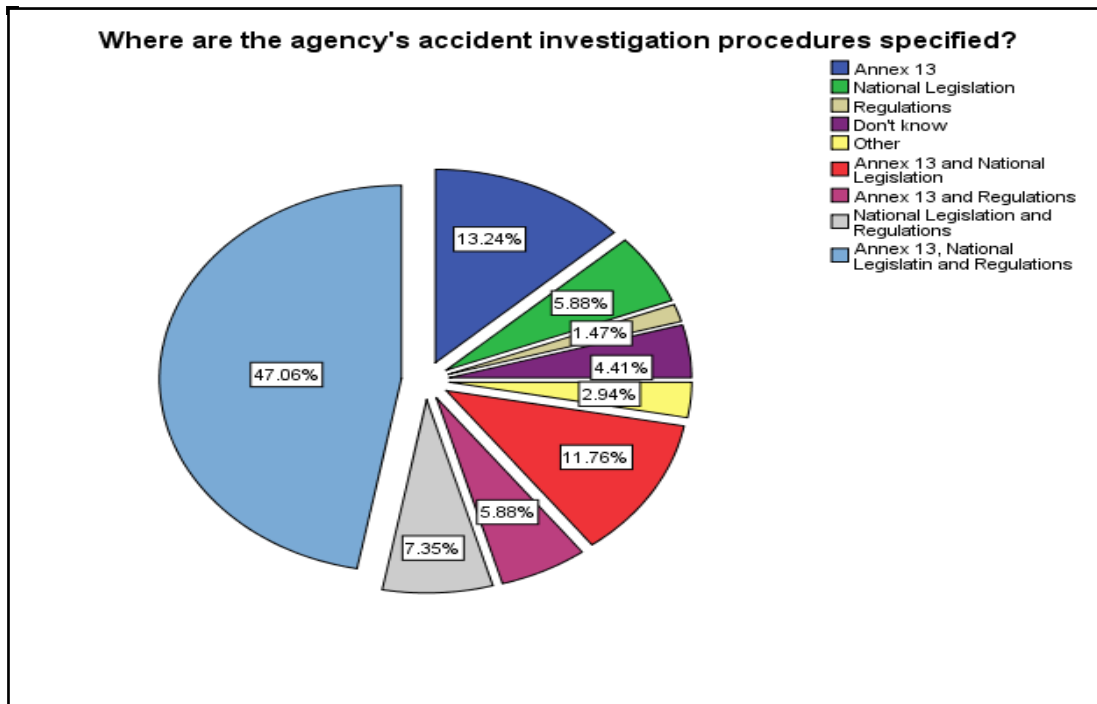
**Where are the agency's accident investigation procedures specified?**

The respondents can choose more than one answer from the following list:

- Annex13
- National Legislation
- Regulations
- Don't know
- Other

**Table 7-21 Where are the agency's accident investigation procedures specified?**

		Frequency	Percent	Cumulative Percent
Valid	Annex 13	9	13.2	13.2
	National Legislation	4	5.9	19.1
	Regulations	1	1.5	20.6
	Don't know	3	4.4	25.0
	Other	2	2.9	27.9
	Annex 13 and National Legislation	8	11.8	39.7
	Annex 13 and Regulations	4	5.9	45.6
	National Legislation and Regulations	5	7.4	52.9
	Annex 13, National Legislation and Regulations	32	47.1	100.0
	Total	68	100.0	



**Figure 7-9 Where are the agency's accident investigation procedures specified?**

Table 7-21 and Figure 7-9 show the data collected to understand where participants think their authority's investigation procedures are specified. As mentioned above, the participants had the chance to choose more than one answer. Surprisingly, 78% (13.2%+11.8%+5.9%+47.1%) thought of ICAO Annex 13 as a regulation for them to follow. 13.2% out of the 78% have Annex 13 as their only source of regulation for accident investigation procedures. This may suggest that there is a widespread false belief that ICAO Annex 13 contains directly applicable regulations at the State's national legislation or regulation level.

This can be looked at from two opposing points of view. On the one hand, this is good because it might be an indication that ICAO SARPs are being enforced in States even though ICAO does not have the legal power to enforce them. On the other hand, this may hamper the independence of the accident investigation authorities in these States because they do not really have regulations in place to give them the legal power to help their independence.

The respondents were asked if the regulations in their States consider finding the causation as the “main” or “sole” purpose of the investigation. Their answers were as follows:

- 47.1% said “main” purpose
- 36.8% said “sole” purpose

The participants were asked if the regulations clearly state that the agency’s investigators are precluded from testifying in courts in litigation processes stemming from the agency’s investigation reports. The responses were as follows:

- 32.4% said yes, clearly stated
- 51.5% said no, not stated

The respondents were also asked if the regulations in their States specify the type of accidents and incidents that the accident investigation agency must investigate. They answered with the following:

- 76.5% said yes
- 22.1% said no

When the participants were asked if the investigation agency can decide to investigate occurrences that it is not obligated to investigate they answered with the following:

- 83.8% said yes
- 5.9% said no
- 10.3% said they don’t know

The answers to the question of who has the first access to witnesses were as follows:

- 10.3% said “the agency’s investigators ALWAYS have first access”
- 48.5% said “the agency’s investigators USUALLY have first access but not always”
- 8.8% said “the judicial (police) ALWAYS have first access”



- 19.1% said “the judicial (police) USUALLY have first access but not always”

The respondents were also asked if their States have regulations to protect the confidentiality of the witnesses. The responses were as follows:

- 73.5% said yes
- 11.8% said no
- 14.7% said they don't know

## 7.2 Three Categories of Independence

There are 68 responses to the survey representing 45 ICAO Member States. Some States are represented more than once, while others are represented only once. The following criteria were adopted to limit the cases to one per ICAO Member State in order to compare between States, their Total Score on the 4DMI scale, and the common practices in each category:

- 1- If there is only one reply for a State, that reply is utilised
- 2- If there is more than one participation, then they are prioritised as follows:
  - a. participation from someone who works for the accident investigation authority itself, or a retired person from it
  - b. If there is no such participation as described in “a” above or if there is more than one participation that has the same level of priority, then the highest score is adopted.

After applying the criteria above to obtain a single reply for each State (see Table 7-22), the 4DMI scale was divided into three categories of independence based on the Total Score as follows:

1. **Low-independence category:** states that scores below 50%. There are 10 States in this category.
2. **Average-independence category:** states that score above 50% and lower than 75%. There is a total of 23 states in this category.

3. **High-Independence category:** contains 12 States with scores between 74.66% and the highest score of 87.74%. Only 11 States scored above 75%, however, the USA (scored 74.66%) was added to this category because of the reputation this state has in accident investigations. Also, because there is a 4.65% of “Don’t Know or missing answers” for this state which affected its Total Score.

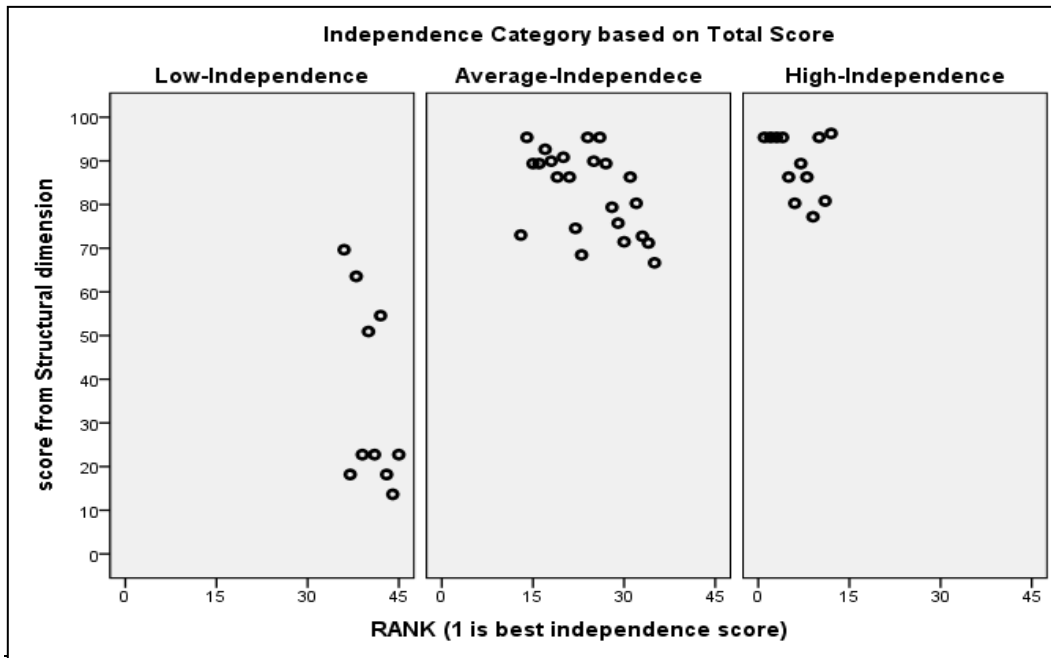
**Table 7-22 Total Score and RANK for 45 States**

ID	Don't know (or missing) %	Percentage of Total Score	ICAO Member States sorted and colour-coded according to their category	RANK
7381258	0.00%	87.74%	Australia	1
7322436	2.33%	84.55%	Germany	2
7291614	0.00%	81.89%	UK	3
7426589	0.00%	79.77%	Poland	4
7322370	0.00%	78.70%	Finland	5
7334963	2.33%	78.36%	UAE	6
7331355	0.00%	77.83%	Portugal	7
7353645	0.00%	76.57%	Lithuania	8
7433742	0.00%	76.57%	Serbia	9
7433772	0.00%	75.51%	Ireland	10
7485138	0.00%	75.30%	Switzerland	11
7736005	4.65%	74.66%	USA	12
7432620	0.00%	74.53%	Greece	13
7436086	0.00%	74.45%	Hungary	14
7476200	0.00%	74.11%	Singapore	15
7323590	0.00%	74.11%	Denmark	16
7705647	2.33%	73.81%	Italy	17
7439738	2.33%	73.17%	Romania	18
7479530	9.30%	72.85%	Austria	19
7485841	4.65%	72.85%	Sweden	20
7662286	0.00%	71.79%	Russia	21

7432755	2.33%	70.64%	Netherlands	22
7333337	4.65%	70.28%	Czech R.	23
7321240	2.33%	69.66%	Estonia	24
7420566	0.00%	68.91%	Iceland	25
7601145	0.00%	68.60%	Bulgaria	26
7323504	2.33%	67.19%	Latvia	27
7317893	6.98%	65.91%	Canada	28
7475610	0.00%	64.53%	Croatia	29
7306664	11.63%	63.53%	Pakistan	30
7429600	6.98%	62.74%	France	31
7576288	0.00%	61.87%	Luxembourg	32
7457483	0.00%	60.64%	Hong Kong	33
7348681	4.65%	59.74%	Slovakia	34
7919248	0.00%	58.15%	Bolivia	35
7864988	20.93%	42.89%	Belgium	36
7338848	16.28%	42.02%	Antigua	37
7629632	6.98%	40.94%	Sudan	38
7427396	0.00%	33.51%	Turkey	39
7457442	9.30%	33.19%	Morocco	40
7561808	2.33%	31.91%	Macedonia	41
7294276	32.56%	30.85%	Malaysia	42
7358909	4.65%	26.60%	Libya	43
7465330	18.60%	15.96%	Tunisia	44
7359109	2.33%	15.96%	Uganda	45

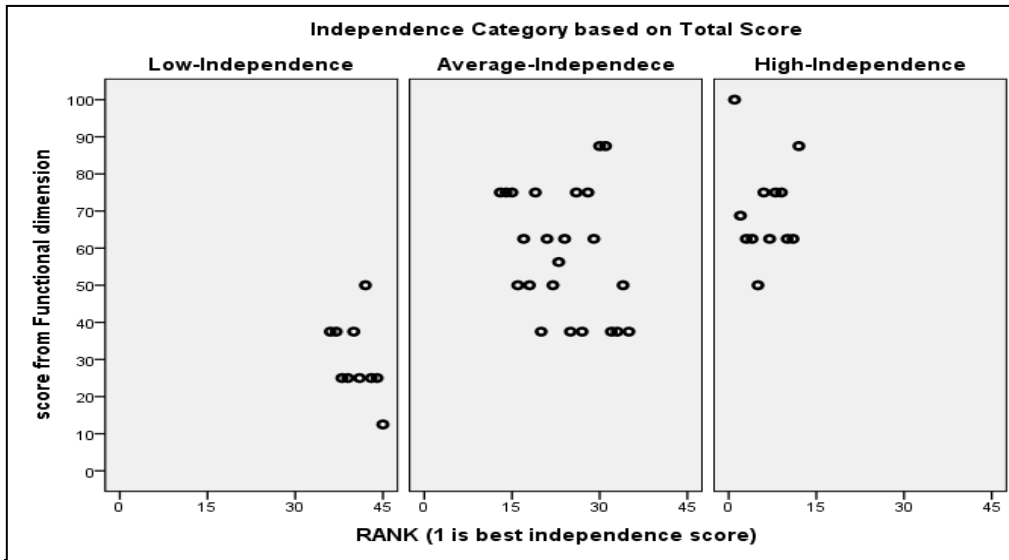
### 7.2.1 Bird's-Eye View of Independence Scores

The following scatter plots give a general idea of how different ICAO Member States scored in general and per specific dimension. The x-axis in the plots represents the RANK for each independence category. The y-axis represents the percentage of the score of each State. Note that these plots are for the 45 cases; each case represents an ICAO Member State.



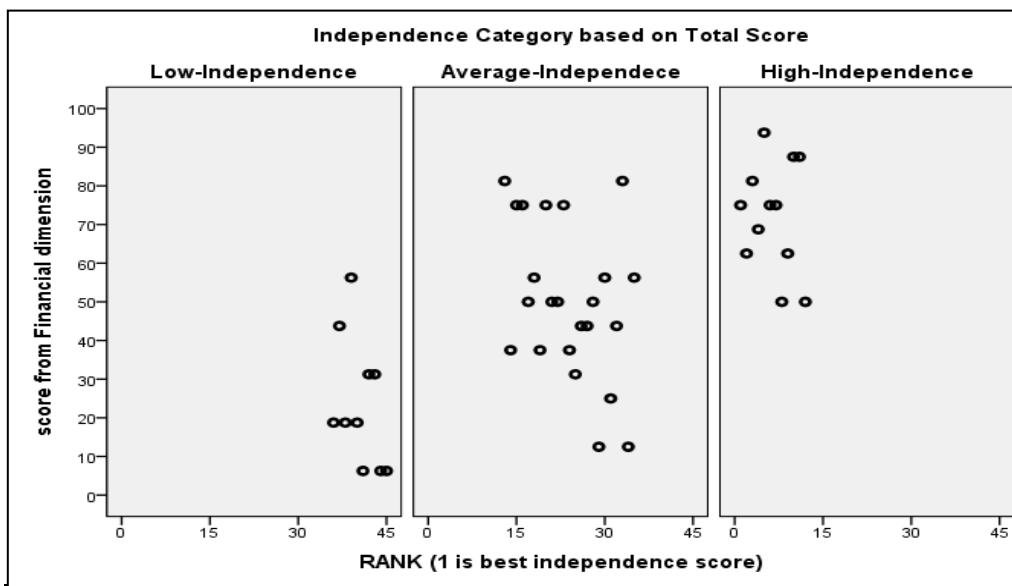
**Figure 7-10 Structural Dimension Scores – scatter plot**

The differences in Structural Dimension scores between the three independence categories are shown in Figure 7-10. Note how the “Low-independence” category scores are lower than the scores of the rest of the categories. These data may suggest that the structural dimension is a big weakness in the States in this category. States in other categories are very similar in their Structural Dimension scores.



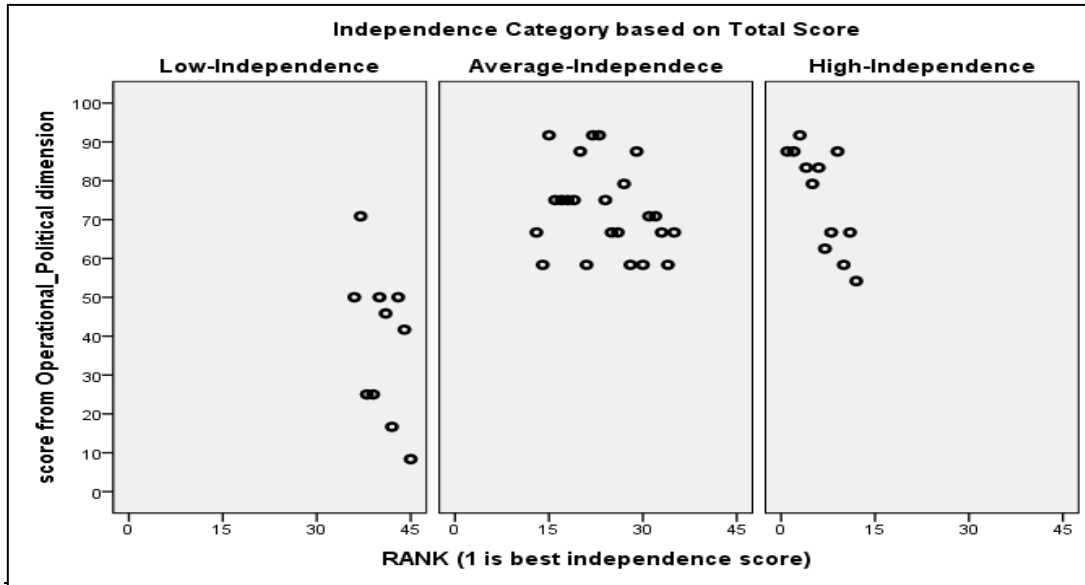
**Figure 7-11 Functional Dimension Scores – scatter plot**

Figure 7-11 shows that within each category several ICAO-Member States scored the same, which may indicate consistency in approaching the functional independence in States within each category. On the other hand, there seems to be big variation between the two extremes of independence categories (Low and High-Independence categories). Scores for the States in the Average-Independence Category, as expected, fall in between the two extremes, but in general their scores seem to be closer to the scores of the States in the High-Independence Category.



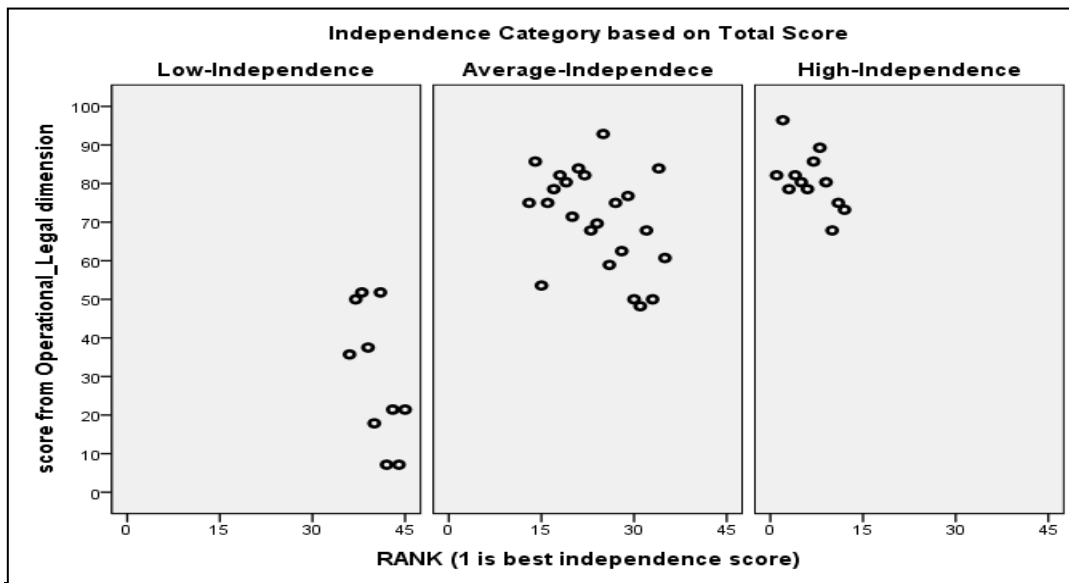
**Figure 7-12 Financial Dimension Scores – scatter plot**

States in the Low-Independence and in the Average-Independence categories are, in general, struggling with their financial independence as shown in Figure 7-12. States in the High-Independence category seem to be scoring better in general than the rest of the States in this dimension.



**Figure 7-13 Operational\_Political Dimension Scores – scatter plot**

Apart from the Low-Independence category, all categories in general scored fairly similarly in the Operational\_Political and Operational\_Legal dimensions as shown in Figure 7-13 and Figure 7-14.



**Figure 7-14 Operational\_Legal Dimension Scores - scatter plot**

### **7.2.2 Similarities and Differences between Categories**

Answers to each question from the survey were thoroughly analysed to understand if there are any similar practices between the countries that belong to each of the three categories: Low-Independence, Average-Independence, and High-Independence. Also, the similarities and differences across the three categories were studied.

Table 7-23 shows the results of the analysis. The criteria of “similarity” in the answers are:

- The occurrence of that answer 70% of the time or more per question.
- If there are no significant similarities within a category, or if there are similarities in the answers for a single question across all of the three categories, that question is ignored because the aim is to study the common practices within the low and high independence categories specifically to understand what affects investigation independence in states in these categories.

**Table 7-23 Significant agreement (70% or more) on answers per Category**

	Text of Q	Low-Independence Category	Average-Independence Category	High-Independence Category
Q2	Please specify your Organization		No Significant Agreement	Accident Investigation Authority 10/12 83.3%
Q3	Does your State have a permanent accident investigation authority/body/agency?		No Significant Agreement	Yes 12/12 100%
Q4	The aircraft accident investigation authority in your State is:	Specific to Aviation 8/10 80%	No Significant Agreement	
Q6	Is the accident investigation authority physically separate from the Civil Aviation Authority (Regulator)?	No, they are located in the same building 10/10 100%	No Significant Agreement	Yes, they are separated in different buildings 10/12 83.3%
Q7	Is the accident investigation authority separate from the operation authority/authorities (airport, air navigation, air traffic controller)?		No Significant Agreement	Yes, they are separated 12/12 100%
Q7_a	Separation details of Investigation Authorities from Operation Authorities		No Significant Agreement	Functionally, Structurally and Physically (different Buildings) 10/12 83.3%
Q8	Are there any employees from the industry (e.g. manufacturers, operators, or others) on loan or working part time for the accident investigation		No Significant Agreement	No 9/12 75%
Q12	Does the State have a law or regulation to prevent the use of safety findings in judicial inquiry?	No, there isn't 8/10 80%	No Significant Agreement	Yes, there is 12/12 100%
Q15	To whom does the head of the accident investigation agency report?		No Significant Agreement	Minister of Transportation or equal level 11/12 91.7%
Q16	Is the independence of the accident investigation agency formally stated (in the regulations or legislation)?		No Significant Agreement	Yes 12/12 100%
Q17	Does the accident investigation authority in your State have a Board?		No Significant Agreement	No 10/12 83.3%
Q18	Can Politicians (government) in your State decide which accidents are investigated by the accident investigation authority?		No Significant Agreement	No 12/12 100%
Q19	Can Politicians (government) stop an on-going investigation?		No Significant Agreement	No 12/12 100%
Q20	Does the accident investigation authority have flight recorder read-out facilities?	No 9/10 90%	No Significant Agreement	
Q21	Does the accident investigation authority have material failure analysis facilities?	No 9/10 90%	No Significant Agreement	No 9/12 75%
Q23	Does the accident investigation authority have a safety database (reports, safety studies, recommendations, etc)?		No Significant Agreement	Yes 12/12 100%
Q24	Does the accident investigation authority require the approval of another government official, body or agency to release a report?	Yes 7/10 70%	No Significant Agreement	No, no approval needed 12/12 100%
Q25	Can the accident investigation agency launch investigations without prior permission from anybody outside of the agency?		No Significant Agreement	Yes, always 12/12 100%
Q27	Do accident investigation agency's safety investigators have immediate and unrestricted access to all relevant evidence WITHOUT prior		No Significant Agreement	Yes, always 12/12 100%
Q28	Where are the agency's accident investigation procedures specified?		No Significant Agreement	Annex 13, National Legislation, and Regulations 9/12 75%
Q32	Is it clearly stated in the regulations that the agency investigators are precluded from testifying in courts in litigation process growing from the agency's	Yes 7/10 70%	No Significant Agreement	
Q33	Is the acceptance rate for the safety recommendations of the accident investigation authority in your State measured?	Yes 7/10 70%	No Significant Agreement	Yes 11/12 91.7%
Q35_a	The greater the independence of the accident investigation agency, the greater the CREDIBILITY of the agency	Yes 7/10 70%	No Significant Agreement	Strongly agree 9/12 75%
Q37	Does the regulation specify the types of accidents and incidents that the investigation agency must investigate?		No Significant Agreement	Yes 12/12 100%
Q38	Can the investigation agency decide to investigate occurrences that it is not obligated to investigate?		No Significant Agreement	Yes 11/12 91.7%
Q42	Does your State have regulations to protect the confidentiality of the witnesses?		No Significant Agreement	Yes 11/12 91.7%
Q43	In the event of an accident, who speaks to the media on behalf of the accident investigation agency?		No Significant Agreement	A spokesperson who works for the agency and speaks on behalf of the agency only 11/12 91.7%
Q47	Do you consider budgetary resources of the agency as		No Significant Agreement	Sufficient 10/12 83.3%



Note that there are 23 States in the Average-Independence category and in order to show any significant agreement (at least 70%) 17 States or more must agree on an answer to a question. As shown in Table 8-25 above, there are no significant agreements between States in any answer for questions shown in the table.

The common answers within the “Low-Independence” category and the “High-Independence” category are examined next.

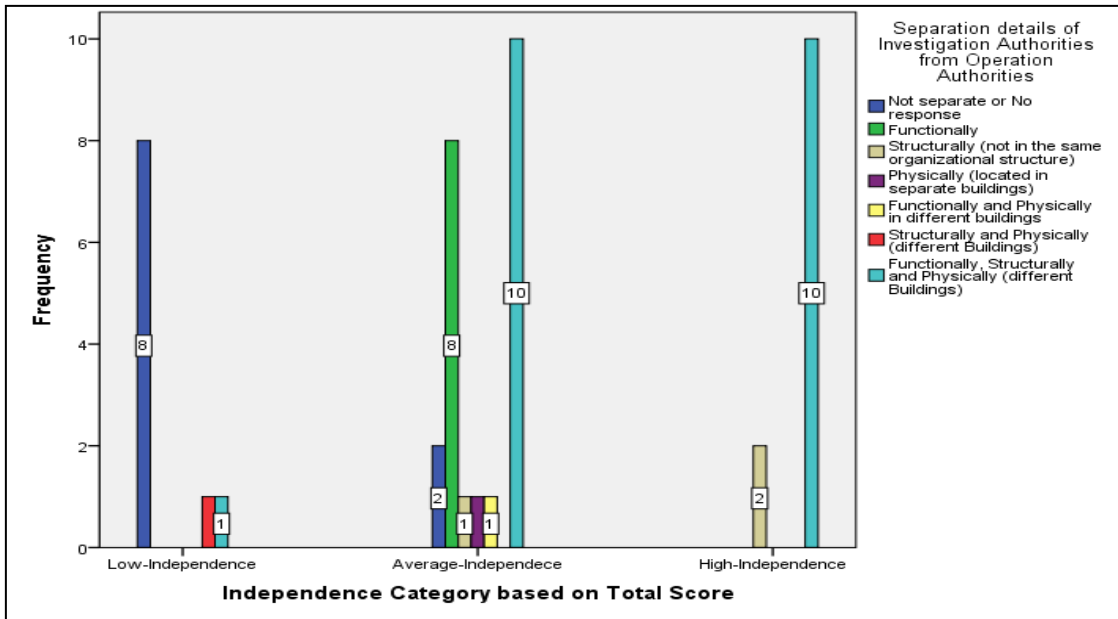
### **7.2.3 Common Answers within the “High-Independence” Category:**

Table 7-24 shows the practices that distinguish the High-Independence category from the rest of the categories. The table also shows the number of States (and the percentage they represent) that agree on that answer within the category.

**Table 7-24 Common answers for the High-Independence category**

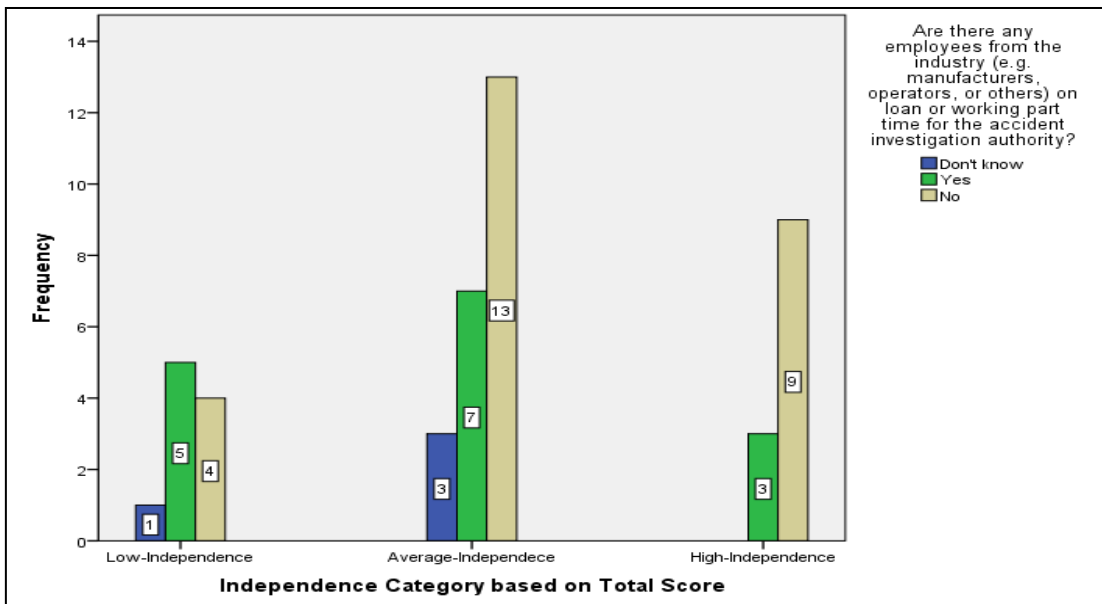
	Text of Question	Category Independent
Q7_a	Separation details of Investigation Authorities from Operation Authorities	Functionally, Structurally and Physically (different Buildings) <b>10/12 83.3%</b>
Q8	Are there any employees from the industry (e.g. manufacturers, operators, or others) on loan or working part-time for the accident investigation authority?	No <b>9/12 75%</b>
Q15	To whom does the head of the accident investigation agency report?	Minister of Transportation or equal level <b>11/12 91.7%</b>
Q27	Do accident investigation agency's safety investigators have immediate and unrestricted access to all relevant evidence WITHOUT prior consent from judicial bodies or other authorities?	Yes, always <b>12/12 100%</b>
Q28	Where are the agency's accident investigation procedures specified?	Annex 13, National Legislation, and Regulations <b>9/12 75%</b>
Q33	Is the acceptance rate for the safety recommendations of the accident investigation authority in your State measured?	Yes <b>11/12 91.7%</b>
Q47	Do you consider budgetary resources of the agency as:	Sufficient <b>10/12 83.3%</b>

Table 7-24 shows seven common practices that are consistent in this category. The data in the table suggest that ICAO Member States that scored higher in the independence scale of the 4DMI have, in general, investigation authorities that are functionally, structurally and physically separate from the Operation Authorities. This type of separation, in addition to the separation from the regulator, is expected in independent authorities (see Figure 7-15).



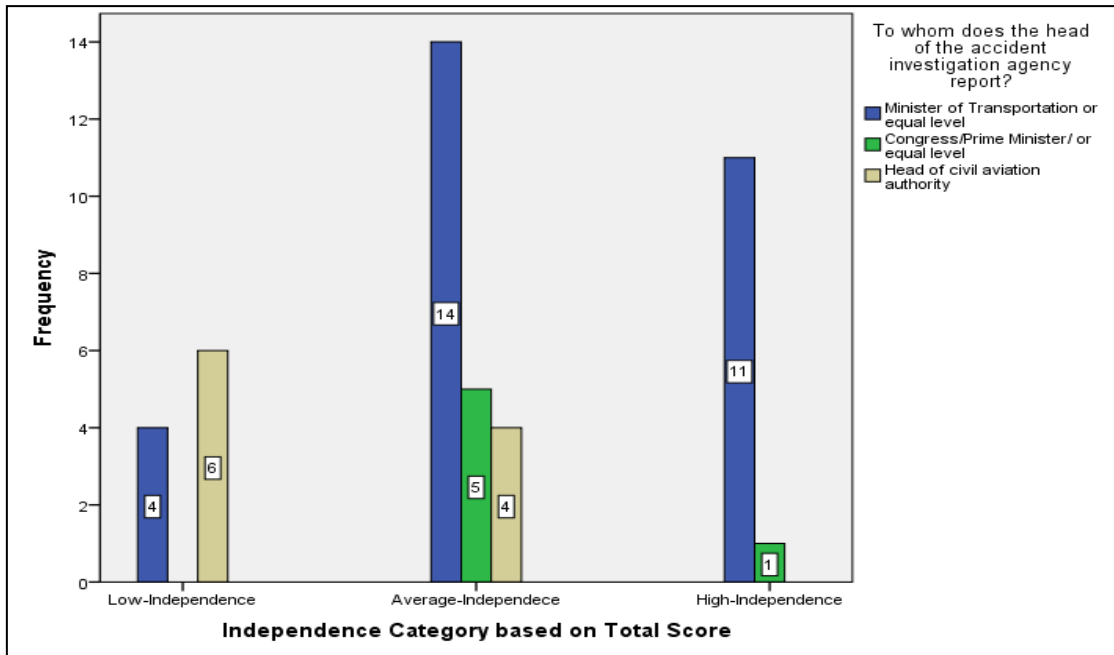
**Figure 7-15 Separation from Operation Authorities**

In general, the investigation authorities in most of the States in this category have no employees on loan from the industry. This practice improves the separation between the investigation authorities and the industry they investigate, and makes sure there is no real or perceived pressure on the employees from the industry (see Figure 7-16).



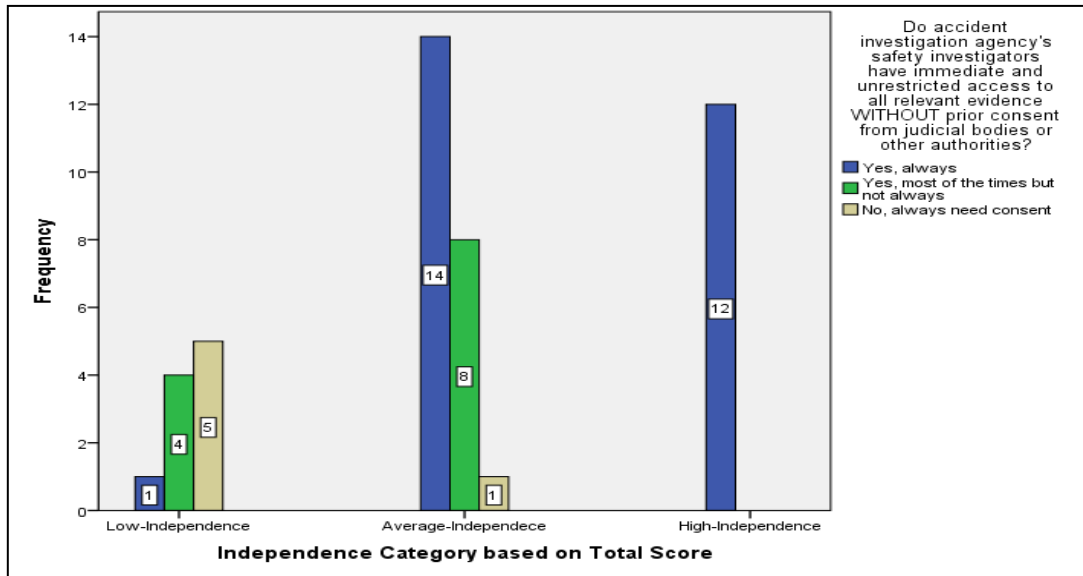
**Figure 7-16 Employees on loan**

Also, in most of the States in this category, the head of the investigation authority reports to the Minister of Transport or equal level. This ensures the independence of the head of the accident investigation authority and removes pressure or influence from interested parties such as the head of the regulation authority (see Figure 7-17).



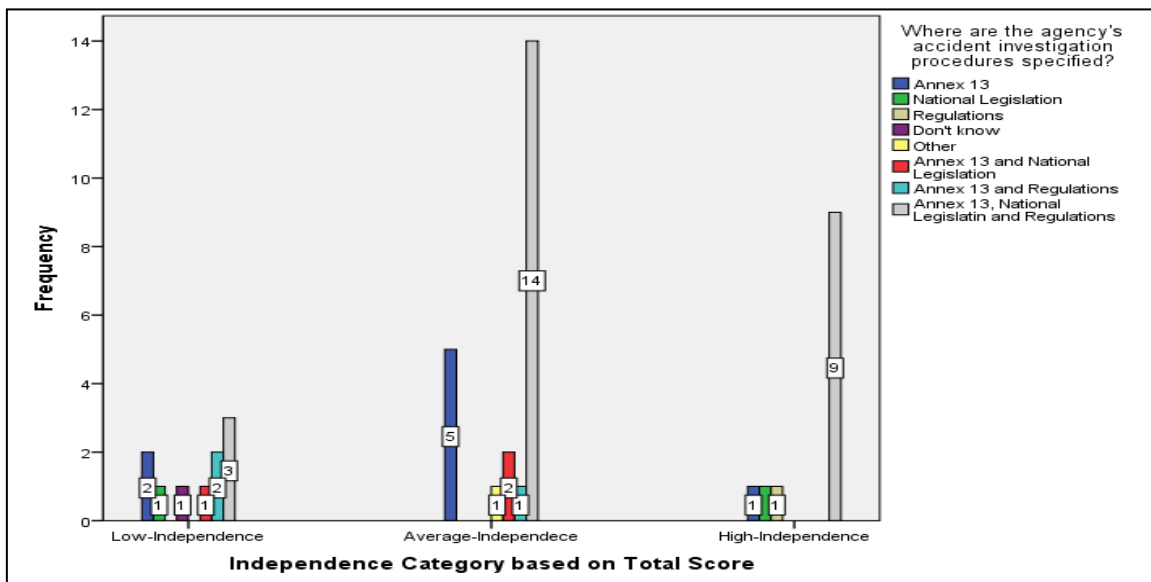
**Figure 7-17 Head of agency chain of command**

Moreover, in this category, safety investigators in all States are allowed immediate and unrestricted access to all evidence and without prior consent from the judicial or other authorities. Not only does this improve the credibility of the investigators, it also ensures that safety investigators get to perishable evidence in timely manner (see Figure 7-18).



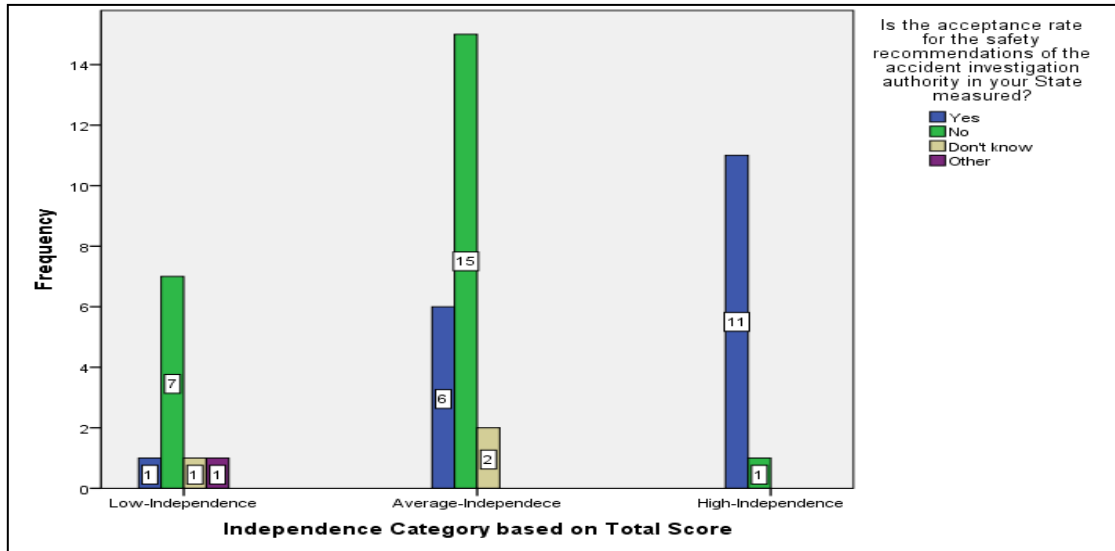
**Figure 7-18 Access to evidence without consent**

Another common practice of the States in this category, in general, is the documentation of the agency's accident investigation procedures in National Legislation and Regulation. However, it is a surprise that participants from these States, in general, also selected Annex 13 as a source of regulation. The data suggest that most of the participants believe that ICAO Annex 13 has legal power in their States even if the Annex 13 SARPs are not incorporated within the National Legislation or Regulation (see Figure 7-19).



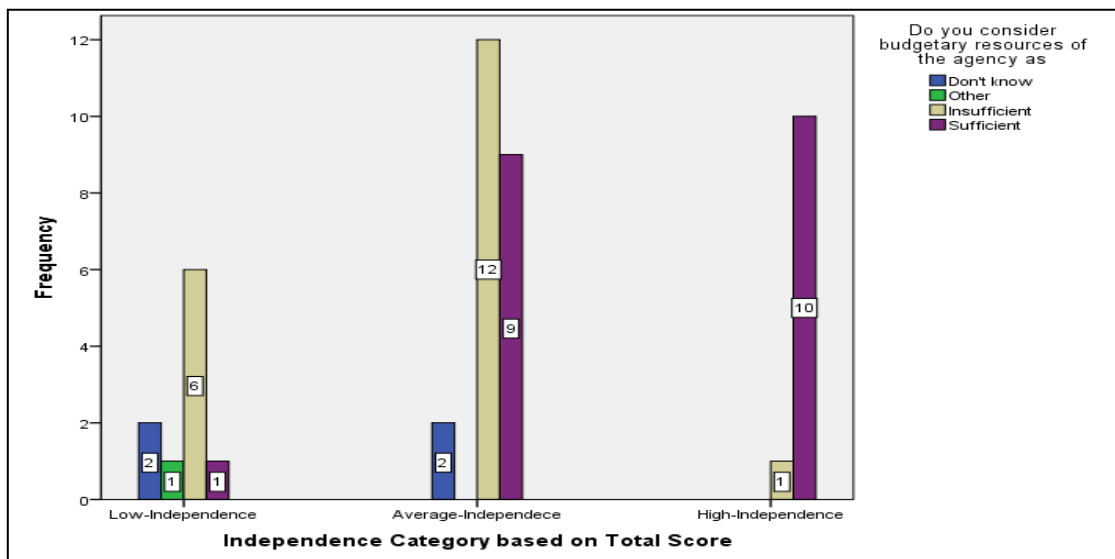
**Figure 7-19 Where are investigation procedures specified?**

It also appears to be common practice for the States in this category, in general, to measure the acceptance rate of their safety recommendations. This could be a means for feedback for the authorities to assess the credibility of their investigations and, therefore, improve their independence (see Figure 7-20).



**Figure 7-20 Is the acceptance rate measured?**

States in this category also agree, in general, that the budgetary resources are sufficient for them to conduct their investigations. This may indicate that there is no financial pressure on the investigation agencies in these States (see Figure 7-21).



**Figure 7-21 Are budgetary resources sufficient?**

The figures above show that although there are practices which are common within the High-Independence category, they are not unique to that category. The figures also show the similarities with other categories, even if these similarities do not show in the tables as “significant” practices.

#### 7.2.4 Common Answers in the “Low-Independence” Category:

In this category, the following two scenarios are examined:

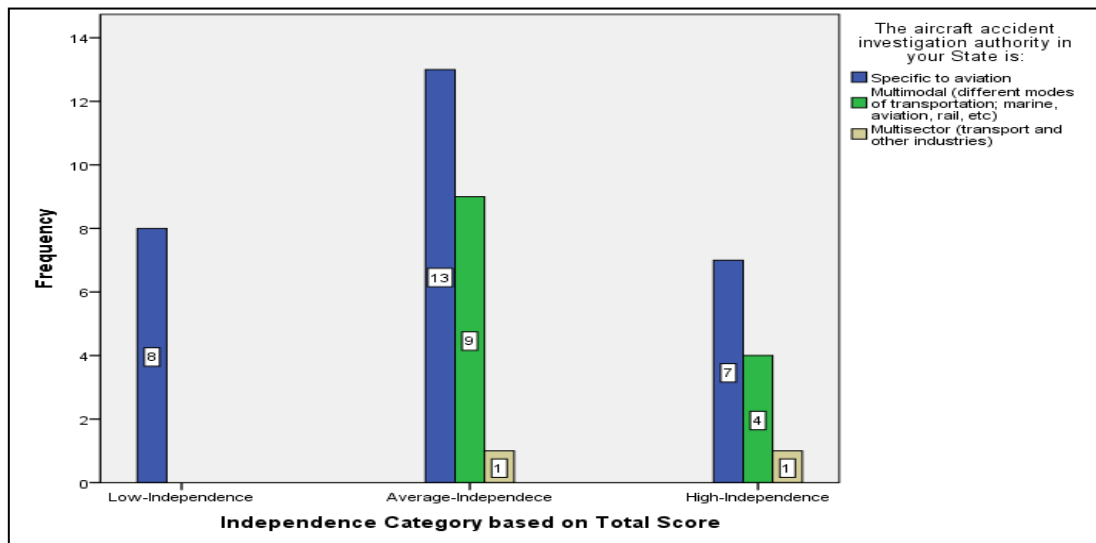
- The agreement on answers within the category, which is different from the rest of the categories (see Table 7-25).
- The disagreement with the rest of the categories, even if there is no common agreement on anything within the “Low-Independence” category (see Table 7-26).

**Table 7-25 Common answers for Low-Independence category**

	Text of Q	Category Low-Independence
Q4	The aircraft accident investigation authority in your State is:	Specific to Aviation 8/10 80%
Q6	Is the accident investigation authority physically separate from the Civil Aviation Authority (Regulator)?	No, they are located in the same building 10/10 100%
Q12	Does the State have a law or regulation to prevent the use of safety findings in a judicial inquiry?	No, there isn't 8/10 80%
Q24	Does the accident investigation authority require the approval of another government official, body or agency to release a report?	Yes 7/10 70%
Q32	Is it clearly stated in the regulations that the agency investigators are precluded from testifying in courts in litigation process growing from the agency's investigation reports?	No, not stated 7/10 70%
Q33	Is the acceptance rate for the safety recommendations of the accident investigation authority in your State measured?	No 7/10 70%

The analysis shown in Table 7-25 indicates six common characteristics in the Low-Independence category.

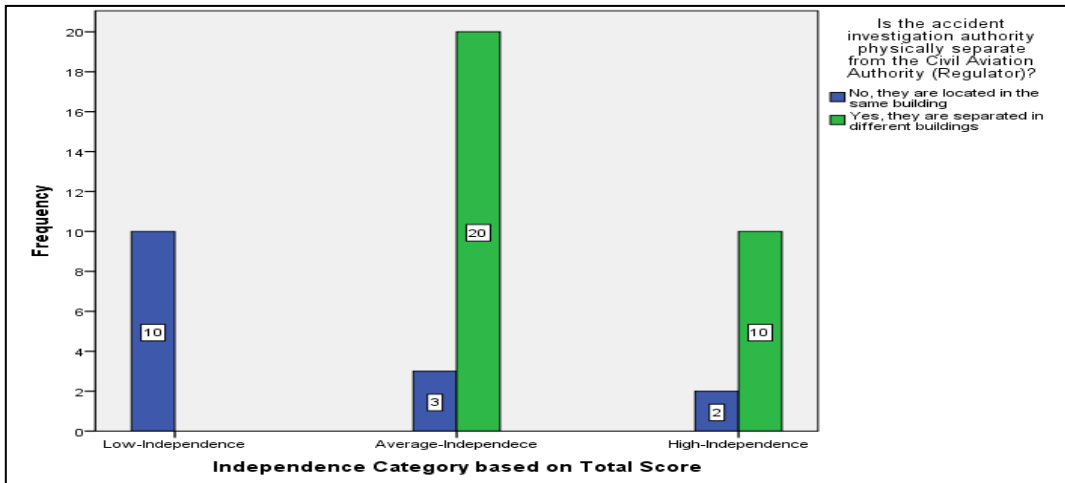
The data show that, in general, States in this category have single-mode, aviation-specific accident investigation authorities (8 out of 10 States, 80%). However, there is no evidence that changing to a multi-modal setup will help the independence of the investigation authority. Other categories do not seem to have an agreement on this point.



**Figure 7-22 Mode of investigation authority**

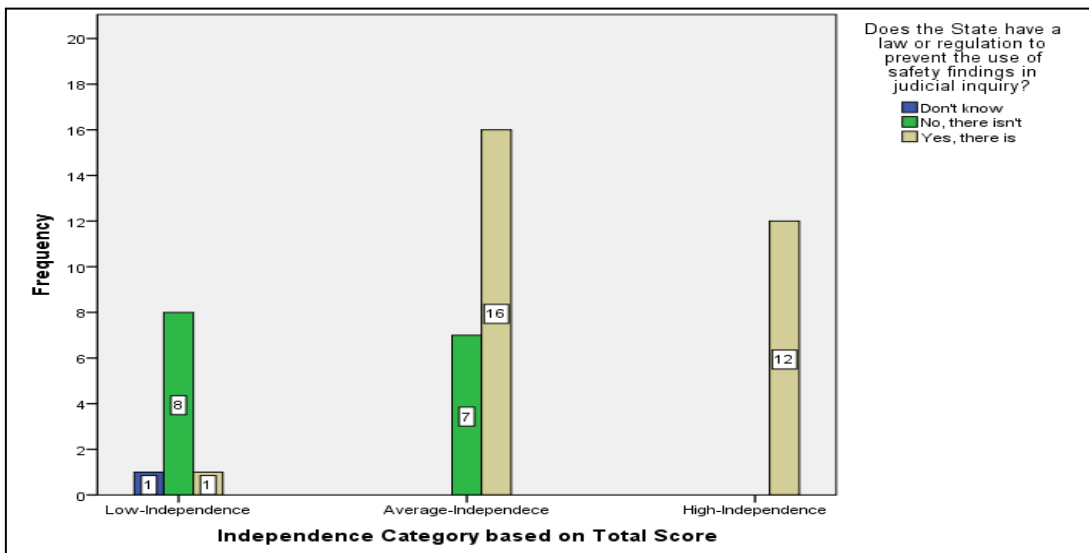
Also, the data suggest that the physical separation between the accident investigation authority and the regulator is a clear characteristic of the States within the Low-Independence category. Within this category 10 out of 10 States (100%) indicated that the accident investigation authorities in their States are not physically separate from the regulator. On the other hand, all other categories indicated that the two are physically separate in their States (see Figure 7-23).





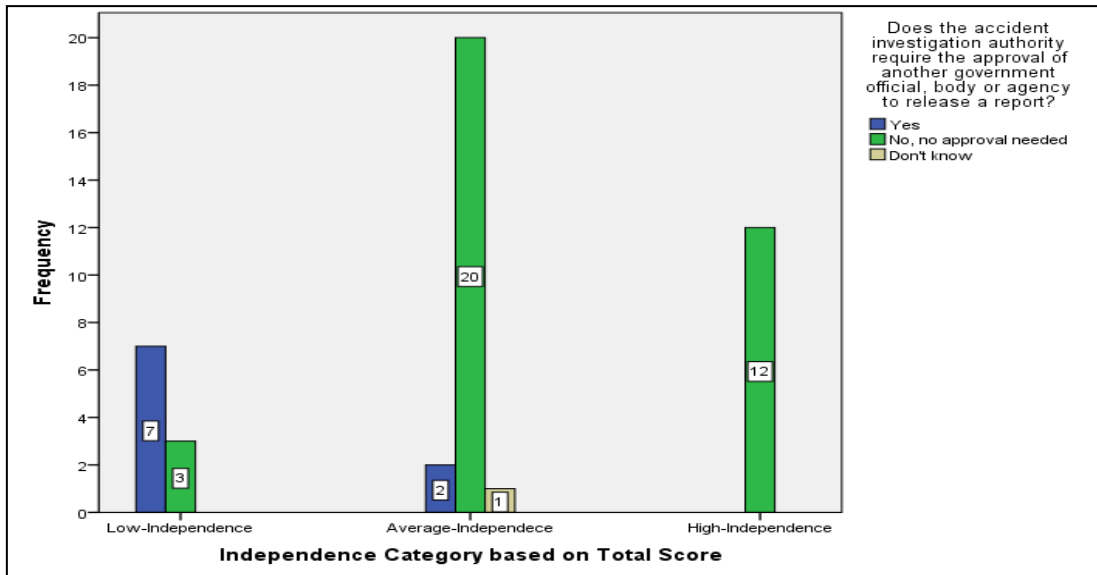
**Figure 7-23 Physical separation from Regulator**

Additionally, most of the States in the Low-Independence category do not have a law to prevent the use of safety findings from safety investigations in a judicial inquiry (8 out of 10 States, 80%). Attachment E of ICAO Annex 13 discusses the need for protecting safety information from inappropriate use to ensure the continued availability of such information. It is therefore expected that the absence of law or regulation to guarantee the protection of safety information in a State could be an indicator of lack of independence in accident investigations in that State (see Figure 7-24).



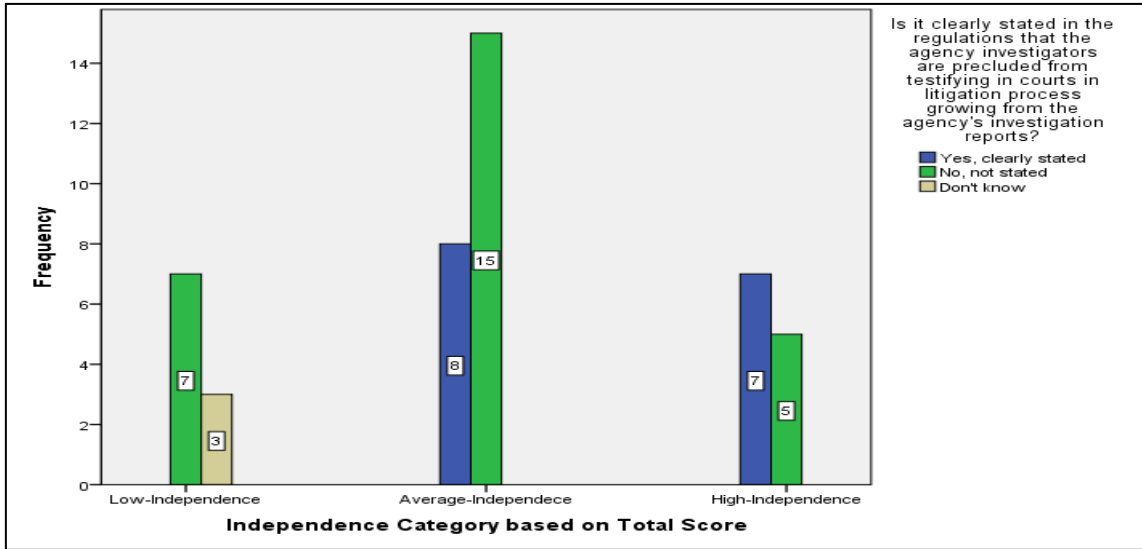
**Figure 7-24 Use of safety findings in a judicial inquiry**

Another indication that the accident investigation authority in a State may not be able to act independently is its ability to release a report without approval from anybody outside the agency. In the Low-Independence category, 7 out of 10 (70%) said their investigation authority needs approval from another entity outside of the agency to release a report (see Figure 7-25).



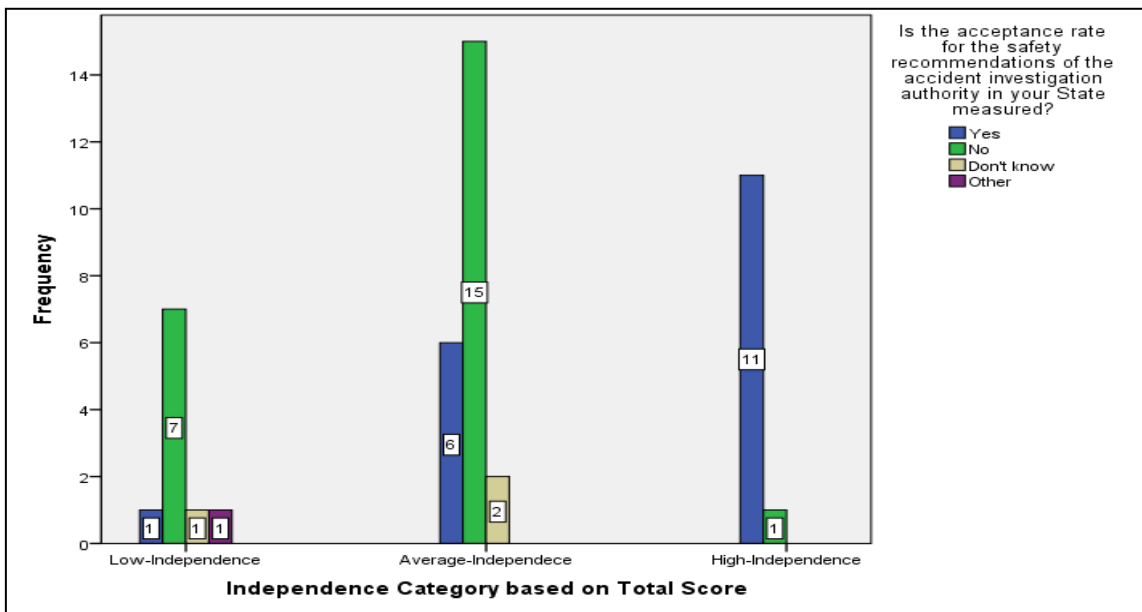
**Figure 7-25 Agency requires approval to release a report?**

Also, 7 out of 10 (70%) of the States in this category indicated that they do not have a regulation to prevent safety investigators from testifying in courts in litigation processes that result from the accident investigation authority's investigation reports. Such actions may lead the public and the industry to lose their trust in the investigation authority and question its independence. Note that the rest of the categories have a similar practice even though it did not show in the table (see Figure 7-26).



**Figure 7-26 Safety investigators testify in courts**

Moreover, 7 out of 10 (70%) in this category indicated that the acceptance rate of the safety recommendations generated by the accident investigation authority is not measured. This may suggest that, in general, failure in measuring the acceptance rate of the authority's recommendations might be an indication that there is a lack of the independence of that authority (see Figure 7-27).



**Figure 7-27 Is the acceptance rate measured?**

The practices that are common in all categories except the Low-Independence category are shown in Table 7-26.

**Table 7-26 Other differences between Low-Independence and other categories**

	Text of Q	Category Low-Independence	Category Average-Independence	Category High-Independent
Q3	Does your State have a permanent accident investigation authority/body/agency?		Yes 23/23 100%	Yes 12/12 100%
Q7	Is the accident investigation authority separate from the operation authority/authorities (airport, air navigation, air traffic controller)?		Yes, they are separated 22/23 95.6%	Yes, they are separated 12/12 100%
Q16	Is the independence of the accident investigation agency formally stated (in the regulations or legislation)?		Yes 21/23 91.3%	Yes 12/12 100%
Q18	Can Politicians (government) in your State decide which accidents are investigated by the accident investigation authority?		No 22/23 95.6%	No 12/12 100%
Q19	Can Politicians (government) stop an ongoing investigation?		No 22/23 95.6%	No 12/12 100%
Q23	Does the accident investigation authority have a safety database (reports, safety studies, recommendations, etc)?		Yes 22/23 95.6%	Yes 12/12 100%
Q25	Can the accident investigation agency launch investigations without prior permission from anybody outside of the agency?		Yes, always 22/23 95.6%	Yes, always 12/12 100%
Q38	Can the investigation agency decide to investigate occurrences that it is not obligated to investigate?		Yes 22/23 95.6%	Yes 11/12 91.7%
Q42	Does your State have regulations to protect the confidentiality of the witnesses?		Yes 20/23 86.9%	Yes 11/12 91.7%
Q43	In the event of an accident, who speaks to the media on behalf of the accident investigation agency?		A spokesperson who works for the agency and speaks on behalf of the agency only 20/23 86.9%	A spokesperson who works for the agency and speaks on behalf of the agency only 11/12 91.7%

Table 7-26 shows patterns that are common in all categories except the category of “Low-Independence”. Although there are no certain common practices related to the questions shown within this category, the fact that the rest of the States outside this category agree in general on certain practices suggests that accident investigation authorities in the States within the Low-Independence category need to adopt these practices to improve their level of aircraft accident investigation independence. However, these practices by

themselves may not be enough to upgrade a State from this category to a higher category of investigation independence. Also, the absence of some of these practices may not be enough to downgrade a State from another category to this category of Low-Independence.

It can be seen from the data shown above that ICAO Member States have different practices when it comes to the independence of accident investigations, even if these States' total 4DMI scores are similar enough to be in the same category.

## 7.2.5 Multinomial Logistic Regression Statistical Tests

### 7.2.5.1 Low-Independence Category

Logistic regression is a statistical technique that offers a method for modelling a binary response variable, which takes values 1 and 0. The logistic regression technique is very similar to linear regression; however, linear regression uses a continuous variable as the dependent variable in the model. The Multinomial Logistic Regression model accepts Dependent Variables (DV) with more than two outcomes.

The Multinomial Logistic Regression model is utilised (using SPSS) to predict the probability of a States, with certain characteristics from the “common answers”, to be in the Low-Independence category or in the High-Independence category when its investigation independence “total score” is calculated using the 4DMI.

**Table 7-27 Recoding Common Answers for Low-Independence Category**

Question from 4DMI	SPSS Original Code	SPSS Recoded Name	SPSS Recoded Value
<b>Q4:</b> <i>The aircraft accident investigation authority in your State is:</i>	1=Specific to Aviation	RecQ4_Com	1->1, else->0
<b>Q6:</b> <i>Is the accident investigation authority physically separate from the Civil Aviation Authority (Regulator)?</i>	1=No, not separated	RecQ6_Com	1->1, else->0

<b>Q12:</b> Does the State have a law or regulation to prevent the use of safety findings in a judicial inquiry?	2=No, it doesn't	RecQ12_Com	2->1, else->0
<b>Q24:</b> Does the accident investigation authority require the approval of another government official, body or agency to release a report?	1= Yes	RecQ24_Com	1->1, else->0
<b>Q32:</b> Is it clearly stated in the regulations that the agency investigators are precluded from testifying in courts in litigation process growing from the agency's investigation reports?	2=No, not stated	RecQ32_Com	2->1, else->0
<b>Q33:</b> Is the acceptance rate for the safety recommendations of the accident investigation authority in your State measured?	2=No	RecQ33_Com	2->1, else->0

Table 7-27 above shows the recoding of SPSS variable of interest to allow for the Logistic regression test.

**Table 7-28 SPSS Parameter Estimates Table for RecQ4\_Com variable**

Independence Category based on Total Score <sup>a</sup>		B	Exp(B)
Low-Independence	Intercept	.134	
	[RecQ4_Com=.00]	-1.050	.350
	[RecQ4_Com=1.00]	0 <sup>b</sup>	.
Average-Independence	Intercept	.619	
	[RecQ4_Com=.00]	.074	1.077
	[RecQ4_Com=1.00]	0 <sup>b</sup>	.

a. The reference category is: High-Independence.

b. This parameter is set to zero because it is redundant.

In this statistical test, the dependent variable is the “Independence Category based on Total Score”, and the independent variable is the recoded Q4 (the mode of the aircraft accident investigation agency) from the 4DMI

“RecQ4\_Com”. SPSS produces several tables; however, only the Parameter Estimates table is of interest for the purpose of this research.

The (B) coefficient in the SPSS output table represents the coefficient for the constant (also called the "intercept") in the null model.

The Exp (B) is the exponentiation of the B coefficient, which is an odds ratio. The reference category is identified in the footnote to the table.

The B coefficient (for the RecQ4\_Com variable) can be interpreted as follows:

<i>(RecQ4_Com)</i> coefficient (B)	<i>Conclusion</i>
<i>If <math>B &gt; 0</math></i> <i>(i.e. <math>Exp(B) &gt; 1</math>)</i>	<b>Non-Single mode, compared to</b> Single mode setups, will <b>more</b> likely be in the specified group <b>relative to</b> the reference group (or category).
<i>If <math>B = 0</math></i> <i>(i.e. <math>Exp(B) = 1</math>)</i>	<b>Non-Single mode, compared to</b> Single mode setups, will <b>equally</b> likely be in the specified group <b>relative to</b> the reference group.
<i>If <math>B &lt; 0</math></i> <i>(i.e. <math>Exp(B) &lt; 1</math>)</i>	<b>Non-Single mode, compared to</b> Single mode setups, will <b>less</b> likely be in the specified group <b>relative to</b> the reference group.

In this analysis, two comparisons will be made:

1. the Low-Independence category will be compared to the High-Independence category (the reference category)
2. the Average-Independence category will be compared to the High-Independence category

The data in the output table (Table 7-28) from SPSS can be interpreted as follows:

There is a **lower** likelihood (negative B value= -1.050) of States with accident investigation body setup that is multimodal or multi-sector (as oppose to single-mode specific to aviation setup) to score in the **Low-Independence** Category relative to **High-Independence** Category when measuring their accident investigation independence using the 4DMI.

In SPSS output, the Exp (B) value, also known as the Odd Ratio (OR), indicates that States that do NOT have single mode setup are, in comparison to those that have single mode setup, 0.35 less likely to be in the **Low-Independence** Category relative to **High-Independence** Category (the reference category). This can be expressed in percentages  **$((0.35-1.0)*100= -99.65\%)$** . This means that the States which did not have “single mode specific to aviation setup” were 99.65% less likely to be in the Low-Independence Category, which proves that this is a characteristic of the States that scored in the Low-Independence category.

In addition, the test also shows that States with multimodal or multi-sector setup, in comparison to single mode, are more likely to score in the Average-Independence Category relative to the reference category (High-Independence). However, the B value is close to zero (0.74) and the Exp (B) is close to one (1.077). This can be approximated to 1, which means that States with that do NOT have single mode setup, in comparison to State that have single mode setup, are equally likely to be in either the Average or High-Independence Categories.

In the next set of tests the focus of this analysis will be on the differences between the High-Independence and Low-Independence categories only.

Re-running SPSS commands for the rest of the “common answers” in the Low-Independence Category produced the results shown in Table 7-29. Note that in



this table the reference category is always “High-Independence” and the values shown are for the “Low-Independence” category.

**Table 7-29 Multinomial Logistic Regression Results for Low-Independence**

Independent Variable	B value	Exp (B)	Interpretation
RecQ6_Com = 0	-23.17	8.652E-11	There is <i>lower</i> likelihood ( <b>more than 99%</b> ) of States with accident investigation body physically separated from the Regulator (as oppose to not separated) to score in the Low-Independence Category relative to High-Independence Category.
RecQ12_Com = 0	-20.95	7.969E-10	There is <i>lower</i> likelihood ( <b>more than 99%</b> ) of States that have a law or regulation to prevent the use of safety findings in Judicial proceedings (as oppose to those that don't have it) to score in the Low-Independence Category relative to High-Independence Category when measuring their accident investigation independence using the 4DMI.
RecQ24_Com = 0	-19.765	2.607E-9	There is <i>lower</i> likelihood ( <b>more than 99%</b> ) of States that do NOT need an approval from another authority to release a report (as oppose to those that need it) to score in the Low-Independence Category relative to High-Independence Category when measuring their accident investigation independence using the 4DMI.
RecQ32_Com = 0	-1.184	0.306	There is <i>lower</i> likelihood ( <b>69.4%</b> ) of States that have regulations precluding safety investigators from testifying in litigations growing from the authorities' investigation reports (as oppose to those that don't have it) to score in the Low-Independence Category relative to High-Independence Category when measuring their accident investigation independence using the 4DMI.
RecQ33_Com = 0	-3.245	0.039	There is <i>lower</i> likelihood ( <b>96.1%</b> ) of States that measure the acceptance rate of their investigation authority's safety recommendations (as oppose to not measuring them) to score in the Low-Independence Category relative to High-Independence Category.

### 7.2.5.2 High-Independence Category

The recoding of SPSS variables and the common answers in the High-Independence category are shown in Table 7-30 below.

**Table 7-30 Recoding Common Answers for High-Independence Category**

Question from Survey	SPSS Original Code of common Answer	SPSS Recoded Name	SPSS Recoded Value
Q7_a: Separation details of Investigation Authorities from Operation Authorities	8=Functional, Structural, and Physical separation	RecQ7_a_HCom	8->1, else->0
Q8: Are there any employees from the industry (e.g. manufacturers, operators, or others) on loan or working part-time for the accident investigation authority?	2= No	RecQ8_HCom	2->1, else->0
Q15: To whom does the head of the accident investigation agency report?	1=Minister of Transport or equal	RecQ15_HCom	1->1, else->0
Q27: Do accident investigation agency's safety investigators have immediate and unrestricted access to all relevant evidence WITHOUT prior consent from judicial bodies or other authorities?	1= Yes, Always	RecQ27_HCom	1->1, else->0
Q28: Where are the agency's accident investigation procedures specified?	123=Annex13, Legislations & Regs	RecQ28_HCom	123->1, else->0
Q33: Is the acceptance rate for the safety recommendations of the accident investigation authority in your State measured?	1=Yes	RecQ33_HCom	1->1, else->0
Q47: Do you consider budgetary resources of the agency as:	3= Sufficient	RecQ47_HCom	3->1, else->0

The Multinomial Logistic Regression model is used again to test the common answers in the High-Independence category. The results are shown in tables Table 7-31 and Table 7-32.

**Table 7-31 SPSS Parameter Estimates Table for RecQ7\_a\_HCom variable**

Independence Category based on Total Score <sup>a</sup>		B	Exp(B)
High-Independence	Intercept	2.303	
	[RecQ7_a_HCom=.00]	-3.807	.022
	[RecQ7_a_HCom=1.00]	0 <sup>b</sup>	.

a. The reference category is: Low-Independence.

b. This parameter is set to zero because it is redundant.

Note that the reference category in the Table 7-31 is the “Low-Independence”.

**Table 7-32 Multinomial Logistic Regression Results for High-Independence**

Independent Variable	B value	Exp (B)	Interpretation
RecQ7_a_HCom=0	-3.807	0.022	There is <i>lower</i> likelihood ( <b>97.8%</b> ) of States with accident investigation body that is NOT functionally, structurally and physically separated from the Operations Authorities (as oppose to separated) to score in the High-Independence Category relative to Low-Independence Category.
RecQ8_HCom=0	-1.504	0.222	There is <i>lower</i> likelihood ( <b>77.8%</b> ) of States that do NOT have employees on-loan from the industry working for them (as oppose to those that have them) to score in the High-Independence Category relative to the Low-Independence Category when measuring their accident investigation independence using the 4DMI.
RecQ15_HCom=0	-2.803	0.061	There is <i>lower</i> likelihood ( <b>93.9%</b> ) of States that do NOT have the Head of the accident investigation body report to the Minister of Transport or equal level (as oppose to those that have them) to score in the High-Independence Category relative to the Low-Independence Category when measuring their accident investigation independence using the 4DMI.
RecQ27_HCom=0	-23.503	6.204E-11	There is <i>lower</i> likelihood ( <b>more than 99%</b> ) of States that the safety investigators in their accident investigation body do NOT have immediate and unrestricted access to all evidence WITHOUT prior consent

			(as oppose to those that have this kind of access ) to score in the High-Independence Category relative to the Low-Independence Category when measuring their accident investigation independence using the 4DMI.
RecQ28_HCom=0	-1.946	0.143	There is <i>lower</i> likelihood ( <b>85.7%</b> ) of States that do NOT have the accident investigation procedures specified in Annex13, Legislations, and regulations (as oppose to those that have them) to score in the High-Independence Category relative to the Low-Independence Category when measuring their accident investigation independence using the 4DMI.
RecQ33_HCom=0	-4.595	0.010	There is <i>lower</i> likelihood ( <b>99%</b> ) of States that do NOT have the acceptance rate for the safety recommendations of their investigation body measured (as oppose to those that have them measured) to score in the High-Independence Category relative to the Low-Independence Category when measuring their accident investigation independence using the 4DMI.
RecQ47_HCom=0	-3.807	0.022	There is <i>lower</i> likelihood ( <b>97.8%</b> ) of States that do NOT have sufficient budgetary resources (as oppose to those that have them) to score in the High-Independence Category relative to the Low-Independence Category when measuring their accident investigation independence using the 4DMI.

In conclusion, the results which are shown above from the Logistic Regression tests support the research findings that the specified characteristics are common to the ICAO-Member States within that specific independence category.

### 7.3 Examining the Effect of Each Dimension

Several tables were created to demonstrate the effect of each dimension on a State's Total score and its RANK in comparison with other States. The tables are collected together in Table 7-33.

The columns in Table 7-33 are explained as follows:

<u>ID#</u>	<i>Unique ID number for each participant</i>
<u>% of Total Score:</u>	<i>The State's Total Score percentage in comparison with the ideal 100%</i>
<u>RANK:</u>	<i>The rank of the State based on its Total Score</i>
<u>ICAO Member State:</u>	<i>The name of ICAO Member State colour-coded according to their category (see section 7.2)</i>
<u>Don't Know (or Missing) %:</u>	<i>The percentage of "Don't Know" or "missing" answers per each participation.</i>
<u>Total (Without Structural + 23.40%):</u>	<i>The percentage of Total Score after removing the scores from the questions of this dimension and adding its percentage</i>
<u>RANK:</u>	<i>The new Rank based on the new Total (compared to the rest of the States)</i>
<u>ICAO Member State:</u>	<i>The name of the State colour-coded based on the new Total</i>

The same thing is then repeated for the other dimensions as shown in the table.

When a dimension is removed, its percentage is added to the Total score to show the effect of removing that dimension. In other words, it is as if all participants scored full marks on that dimension. Therefore, the colour coding scheme stays the same as before and the new score can now be compared with the actual score.

The breakdown of these percentages is shown in section 6.1.1 of this thesis.

For example, to examine the effect of the Functional dimension:

- 8- The questions from the Functional dimension alone contribute 17.02% to the Total Score of each State.
- 9- The functional dimension's questions (and their scores) are removed from the 4DMI.
- 10-To be able to compare with the actual scores (to examine the effect of removing the dimension on the actual scores) and to keep the colour-coding scheme, the full percentage of 17.02% is added to the Total Score of each State.
- 11-Because of the above procedure, everything stays the same as before. The only difference is that all States scored 100% in the Functional dimension.
- 12-The effect of the Functional dimension for State A, for example, depends on its actual Functional score and the new Total score, and can be understood as follows:
  - a) If State A's actual score in the Functional dimension was high: the effect will be minimal and therefore this dimension is NOT a weakness in this State.
  - b) If State A's actual score in the Functional dimension was low: the effect will be high and may even upgrade State A to a higher independence category (if it is not already in the highest category). Therefore, this dimension is a weakness in this State and more resources should be allocated to rectify this weakness (lack of independence).

The above is also applicable to all other dimensions.

For example, looking at the results of Slovakia and France (see Table 7-34), note that:

- The colour-code changes when a State's score moves from one category to another.

- The RANK changes in comparison to other States' scores. It is only an indication of how a State's score has changed in comparison to how other States' scores after removing a dimension.

Changes in RANKs after removing a dimension suggest that some of the States that rank low in general may actually do better in some dimensions than the higher ranking States. This is further proof that States ensure the independence of their investigation authorities using different methods.

Table 7-33 Effect on Total Score and RANK after removing each dimension

ID#	% of Total Score	RANK	ICAO-Member State	Don't know (or missing) %	Total (Without Structural + 23.40%)	RANK	ICAO-Member State	Don't know (or missing) %	Total (Without Functional + 17.02%)	RANK	ICAO-Member State	Don't know (or missing) %	Total (Without Financial + 17.02%)	RANK	ICAO-Member State	Don't know (or missing) %	Total (Without Operational_Political + 12.76%)	RANK	ICAO-Member State	Don't know (or missing) %	Total (Without Operational_Legal + 29.79%)	RANK	ICAO-Member State	Don't know (or missing) %
7381258	87.74%	1	Australia	0.00%	88.83%	1	Australia	0.00%	87.74%	3	Australia	0.00%	92.00%	1	Australia	0.00%	89.33%	1	Australia	0.00%	93.07%	1	Australia	0.00%
7322436	84.55%	2	Germany	2.33%	85.63%	2	Germany	2.33%	89.87%	1	Germany	2.33%	90.93%	2	Germany	0.00%	86.14%	2	Germany	2.33%	85.62%	4	Germany	2.33%
7291614	81.89%	3	UK	0.00%	82.97%	3	UK	0.00%	88.28%	2	UK	0.00%	85.08%	6	UK	0.00%	82.95%	3	UK	0.00%	88.28%	2	UK	0.00%
7426589	79.77%	4	Poland	0.00%	80.85%	7	Poland	0.00%	86.15%	5	Poland	0.00%	85.08%	4	Poland	0.00%	81.89%	5	Poland	0.00%	85.09%	6	Poland	0.00%
7322370	78.70%	5	Finland	0.00%	81.91%	5	Finland	0.00%	87.21%	4	Finland	0.00%	79.76%	17	Finland	0.00%	81.36%	6	Finland	0.00%	84.56%	8	Finland	0.00%
7334963	78.36%	6	UAE	2.33%	82.97%	4	UAE	2.33%	82.62%	8	UAE	2.33%	82.62%	10	UAE	0.00%	80.48%	10	UAE	2.33%	84.75%	7	UAE	2.33%
7331355	77.83%	7	Portugal	0.00%	80.31%	9	Portugal	0.00%	84.21%	6	Portugal	0.00%	82.08%	12	Portugal	0.00%	82.61%	4	Portugal	0.00%	82.09%	12	Portugal	0.00%
7353645	76.57%	8	Lithuania	0.00%	79.78%	10	Lithuania	0.00%	80.83%	14	Lithuania	0.00%	85.08%	5	Lithuania	0.00%	80.82%	7	Lithuania	0.00%	79.77%	19	Lithuania	0.00%
7433742	76.57%	9	Serbia	0.00%	81.91%	6	Serbia	0.00%	80.83%	13	Serbia	0.00%	82.96%	9	Serbia	0.00%	78.16%	14	Serbia	0.00%	82.43%	11	Serbia	0.00%
7433772	75.51%	10	Ireland	0.00%	76.59%	13	Ireland	0.00%	81.89%	10	Ireland	0.00%	77.64%	24	Ireland	0.00%	80.82%	8	Ireland	0.00%	85.09%	5	Ireland	2.33%
7485138	75.30%	11	Switzerland	0.00%	79.78%	11	Switzerland	0.00%	81.68%	11	Switzerland	0.00%	77.42%	25	Switzerland	0.00%	79.55%	12	Switzerland	0.00%	82.75%	9	Switzerland	0.00%
7736005	74.66%	12	USA	4.65%	75.53%	18	USA	4.65%	76.79%	25	USA	4.65%	83.17%	8	USA	4.65%	80.50%	9	USA	0.00%	82.64%	10	USA	4.65%
7432620	74.53%	13	Greece	0.00%	80.85%	8	Greece	0.00%	78.79%	18	Greece	0.00%	77.72%	23	Greece	0.00%	78.78%	13	Greece	0.00%	81.98%	13	Greece	0.00%
7436086	74.45%	14	Hungary	0.00%	75.53%	19	Hungary	0.00%	78.70%	19	Hungary	0.00%	85.08%	3	Hungary	0.00%	79.76%	11	Hungary	0.00%	78.70%	21	Hungary	9.30%
7476200	74.11%	15	Singapore	0.00%	76.59%	14	Singapore	0.00%	78.36%	20	Singapore	0.00%	78.36%	20	Singapore	0.00%	75.16%	20	Singapore	0.00%	87.94%	3	Singapore	0.00%
7323590	74.11%	16	Denmark	0.00%	76.59%	15	Denmark	0.00%	82.62%	9	Denmark	0.00%	78.36%	21	Denmark	0.00%	77.29%	15	Denmark	0.00%	81.56%	14	Denmark	0.00%
7705647	73.81%	17	Italy	2.33%	75.53%	20	Italy	2.33%	80.19%	15	Italy	2.33%	82.32%	11	Italy	0.00%	76.99%	17	Italy	2.33%	80.19%	17	Italy	2.33%
7439738	73.17%	18	Romania	2.33%	75.53%	21	Romania	2.33%	81.68%	12	Romania	2.33%	80.62%	13	Romania	0.00%	76.36%	18	Romania	2.33%	78.49%	23	Romania	2.33%
7479530	72.85%	19	Austria	9.30%	76.06%	17	Austria	6.98%	77.11%	24	Austria	9.30%	83.49%	7	Austria	4.65%	76.04%	19	Austria	6.98%	78.70%	20	Austria	0.00%
7485841	72.85%	20	Sweden	4.65%	75.00%	22	Sweden	4.65%	83.49%	7	Sweden	2.33%	77.11%	26	Sweden	2.33%	74.44%	21	Sweden	4.65%	81.36%	15	Sweden	4.65%
7662286	71.79%	21	Russia	0.00%	75.00%	23	Russia	0.00%	78.17%	21	Russia	0.00%	80.30%	15	Russia	0.00%	77.10%	16	Russia	0.00%	76.58%	27	Russia	0.00%
7432755	70.64%	22	Netherlands	2.33%	76.59%	16	Netherlands	2.33%	79.15%	17	Netherlands	2.33%	79.15%	19	Netherlands	0.00%	71.70%	25	Netherlands	2.33%	75.96%	28	Netherlands	2.33%
7333337	70.28%	23	Czech R.	4.65%	77.66%	12	Czech R.	2.33%	77.72%	23	Czech R.	2.33%	74.53%	30	Czech R.	4.65%	71.33%	26	Czech R.	4.65%	79.85%	18	Czech R.	4.65%
7321240	69.66%	24	Estonia	2.33%	70.74%	25	Estonia	2.33%	76.04%	26	Estonia	2.33%	80.30%	16	Estonia	0.00%	72.85%	24	Estonia	2.33%	78.70%	22	Estonia	2.33%
7420566	68.91%	25	Iceland	0.00%	71.27%	24	Iceland	0.00%	79.55%	16	Iceland	0.00%	80.62%	14	Iceland	0.00%	73.16%	22	Iceland	0.00%	71.05%	33	Iceland	0.00%
7601145	68.60%	26	Bulgaria	0.00%	69.68%	29	Bulgaria	0.00%	72.85%	27	Bulgaria	0.00%	78.17%	22	Bulgaria	0.00%	72.85%	23	Bulgaria	0.00%	80.83%	16	Bulgaria	0.00%
7323504	67.19%	27	Latvia	2.33%	69.68%	30	Latvia	2.33%	77.83%	22	Latvia	2.33%	76.76%	27	Latvia	0.00%	69.85%	28	Latvia	2.33%	74.64%	30	Latvia	2.33%
7317893	65.91%	28	Canada	6.98%	70.74%	26	Canada	4.65%	70.17%	31	Canada	6.98%	74.42%	31	Canada	6.98%	71.23%	27	Canada	4.65%	77.09%	26	Canada	4.65%
7475610	64.53%	29	Croatia	0.00%	70.21%	27	Croatia	0.00%	70.91%	30	Croatia	0.00%	79.42%	18	Croatia	0.00%	66.12%	31	Croatia	0.00%	71.45%	32	Croatia	0.00%
7306664	63.53%	30	Pakistan	11.63%	70.21%	28	Pakistan	11.63%	65.66%	34	Pakistan	9.30%	70.98%	33	Pakistan	9.30%	68.85%	29	Pakistan	9.30%	78.43%	24	Pakistan	6.98%
7429600	62.74%	31	France	6.98%	65.95%	34	France	4.65%	64.87%	35	France	6.98%	75.51%	28	France	4.65%	66.46%	30	France	4.65%	78.17%	25	France	6.98%
7576288	61.87%	32	Luxembourg	0.00%	66.49%	32	Luxembourg	0.00%	72.51%	28	Luxembourg	0.00%	71.45%	32	Luxembourg	0.00%	65.59%	32	Luxembourg	0.00%	71.45%	31	Luxembourg	0.00%
7457483	60.64%	33	Hong Kong	0.00%	67.02%	31	Hong Kong	0.00%	71.28%	29	Hong Kong	0.00%	63.83%	35	Hong Kong	0.00%	64.89%	34	Hong Kong	0.00%	75.53%	29	Hong Kong	0.00%
7348681	59.74%	34	Slovakia	4.65%	66.49%	33	Slovakia	4.65%	68.25%	33	Slovakia	2.33%	74.64%	29	Slovakia	2.33%	65.06%	33	Slovakia	4.65%	64.53%	35	Slovakia	4.65%
7919248	58.15%	35	Bolivia	0.00%	65.95%	35	Bolivia	0.00%	68.79%	32	Bolivia	0.00%	65.59%	34	Bolivia	0.00%	62.40%	35	Bolivia	0.00%	69.85%	34	Bolivia	0.00%
7864988	42.89%	36	Belgium	20.93%	50.00%	38	Belgium	20.93%	53.53%	37	Belgium	16.28%	56.72%	36	Belgium	16.28%	49.27%	37	Belgium	18.60%	62.05%	36	Belgium	11.63%
7338848	42.02%	37	Antigua	16.28%	61.17%	36	Antigua	13.95%	52.66%	38	Antigua	13.95%	51.59%	38	Antigua	9.30%	45.74%	38	Antigua	16.28%	56.92%	39	Antigua	11.63%
7629632	40.94%	38	Sudan	6.98%	49.46%	40	Sudan	6.98%	53.70%	36	Sudan	6.98%	54.76%	37	Sudan	6.98%	50.50%	36	Sudan	6.98%	55.30%	40	Sudan	0.00%
7427396	33.51%	39	Turkey	0.00%	51.59%	37	Turkey	0.00%	46.28%	39	Turkey	0.00%	40.96%	42	Turkey	0.00%	43.08%	39	Turkey	0.00%	52.13%	41	Turkey	0.00%
7457442	33.19%	40	Morocco	9.30%	44.68%	42	Morocco	6.98%	43.83%	41	Morocco	6.98%	47.02%	40	Morocco	6.98%	39.57%	41	Morocco	9.30%	57.66%	38	Morocco	6.98%
7561808	31.91%	41	Macedonia	2.33%	50.00%	39	Macedonia	2.33%	44.68%	40	Macedonia	2.33%	47.87%	39	Macedonia	2.33%	38.82%	42	Macedonia	2.33%	46.28%	43	Macedonia	0.00%
7294276	30.85%	42	Malaysia	32.56%	41.49%	43	Malaysia	30.23%	39.36%	43	Malaysia	30.23%	42.55%	41	Malaysia	25.58%	41.48%	40	Malaysia	23.26%	58.51%	37	Malaysia	20.93%
7358909	26.60%	43	Libya	4.65%	45.74%	41	Libya	4.65%	39.36%	42	Libya	4.65%	38.30%	43	Libya	2.33%	32.97%	43	Libya	4.65%	50.00%	42	Libya	2.33%
7465330	15.96%	44	Tunisia	18.60%	36.17%	44	Tunisia	13.95%	28.72%	45	Tunisia	18.60%	31.91%	44	Tunisia	13.95%	23.40%	45	Tunisia	18.60%	43.62%	44	Tunisia	9.30%
7359109	15.96%	45	Uganda	2.33%	34.04%	45	Uganda	2.33%	30.85%	44	Uganda	2.33%	31.91%	45	Uganda	0.00%	27.65%	44	Uganda	2.33%	39.36%	45	Uganda	2.33%



In the example in Table 7-34, note that Slovakia's scored the highest percentage when the Financial dimension was removed. This suggests that Slovakia should focus more to improve its financial independence to achieve a higher overall level of investigation independence.

France, on the other hand, moved from one category to another (changed colour code) when the Financial dimension was removed and also when the Operational\_Legal dimension was removed. This suggests that the Financial and the Operational\_Legal dimensions have a big effect on causing France to score lower in the 4DMI scale. It also suggests that the accident investigation authority in France should consider improving its practices within these two dimensions to improve its overall investigation independence.

**Table 7-34 Slovakia and France example – removing dimensions**

	<b>Total score &amp; RANK (Slovakia)</b>	<b>Total score &amp; RANK (France)</b>
<b>All Dimensions</b>	59.74%, RANK=34	62.74%, RANK=31
<b>Without Structural</b>	66.49%, RANK=33	65.95%, RANK=34
<b>Without Functional</b>	68.25%, RANK=33	64.87%, RANK=35
<b>Without Financial</b>	74.64%, RANK=29	75.51%, RANK=28
<b>Without Operational_Political</b>	65.06%, RANK=33	66.46%, RANK=30
<b>Without Operational_Legal</b>	64.53%, RANK=35	78.17%, RANK=25

## 7.4 Comparing Scores from Each Dimension Separately

Another set of tables was created to examine the scores of each dimension separately. Table 7-36 below shows all these tables together in a single table. Note that there is no colour-coding. The percentages shown are out of the total that could be achieved from that specific dimension only.

The percentages are reported for the purpose of comparison between the scores of all participants within that dimension. Moreover, the changes in the RANK based on the scores from each dimension alone are shown in the table to illustrate the performance of each State in comparison to the rest of the participating States.

The logic here is straightforward. The scores shown are the percentages that each State scored from the 100% possible score in that dimension alone.

The same examples as before will be used, i.e. Slovakia and France (see Table 7-35). The results show that the lowest score, percentage-wise, for Slovakia came from the Financial dimension (12.50%). This confirms the results found before (see Table 7-34) by removing the Financial dimension.

**Table 7-35 Slovakia and France example – for each dimension**

	<b>Total score &amp; RANK (Slovakia)</b>	<b>Total score &amp; RANK (France)</b>
<b>Structural</b>	71.19%, RANK=33	86.29%, RANK=22
<b>Functional</b>	50.00%, RANK=29	87.50%, RANK=4
<b>Financial</b>	12.50%, RANK=42	25.00%, RANK=37
<b>Operational_Political</b>	58.36%, RANK=35	70.87%, RANK=19
<b>Operational_Legal</b>	83.92%, RANK=7	48.21%, RANK=38

The same can be said about France with regard to the Financial dimension. However, in the case of France there is another dimension that has a big effect on its score and that is the Operational\_Legal dimension. Using only the tables that show the score from each dimension separately does not show the effect of this dimension because there is always room for improvement in all dimensions. Hence, it is important to use both of the tables (Table 7-33 and Table 7-36) to see the big picture.

By using both tables it can be seen that the accident investigation authority in France can dramatically improve its overall independence by improving either the Financial independence or Operational\_Legal independence, or both. On the other hand, findings suggest that Slovakia can improve its current total score of investigation independence (obtained from the 4DMI) by improving its practices in all dimensions, although the Financial dimension seems to be the weakest between all dimensions.

Table 7-36 Total Score from each dimension separately

ID#	% of Total Score	RANK	ICAO-Member State	Don't know (or missing) %	% of score from Structural dimension	RANK (Structural Dimension)	ICAO-Member State	Don't know (or missing) %	% of score from Functional dimension	RANK (Functional Dimension)	ICAO-Member State	Don't know (or missing) %	% of score from Financial dimension	RANK (Financial Dimension)	ICAO-Member State	Don't know (or missing) %	% of Score from Operational_Political Dimension	RANK (Operational_Political Dimension)	ICAO-Member State	Don't know (or missing) %	% of Score from Operational_Legal Dimension	RANK (Operational_Legal Dimension)	ICAO-Member State	Don't know (or missing) %
7381258	87.74%	1	Australia	0.00%	95.38%	2	Australia	0.00%	100.00%	1	Australia	0.00%	75.01%	7	Australia	0.00%	87.54%	5	Australia	0.00%	82.14%	8	Australia	0.00%
7322436	84.55%	2	Germany	2.33%	95.38%	3	Germany	0.00%	68.75%	14	Germany	0.00%	62.50%	15	Germany	2.33%	87.54%	6	Germany	0.00%	96.42%	1	Germany	0.00%
7291614	81.89%	3	UK	0.00%	95.38%	4	UK	2.33%	62.50%	15	UK	0.00%	81.26%	4	UK	0.00%	91.71%	1	UK	0.00%	78.56%	15	UK	0.00%
7426589	79.77%	4	Poland	0.00%	95.38%	5	Poland	0.00%	62.50%	16	Poland	0.00%	68.76%	14	Poland	0.00%	83.37%	10	Poland	0.00%	82.14%	9	Poland	0.00%
7322370	78.70%	5	Finland	0.00%	86.29%	18	Finland	0.00%	50.00%	25	Finland	0.00%	93.76%	1	Finland	0.00%	79.20%	12	Finland	0.00%	80.35%	12	Finland	0.00%
7334963	78.36%	6	UAE	2.33%	80.29%	24	UAE	0.00%	75.00%	5	UAE	0.00%	75.01%	8	UAE	2.33%	83.37%	11	UAE	0.00%	78.56%	16	UAE	0.00%
7331355	77.83%	7	Portugal	0.00%	89.38%	14	Portugal	0.00%	62.50%	17	Portugal	0.00%	75.01%	9	Portugal	0.00%	62.53%	29	Portugal	0.00%	85.71%	4	Portugal	0.00%
7353645	76.57%	8	Lithuania	0.00%	86.29%	19	Lithuania	0.00%	75.00%	6	Lithuania	0.00%	50.00%	21	Lithuania	0.00%	66.70%	22	Lithuania	0.00%	89.28%	3	Lithuania	0.00%
7433742	76.57%	9	Serbia	0.00%	77.20%	27	Serbia	9.30%	75.00%	7	Serbia	0.00%	62.50%	16	Serbia	0.00%	87.54%	7	Serbia	0.00%	80.35%	13	Serbia	0.00%
7433772	75.51%	10	Ireland	0.00%	95.38%	6	Ireland	0.00%	62.50%	18	Ireland	0.00%	87.51%	2	Ireland	0.00%	58.36%	30	Ireland	0.00%	67.85%	26	Ireland	0.00%
7485138	75.30%	11	Switzerland	0.00%	80.83%	23	Switzerland	0.00%	62.50%	19	Switzerland	0.00%	87.51%	3	Switzerland	0.00%	66.70%	23	Switzerland	0.00%	74.99%	19	Switzerland	0.00%
7736005	74.66%	12	USA	4.65%	96.29%	1	USA	0.00%	87.50%	2	USA	0.00%	50.00%	22	USA	0.00%	54.19%	36	USA	4.65%	73.21%	23	USA	0.00%
7432620	74.53%	13	Greece	0.00%	73.01%	30	Greece	0.00%	75.00%	8	Greece	0.00%	81.26%	5	Greece	0.00%	66.70%	24	Greece	0.00%	74.99%	20	Greece	0.00%
7436086	74.45%	14	Hungary	0.00%	95.38%	7	Hungary	0.00%	75.00%	9	Hungary	0.00%	37.50%	31	Hungary	0.00%	58.36%	31	Hungary	0.00%	85.71%	5	Hungary	0.00%
7476200	74.11%	15	Singapore	0.00%	89.38%	16	Denmark	0.00%	75.00%	10	Singapore	0.00%	75.01%	10	Singapore	0.00%	91.71%	2	Singapore	0.00%	53.57%	32	Singapore	0.00%
7323590	74.11%	16	Denmark	0.00%	89.38%	15	Singapore	0.00%	50.00%	26	Denmark	0.00%	75.01%	11	Denmark	0.00%	75.04%	14	Denmark	0.00%	74.99%	21	Denmark	0.00%
7705647	73.81%	17	Italy	2.33%	92.65%	10	Italy	0.00%	62.50%	20	Italy	0.00%	50.00%	23	Italy	2.33%	75.04%	15	Italy	0.00%	78.56%	17	Italy	0.00%
7439738	73.17%	18	Romania	2.33%	89.93%	12	Romania	0.00%	50.00%	27	Romania	0.00%	56.25%	17	Romania	2.33%	75.04%	16	Romania	0.00%	82.14%	10	Romania	0.00%
7479530	72.85%	19	Austria	9.30%	86.29%	20	Austria	0.00%	75.00%	11	Austria	0.00%	37.50%	32	Austria	4.65%	75.04%	17	Austria	2.33%	80.35%	14	Austria	0.00%
7485841	72.85%	20	Sweden	4.65%	90.83%	11	Sweden	0.00%	37.50%	31	Sweden	2.33%	75.01%	12	Sweden	2.33%	87.54%	8	Sweden	0.00%	71.42%	24	Sweden	0.00%
7662286	71.79%	21	Russia	0.00%	86.29%	21	Russia	0.00%	62.50%	21	Russia	0.00%	50.00%	24	Russia	0.00%	58.36%	32	Russia	0.00%	83.92%	6	Russia	0.00%
7432755	70.64%	22	Netherlands	2.33%	74.56%	29	Netherlands	2.33%	50.00%	28	Netherlands	0.00%	50.00%	25	Netherlands	2.33%	91.71%	3	Netherlands	0.00%	82.14%	11	Netherlands	0.00%
7333337	70.28%	23	Czech R.	4.65%	68.47%	35	Czech R.	0.00%	56.25%	24	Czech R.	2.33%	75.01%	13	Czech R.	0.00%	91.71%	4	Czech R.	0.00%	67.85%	27	Czech R.	0.00%
7321240	69.66%	24	Estonia	2.33%	95.38%	8	Estonia	0.00%	62.50%	22	Estonia	0.00%	37.50%	33	Estonia	2.33%	75.04%	18	Estonia	0.00%	69.64%	25	Estonia	0.00%
7420566	68.91%	25	Iceland	0.00%	89.93%	13	Iceland	0.00%	37.50%	32	Iceland	0.00%	31.25%	34	Iceland	0.00%	66.70%	25	Iceland	0.00%	92.85%	2	Iceland	0.00%
7601145	68.60%	26	Bulgaria	0.00%	95.38%	9	Bulgaria	0.00%	75.00%	12	Bulgaria	0.00%	43.75%	27	Bulgaria	0.00%	66.70%	26	Bulgaria	0.00%	58.92%	31	Bulgaria	0.00%
7323504	67.19%	27	Latvia	2.33%	89.38%	17	Latvia	4.65%	37.50%	33	Latvia	0.00%	43.75%	28	Latvia	2.33%	79.20%	13	Latvia	0.00%	74.99%	22	Latvia	0.00%
7317893	65.91%	28	Canada	6.98%	79.38%	26	Canada	0.00%	75.00%	13	Canada	0.00%	50.00%	26	Canada	0.00%	58.36%	33	Canada	2.33%	62.49%	29	Canada	2.33%
7475610	64.53%	29	Croatia	0.00%	75.74%	28	Croatia	6.98%	62.50%	23	Croatia	0.00%	12.50%	41	Croatia	0.00%	87.54%	9	Croatia	0.00%	76.78%	18	Croatia	0.00%
7306664	63.53%	30	Pakistan	11.63%	71.47%	32	Pakistan	0.00%	87.50%	3	Pakistan	2.33%	56.25%	18	Pakistan	2.33%	58.36%	34	Pakistan	2.33%	50.00%	35	Pakistan	4.65%
7429600	62.74%	31	France	6.98%	86.29%	22	France	0.00%	87.50%	4	France	0.00%	25.00%	37	France	2.33%	70.87%	19	France	2.33%	48.21%	38	France	0.00%
7576288	61.87%	32	Luxembourg	0.00%	80.29%	25	Luxembourg	0.00%	37.50%	34	Luxembourg	0.00%	43.75%	29	Luxembourg	0.00%	70.87%	20	Luxembourg	0.00%	67.85%	28	Luxembourg	0.00%
7457483	60.64%	33	Hong Kong	0.00%	72.74%	31	Hong Kong	0.00%	37.50%	35	Hong Kong	0.00%	81.26%	6	Hong Kong	0.00%	66.70%	27	Hong Kong	0.00%	50.00%	36	Hong Kong	0.00%
7348681	59.74%	34	Slovakia	4.65%	71.19%	33	Slovakia	0.00%	50.00%	29	Slovakia	2.33%	12.50%	42	Slovakia	2.33%	58.36%	35	Slovakia	0.00%	83.92%	7	Slovakia	0.00%
7919248	58.15%	35	Bolivia	0.00%	66.65%	36	Bolivia	0.00%	37.50%	36	Bolivia	0.00%	56.25%	19	Bolivia	0.00%	66.70%	28	Bolivia	0.00%	60.71%	30	Bolivia	0.00%
7864988	42.89%	36	Belgium	20.93%	69.65%	34	Belgium	6.98%	37.50%	37	Belgium	4.65%	18.75%	38	Belgium	4.65%	50.02%	37	Belgium	2.33%	35.71%	40	Belgium	9.30%
7338848	42.02%	37	Antigua	16.28%	18.19%	43	Antigua	2.33%	37.50%	38	Antigua	2.33%	43.75%	30	Antigua	6.98%	70.87%	21	Antigua	0.00%	50.00%	37	Antigua	4.65%
7629632	40.94%	38	Sudan	6.98%	63.56%	37	Sudan	2.33%	25.00%	40	Sudan	0.00%	18.75%	39	Sudan	0.00%	25.01%	42	Sudan	0.00%	51.78%	33	Sudan	6.98%
7427396	33.51%	39	Turkey	0.00%	22.73%	40	Turkey	0.00%	25.00%	41	Turkey	0.00%	56.25%	20	Turkey	0.00%	25.01%	43	Turkey	0.00%	37.50%	39	Turkey	0.00%
7457442	33.19%	40	Morocco	9.30%	50.92%	39	Morocco	0.00%	37.50%	39	Morocco	2.33%	18.75%	40	Morocco	2.33%	50.02%	38	Morocco	0.00%	17.86%	43	Morocco	2.33%
7561808	31.91%	41	Macedonia	2.33%	22.73%	41	Macedonia	2.33%	25.00%	42	Macedonia	0.00%	6.25%	43	Macedonia	0.00%	45.85%	40	Macedonia	0.00%	51.78%	34	Macedonia	2.33%
7294276	30.85%	42	Malaysia	32.56%	54.56%	38	Malaysia	0.00%	50.00%	30	Malaysia	2.33%	31.25%	35	Malaysia	6.98%	16.67%	44	Malaysia	9.30%	7.14%	44	Malaysia	11.63%
7358909	26.60%	43	Libya	4.65%	18.19%	44	Libya	0.00%	25.00%	43	Libya	0.00%	31.25%	36	Libya	2.33%	50.02%	39	Libya	0.00%	21.43%	41	Libya	2.33%
7465330	15.96%	44	Tunisia	18.60%	13.64%	45	Tunisia	4.65%	25.00%	44	Tunisia	0.00%	6.25%	44	Tunisia	4.65%	41.69%	41	Tunisia	0.00%	7.14%	45	Tunisia	9.30%
7359109	15.96%	45	Uganda	2.33%	22.73%	42	Uganda	0.00%	12.50%	45	Uganda	0.00%	6.25%	45	Uganda	2.33%	8.34%	45	Uganda	0.00%	21.43%	42	Uganda	0.00%

## 7.5 Results from Qualitative Questions

In this questionnaire, three qualitative, open-ended questions were asked. The answers were analysed and grouped into categories where appropriate.

In response to question Q26 “***How do you know if the agency’s investigations are perceived by the public as being credible and impartial?***” 20 out of 68 responses (around 30%) said they “don’t know”. Some have indicated that the investigations are not being perceived by the public as credible or impartial (seven times). Other respondents have identified one or more factors that they consider as indicators of the public perceiving the investigations as credible and impartial. Table 7-37 show the categories and corresponding number of responses for each category.

Actual and perceived independence can be different. Chapter 2 of this thesis discussed the perception of independence and its requirements, as stated in ICAO document Doc 9756 titled “*Manual of Aircraft Accident and Incident Investigation*”. The document states that [emphasis added], “the investigation authority ***must be strictly*** objective and ***totally*** impartial and ***must also be*** perceived to be so”. The ICAO document indicates how important impartiality is and also the perception of being impartial. Nevertheless, the data suggest that many ICAO States still do not know how to “sense” or “measure” this perception.

Some participants (16) indicated that investigation agencies use feedback for this purpose. Others (14) indicated that media or press is the source of this information. Feedback is an active process where the accident investigation authority seeks feedback from the public using questionnaires or similar tools, or at least invites it using their website or similar means. The media or press, on the other hand, are passive techniques in collecting feedback about the perception of the public. Therefore, accident investigation agencies can only *react* to the media/press after the fact, while agencies that seek feedback from the public are *proactive* in their approach. The feedback that comes through the

media/press is usually harmful to the independence of the agency and creates a lot of pressure from the public, government, and other parties. For these reasons, the 4DMI model gives a score of one point to all answers that mention “feedback”, and zero otherwise, including the answers that mention “media/press” as indicators of public perception.

One participant stated that in their “culture” this is “out of question”. There are no further data to explain why this is the case in this State. This answer could be related to other replies (three) such as “that is how the agency is setup”, which suggests that it is culturally out of question.

In general, the results suggest that there is no agreement on how to “measure” this public perception of the level of credibility and impartiality of the agency’s investigations. Additionally, there is no clear guidance available to describe how to go about this. The results also suggest that different countries do this in different ways and the most notable is by using direct feedback or feedback from the media or press.

**Table 7-37 Qualitative analysis for Q26**

Categories (Q26)	Number of responses
Don't Know	20
Feedback	16
Media or Press	14
My own experience	8
Not (credible/impartial)	7
Published Reports	6
Public not aware or Don't know	4
Absence of litigation	3
That is how the agency is setup	3
Transparency	1
Culture	1
Method of investigation	1
Open meetings	1
From Politicians	1
Experienced Staff	1
Separation from others	1

In response to question Q48 ***“In your opinion, what factors influence the independence of the accident investigation agency/authority?”*** 32 out of the 68 (47%) respondents either said “don’t know” or did not answer this question. Table 7-38 shows the replies in categories.

The purpose of this question is to understand what factors are considered by professionals as threats to the independence of accident investigations. Out of 68 total participants, 32 responses (47%) said that they don’t know or did not answer. This is an optional question. It is not clear why this many did not answer the question. However, if the 30% who said they don’t know to the obligatory question (Q26) above are considered, which draws from the respondents’ experiences in the same domain as this question, it can be said that the respondents may actually not know the answer to this question as opposed to the probability that they skipped it for other reasons. In this case, it

could be an indication that most of the participants do not understand the threats that could influence the independence of accident investigations.

On the other hand, the number one reason given by most respondents in answer to this question is that they believe budget influences the independence of investigations. It is interesting that budget comes before the consideration of separation from government. In fact, “separation from government” comes third after “budget” and “external pressure”, which also has elements of financial influence.

So, can money simply solve the problem of investigation independence?

Nigeria has been spending a great deal of money recently to recover from the setback in its economy caused by the weak safety record of its aviation industry. On 3rd June 2012, DANA Air Flight 992, registration 5N-RAM, a Boeing MD-83 aircraft, crashed into a densely populated area during a forced landing following a total loss of power in both engines while on approach to Murtala Muhammed Airport of Lagos, Nigeria. 153 people on board died as a result of the crash in addition to ten more deaths on the ground. Weather conditions were poor at the time. The airplane was destroyed as a result of the crash and the post-crash fire (AIB of Nigeria, 2012).

(CBSNEWS, 3 June 2012; DailyMail, 3 June 2012) reported that the Nigerian authorities could not prevent thousands of people from gathering at the crash site of Dana Air aircraft, which crashed into a densely populated site in the largest city in Nigeria. People were trying to help rescue any survivors, but they were all over the landing gear, wings and evidence of the crash site.

Witnesses reported that the fire-fighters could not put out the fire for many hours and if it was not for the help of volunteers, the fire would have spread to the immediate neighbourhood and caused other disasters (Ezeobi and Akintunde, 2012). The Nigerian Aircraft Investigation Bureau (AIB) disclosed that the FDR of the Dana Air crashed aircraft was damaged because of the post crash fire. Usman Mukhtar, the AIB Commissioner explained that the FDR's



solid component was retrieved but the data were lost (The Street Journal, December 2012).

In December, 2012 Mukhtar reported that the Nigerian Air Investigation Bureau (AIB) was close to inaugurating its CVR/FDR laboratory, which cost \$5.5 million (Ateba, Dec 2012). However, there can be no benefit from FDR reading facilities that cost a great deal of money if the FDR itself is damaged.

Financial issues are discussed again in the analysis of the answers to the financial dimension's questions.

**Table 7-38 Qualitative analysis for Q48**

Categories (Q48)	Number of responses
Don't know or Missing	32
Budget	14
External pressure	12
Separation from Government	11
Staff quality and experience	7
Public expectation/ Attitude/ Culture	6
Legislation/ Law	6
Chief Inspector integrity/ Strength /Independence	4
Agency tradition	1
Loss of focus	1
Lack of participation, other than of the Manufacturers	1
Shortage of resources (Staff)	1
Understanding Int'l constraints	1
Cooperation and Communication	1
Industry size	1

As shown in Table 8-2, many of the participants mentioned lack of resources (budget/staff) as factors that could influence the independence of aircraft accident investigations. ICAO has addressed this problem by proposing a solution to share resources between States in the same region, as will be discussed next.

### **7.5.1 Regional Accident and Incident Investigation Organisations (RAIO) as a Solution**

Costa, the Chief of Accident Investigation and Prevention Section in ICAO, reported that ICAO USOAP audits found “in many regions a number of states have not been able to implement an effective accident and incident investigation system”, which means that these States are not complying with Article 26 of the Chicago Convention. Article 26 of the Chicago Convention obligates the State of occurrence, i.e. in which an aircraft accident occurs, to launch an investigation into the circumstances of the accident. The State cannot meet its mandate unless it has a proper organisation in place when it faces such a scenario. This lack of effective implementation has been linked to the insufficient human and financial resources, according to Costa. Other contributing factors to this problem have been identified as: lack of appropriate legislation and regulation; lack of training system for investigators; and lack of equipment to conduct investigations (Costa, 2011).

Costa suggested forming a regional investigation system as a solution to this problem. A regional investigation system would allow sharing of resources, which in turn would help States in meeting their obligations.

ICAO published a Regional Accident and Incident Investigation Organization (RAIO) (Doc. 9946) manual to help States in the establishment of such a system. This is the first time that ICAO has done this. The RAIO manual is aimed at high-level government decision makers.

Costa discussed the importance of the independence of RAIO. He explained that “independence” means functionally independent from other organisations, especially the CAA. He also mentioned that RAIO independence is necessary for the credibility of investigations and to avoid real or perceived conflicts of interest.

Costa (2011) listed the following reasons to support the need for establishing an RAIO:

- To share human, technical, and financial resources and eliminate duplication of efforts
- To improve effectiveness and efficiency by achieving economies of scale
- To enable investigators to gain experience more quickly
- To help achieve the independence of investigations

Two examples of RAIOS that have already been established are: the *Inter-state Aviation Committee* representing 12 states (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, the Republic of Moldova, the Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan); and the *Banjul Accord Group Accident Investigation Agency* (BAGAIA) in Africa consisting of seven states (Cape Verde, Gambia, Ghana, Guinea, Liberia, Nigeria, and Sierra Leone).

RAIO objectives are summarised as (Costa, 2011):

- Enhance cooperation and collaboration in aircraft accidents and incidents investigation between its Member States
- Ensure the establishment of an independent, impartial, professionally trained, and adequately funded RAIO
- Enhance accidents and incidents information sharing between its members and the rest of the international community
- Ensure that all aircraft accidents and incidents that occur in its Member States are investigated in compliance with ICAO Annex 13 SARPs

#### **7.5.1.1 RAIO Investigation Effectiveness and Independence**

The Interstate Aviation Committee (IAC), the RAIO mentioned above, investigated one of the most controversial and high profile air accidents in the recent history, namely the Polish Tu-154M crash in Russia occurred on 10 April 2010.

A Tupolev Tu-154M Polish aircraft, carrying Polish president Lech Kaczynski and his wife, 18 Polish parliament members, Poland's deputy foreign minister, and other senior Polish officials, crashed near the city of Smolensk, Russia on

10 April 2010 killing 96 people on board. The pilots attempted landing in reduced visibility. The aircraft approached the runway too low, hit trees that were not visible because of the fog, and crashed (IAC, 2011; Committee for Investigation of National Aviation Accidents, 2011).

According to ICAO-Annex13, the State of Occurrence (Russia in this case) is responsible for investigating the accident, which it did. In addition, Poland started its own investigation. Moreover, prosecutors from both countries launched criminal investigations.

Russian Prime Minister Valdimir Putin said “everything must be done to establish the reasons for this tragedy in the shortest possible time...”, and announced that he would personally oversee the investigation into the crash (BBC News, 2010).

This statement from the Russian Prime Minister can be taken as an indication of political pressure and interference with the safety investigation. The investigation may not be considered independent, and certainly is not perceived by the public as being independent.

Soon after the crash, the President of Russia established a special commission for the investigation of the accident with the Russian Prime Minister as the Investigator-In-Charge (Lenta.RU, 2010).

The IAC and Polish final reports blamed the accident on pilots for descending too low. Poland’s special aviation and its leaders are strongly criticised in the Polish report. Also, the Polish report criticized the lack in performance of the Russian ATC and airport’s lighting. In general, and despite the initial suspicions of political influence, Poland stated that the investigation was conducted in an open and fair manner (IAC, 2011; Committee for Investigation of National Aviation Accidents, 2011).

The public, however, felt differently. A website has been created by the 2010 Katyn Families Association (set up and run by family members of the victims) protesting against the findings of the reports and the whole investigation

process. Initially, however, the website was created for the promotion of the public hearing organised by The European Conservatives and Reformists Group and the 2010 Katyn Families Association and held in the European Parliament in Brussels on March 28th 2012. According to the website, the public hearing was an “*opportunity for the international public at large to find out how inadequate the investigation and evidence examination has been to date.*” (The 2010 Katyn Families Association, 2010)

The website claims that both the Russian and Polish reports are “unavoidably political”, biased, and has inherent conflict of interest. The website indicated that the people who were responsible for organising the Tu-154 flight are the ones who prepared the final Polish government report. Moreover, they claim that most of the findings in both reports have been proven to be false and unfounded. In addition, the Polish final report has no legal basis because the committee investigated the crash was created and operated in accordance to provisions that are contradictory to aviation law, according to the website.

The objective of this website is to (The 2010 Katyn Families Association, 2010):

- abolish false, hasty judgments and verdicts made;
- bring awareness and inform the general public at large of new findings;
- bring to light the true nature of events and circumstances behind the tragedy of April 10th 2010;
- lobby for the establishment of an independent body of international experts, to carry out the investigation of the 2010 Polish Air Force Tu-154M crash transparently in accordance with international standards and supervision, free from any potential conflict of interests.

It is obvious how the political influence has demolished public trust in the investigations and reduced the effectiveness of the RAIO. The IAC and Polish investigations are not being perceived as independent, regardless of the investigations’ final results.

As a result of people's perception of the investigation, more conspiracy erupted. For example, some believe that (Piasta, 2010):

- The claim of the plane's collision with a tree is not backed by evidence in the Russian IAC's official report.
- Crucial evidence was tampered with and even destroyed.
- The reported readings from the FDRs were altered to misrepresent the situation in the cockpit during the final stage of the flight.
- The autopsies data provided by Russians have been proven to be false.
- Independent investigators proved that the disintegration of the aircraft started 26 meters above the ground, as a result of two successive disturbances of unknown nature, which shook the aircraft.
- The Polish Parliamentary Group for the Investigation of the Polish President Plane Crash was formed by opposition MP's to investigate this case; however, they have a very limited access to crucial pieces of evidence which are being withheld by Russia as well as by Polish Authorities.

There are many benefits in establishing RAIOS. RAIOS are designed in such a way that they are a means of sharing valuable resources between RAIO members and a way to reduce duplication in efforts. In addition, RAIOS allow involved investigators in that region to gain experience quickly. However these benefits are faced with challenges specific to such setups.

The main challenges for the establishment of RAIOS are (ICAO-RASG, 2008):

- lack of a solid regional framework;
- resistance to the change "regional dimension";
- lack of resources (funds and expertise);
- sovereignty;
- self-sufficiency; and
- lack of coordination of the initiatives:
  - within the region; and
  - with the int'l partners and donors.

It is not clear if ICAO audit RAIOs in the same way as they audit ICAO Member States, however, the independence of the RAIO must be ensured to realise the benefits of such setup. The IAC, and the Polish, investigations discussed above did not demonstrate adequate investigation independence and because of that lost the trust and confidence of the public.

### **7.5.2 Correlation between ICAO USOAP Results and 4DMI Results**

The SPSS software was used to perform a correlation analysis between the published results from ICAO USOAP audits (level of implementation) that are related to accident investigations, and the results from the 4DMI model introduced in this research. The results from the 4DMI model are expected to have some level of correlation with the results from the “level of implementation” published by ICAO, but strong correlation is not expected because, while the 4DMI is a measure of investigation independence, the USOAP is a measure of compliance. Correlation is expected, however, because the analysis of Annex 13 done in Chapter 6 of this thesis shows that Annex 13 is based on the principle of investigation independence and, therefore, States that score high in their compliance with the Annex should score high in their 4DMI scores.

ICAO reports the level of implementation in a different way from the reported results from the 4DMI. ICAO reports results between 0 and 10, where “0” means “not implemented” and “10” means “fully implemented”, as shown in the Safety Audit Information page in the ICAO website (ICAO, 2013). The 4DMI Total scores are treated to prepare them for the correlation analysis. All Total scores were approximated to the nearest integer and divided by 10 to match the ICAO system. For example, a score of 77.30 is approximated to 80 and divided by 10 to give a result of 8 to match the ICAO scale. The results of the correlation analysis are shown in Table 7-39.

**Table 7-39 Correlations between 4DMI and ICAO USOAP results**

		Rank from ICAO Level of implementation	Approximate Total Score to compare with ICAO rank
Rank from ICAO Level of implementation	Pearson Correlation	1	.548**
	Sig. (2-tailed)		.000
	N	45	45
Approximate Total Score to compare with ICAO rank	Pearson Correlation	.548**	1
	Sig. (2-tailed)	.000	
	N	45	45

\*\* . Correlation is significant at the 0.01 level (2-tailed).

In conclusion, as expected, there is a moderate positive correlation between the two variables (ICAO USOAP level of implementation and 4DMI independence score) with 99% confidence level. The Pearson’s correlation coefficient (r=0.548) and the correlation is statistically significant (sig<0.01) as shown in Table 7-39.

The results suggest that States that score high in the 4DMI are expected, in general, to score high in the ICAO USOAP level of implementation index.

## 7.6 Key Findings and Conclusions

The research identifies the following seven common characteristics that are mostly found in, or practised by, accident investigation authorities in the States that have higher levels of investigation independence:

1. They are separated functionally, structurally and physically (in different buildings) from the Operation authorities.
2. They do not have on-loan or part-time employees from the industry working for them.
3. The head of the investigation authority reports to the Minister of Transportation or equal level.
4. Safety investigators have immediate and unrestricted access to all relevant evidence without prior consent from anybody.
5. The accident investigation procedures are specified in the National Legislation and Regulations.



6. The acceptance rate for the safety recommendations is measured.
7. The investigation authority has sufficient budgetary resources.

In addition, the research identified the following six common characteristics that are mostly found in, or practised by accident investigation authorities in the States that have the lowest levels of investigation independence:

1. The investigation authority is specific to aviation.
2. The investigation authority is not physically separate from the regulator.
3. There is no law or regulation to prevent the use of safety findings in a judicial inquiry.
4. The investigation authority requires the approval of another government body to release a report.
5. The regulation does not clearly state that safety investigators are precluded from testifying in courts in litigation processes emanating from safety investigation reports.
6. The safety recommendations acceptance rate is not measured.

Additionally, the data show that States in this category (Low-independence) have single-mode, aviation-specific accident investigation authorities in general (8 out of 10 States, 80%). However, there is no evidence that changing to a multi-modal setup will help the independence of the investigation authority. Other categories do not seem to have any agreement on this point.

Also, the data suggest that the physical separation between the accident investigation authority and the regulator is a clear characteristic of the States within the Low-Independence category. 10 out of 10 States (100%) within this category indicated that the accident investigation authorities in their States are not physically separate from the regulator. On the other hand, all other categories indicated that the two are physically separate in their States (see Figure 7-23).

ICAO document Doc 9756 titled *“Manual of Aircraft Accident and Incident Investigation”* indicates how important is both impartiality and the perception of being impartial. Nevertheless, the data collected in this research suggest that many ICAO States still do not know how to “sense” or “measure” this perception. In general, the results may suggest that there is no agreement

about how to “measure” this public perception of the level of credibility and impartiality of the agency’s investigations. Additionally, there is no clear guidance available to describe how to go about this. The results also suggest that different countries do this in different ways. Some States use a proactive approach by seeking feedback using questionnaires or similar tools, and other States use a reactive approach by relying on feedback from the media and press.

In addition, the results show that the focus of many ICAO Member States is on the separation from the CAA. Moreover, this separation is focused on “functional” and “structural” separation; however, less emphasis is given to physical separation. This may suggest that the focus is centred on compliance with ICAO Annex 13 requirements.

Also, data show that most of the participants in the survey (73.53% out of 68 replies) indicated that the accident investigation authority in their States is structured in a way that allows it to speak freely to the media through its own spokesperson in the event of an accident.

Out of 68 respondents, 51.5% said their States do not have FDR readout facilities. When the frequency analysis was regenerated for 45 cases, where each State has one entry only, the results indicated that 66% (30 States out of 45) do not have these facilities. This situation may suggest dependency on outside facilities, their integrity, and the integrity of their employees, and therefore may suggest a lack of functional independence of these accident investigation authorities.

Only 42.6% (out of 68 participants) said that the accident investigation authority in their States has a “voluntary accident reporting system”. Although having a voluntary reporting system within the accident investigation authority is not a requirement, it can highly enhance the independence and perception of independence of the accident investigation authority.

Surprisingly, 78% (out of 68 replies) thought of ICAO Annex 13 as a regulation; 13.2% out of the 78% have Annex 13 as their only source of regulation for accident investigation procedures. This may suggest that there is a widespread, false belief that ICAO Annex 13 contains directly applicable regulations at the State's national legislation or regulation level.

Moreover, the results from the analysis of ICAO Annex 13 show that there are 12 elements that can be considered as indicators of Annex 13 SARPs "spirit" with regard to the independence of aircraft accident investigation. Their benefits can be achieved by any aircraft accident investigation authority if they are understood and implemented correctly. ICAO provides guidance on how to implement Annex 13 correctly. However, out of 68 participants, 60% of the participants in this research indicated that ICAO guidance "could be improved."



## **8 CONCLUSIONS AND FUTURE WORK**

### **8.1 Achievement of Research Objectives and Answering the Research Question**

The objectives of this research, as stated in Chapter 1, have been achieved as follows:

1. The current measures of independence that exist in aviation and other disciplines such as the Economy, Legal, and Political Science were studied and, where possible, utilised.
2. A methodology to measure the formal and informal (*de jure* and *de facto*) independence of air accident investigation in ICAO Member States was developed.
3. The developed methodology was used to expose the gaps that need to be filled to bring an ICAO Member State's accident investigation to the desired level of independence.
4. The results from applying the developed measuring index to a sample of ICAO Member States were analysed and presented.

Moreover, the main research question was answered:

*Is it possible to measure the independence of air accident investigation in ICAO Member States?*

The answer to the question is "Yes it can be measured." This research proves the possibility of measuring the independence of air accident investigations in ICAO Member States.

### **8.2 Originality**

The research benefits from extensively modifying and applying measuring techniques from different disciplines such as Political Science, Judicial Systems, and Banking Systems.

The research also establishes the bases for new research in improving aviation safety by proactively measuring the current situation to clearly establish where

valuable resources can be utilised to improve the independence of aircraft accident investigation authorities.

In addition, the research introduces a four dimensional measuring index (4DMI) which bridges some of the existing research gaps in the area of investigation independence in the field of Air Transport.

Moreover, the research provides analysis for ICAO Annex 13 to extract the most important elements that are related to investigation independence, and shows that it is based on the concept of independent accident investigation.

Finally, this study analyses and presents data from accident investigation authorities from 45 different countries.

### **8.3 Contributions**

The independence of air accident investigations is a required characteristic that ensures the credibility of investigation authorities and allows stakeholders to trust them and voluntarily provide sensitive and valuable information that could ensure greater safety of air transport. Although a fundamental principle, very few studies have attempted to understand and/or measure the concept of independence, such as the studies concerned with the independence of Central Banks, independence in transportation in general, and the independence of Regulatory Agencies. However, there are no in-depth studies in this area specific to aircraft accident investigations. In addition, the development of a comprehensive measuring index for the independence of aircraft accident investigations in ICAO Member States has not been done before. This research fills this gap by introducing a comprehensive four dimensional measuring index (4DMI) that is specifically developed for measuring the independence of aircraft accident investigation authorities in ICAO Member States. This research also presents the analysis and the results of applying the 4DMI index to 45 ICAO Member States.

## 8.4 Summary of Research

This research investigates safety and air accident investigations focusing on the concept of independence. The literature was consulted for previous, related research in the field of air transport and other fields in order to understand this concept. Also, ICAO Annex 13 was analysed to extract the main elements within the Annex SARPs that are related to the concept of independence. Moreover, several interviews were conducted with experts from the field of air transport to understand more about this concept. Finally, an electronic survey was created and sent to air accident investigation authorities around the world to collect data and learn from their experiences.

The argument in this research deals with the possibility of measuring the independence of air accident investigations in ICAO Member States. But the attempt to measure brought other questions: Why do we want to measure? How do we measure? What is the “investigation independence” that we want to measure?

This research claims that “investigation independence” can be understood and measured using several indicators that give indications about the “benefits” or “goals” of investigation independence. Experts’ understandings, ICAO documents, and other related studies were the source of the indicators used in the survey and in the 4DMI measuring index.

ICAO Annex 13 was analysed to extract the elements related to the concept of investigation independence. Moreover, published articles, reports, experts’ interviews, and experts’ talks were used where possible to extract what they consider to be important indicators of good investigation independence or a lack of independence.

A survey was created using these indicators and piloted. The refined survey was sent electronically to accident investigation authorities around the world, with a covering letter from an expert in the field to encourage them to respond for the purpose of research. All this was done in accordance with the guidelines

from the Ethics Committee of Cranfield University. An ethics proposal was submitted to the Committee highlighting the research plan with a copy of the survey and was later approved by the Committee.

After receiving the responses, the scoring scheme was discussed with two experts in the field of Air Transport to make sure that the researcher understood what factors would benefit the independence of the investigations and what would not. The necessary changes were made to the measuring index to reflect experts' remarks.

Because this is exploratory research, most of the questions have "Other" options to allow respondents to add new thoughts to their responses. The responses under this option were analysed and, where possible, assigned to one of the predefined options. To increase the reliability of this process, a sample from the responses was given to another expert in the field of safety of air transport to match the answers in "Other" options with the predefined options where possible. The results from the researcher and the results from the expert were compared and found to match more than 86% of the time and therefore, the researcher's analyses were accepted.

The researcher did not find any previous studies similar to this research and therefore there are no pre-existing views to challenge. However, at the beginning of this research, the researcher found it strange and considered it inadequate that ICAO require something and yet refrain from defining it. Why did ICAO leave the required investigation independence without a clear definition?

After analysing the responses to the survey, it becomes clearer now that the question should not be "Why" but "Is it possible for ICAO to publish a single clear definition for accident investigation independence?" In reality, ICAO is made up of its Member States around the world. If these States do not, or cannot, fully agree on how to ensure the independence of their investigations, as shown from the results in this research, then ICAO will not be able to define one acceptable setup and ignore the rest. ICAO, therefore, indicated only what



it considered necessary to establish an independent accident investigation, namely: functional and structural (in the 10<sup>th</sup> edition) independence, and the protection of records.

## **8.5 Changing the Way We Think About Investigation Independence**

Almost all initiatives for improving investigation independence are based on conformity (see chapter 2 of this thesis) while the results from this research suggest that they should be based on diversity. Because of these diversities, there is a need for more research to look deeper into the systems and how they interrelate, and learn what works, how and why it works, and what does not work.

Research and training should not only focus on the basic characteristics of independence such as the separation from regulators and operators (airlines, ground support, traffic control, etc.), rather they should cover the wide span of factors that affect investigation independence.

The results from this research show that although a few countries (six) do not have permanent accident investigation authorities, there are other countries with permanent accident investigation authorities that performed, in general, at the same level. This suggests that there are countries which are involved in the activity of building an independent accident investigation authority but not accomplishing the goals. It could simply be because these goals are not clear to them or it could be because of other complex reasons that prevent the realisation of these goals.

Part of the problem is that the focus is on successfully passing ICAO USOAP audits even if there are no real achievements with regard to independence. This is not to say USOAP audits are not important. They have their own merits and their benefits are well documented. However, audits should not be the dominant and only measure when it comes to a very important and complex concept such as investigation independence.

The ICAO approach to USOAP audits using clearly defined indicators may not be suitable to promote and actually achieve the benefits of independent accident investigations. The current approach, although far from being rigid, does not acknowledge the inherent diversity in achieving the goals of investigation independence, which does not help in preventing the drawbacks of a lack of independence in accident investigation authorities.

RAIO is one way that acknowledges the diversity of ICAO Member States when it comes to resources. ICAO has realised that not all States have the necessary resources to be in full compliance with Annex 13 SARPs. ICAO's answer to the diversity in resources is to ask the States concerned to form an RAIO that fits ICAO's "compliance" approach.

ICAO keeps modifying Annex 13 hoping to achieve enough SARPs to make the independence of accident investigation achievable through "compliance". This will not work because investigation independence is an activity that involves human interaction, perception, understanding, and implementation and therefore needs to account for all of these.

Unlike the mechanical systems of licensing and certification, achieving adequate accident investigation independence is a system of human factors and should be dealt with as such.

Although there are trends in the survey results, each case is indeed unique. Each practice that relates to accident investigation has a reason that can be grossly misunderstood if removed from its context. The level of independence changes with a change in circumstances, which means the levels of accident investigation independence are as diverse as the circumstances of the accidents themselves.

ICAO and similar international bodies will not be able to accommodate for all the variations in accident investigation authorities when it comes to ensuring their independence. The diversities should be acknowledged and only guidelines with specific goals should be set for all States to achieve. This is not

to say States should be left unaccountable for the lack of investigation independence, but the right conditions when they exist will bring opportunities and make it possible for countries with few resources and little known circumstances to achieve the goals and benefits of investigation independence.

## **8.6 Limitations**

Although the research has reached its aims, there were some unavoidable limitations. First, the sample size is relatively small due to the sensitive nature of the data needed. In addition, the participating States are audited by ICAO which makes it difficult for them to release sensitive information. Nevertheless, enough data were collected to provide insights into this issue of investigation independence.

Second, the sample is skewed to European States because most of the replies came from that area of the world.

Another limitation is that the data are a self-reporting type of data which must be taken at face value because they cannot be independently verified. However, the survey targeted heads of accident investigation authorities and the professionals in this field in order to collect reliable data.

## **8.7 Recommendations**

This research recommends that aircraft accident investigation authorities should consider implementing the seven practices/characteristics that are commonly found in the States that have a high level of investigation independence (High-Independence category), as identified in the results.

This research also recommends that States identified in the research as being part of the “Low-Independence” category should consider resolving the six common practices identified in this category, with the exception of the common practice of a single-mode setup, in order to improve their overall level of investigation independence.

Additionally, ICAO Member States should consider using the developed measuring index to measure their current position and plan for improvement, knowing where to effectively spend their resources. Moreover, using the results from the analysis of the measuring index, ICAO Member States that wish to establish new air accident investigation authorities can make informed decisions on what features they need to implement to ensure the adequate independence of the newly established authorities.

Moreover, ICAO Member States should consider sharing information about the independence of accident investigation authorities. There are systems available to share sensitive data that are found from accident investigations or provided through voluntary information systems, but the success and failure of the independence of the investigation authorities that are part of the system, on which this whole system depends, are not reported. Knowing the integrity and credibility of the system will at least, if it does not improve the system, ensure the system does not degrade. This proactive approach will also uncover and prevent any hidden “confidence crisis” in the aviation system that could suddenly erupt, similarly to the sudden financial crisis that was discussed earlier in this thesis.

## **8.8 Future Research**

Although this study helps bridge some of the gaps, there is still a lack of research in this area. There is a need for more research to further our understanding of the concept of independence in the context of air accident investigations. The following are some recommendations for future research.

This study revealed certain characteristics that are common to ICAO Member States that scored the highest in the 4DMI (High-Independence category), and revealed other characteristics that are common to the States that scored the lowest in the 4DMI (Low-Independence category). It might be sensible to replicate the work done here with a different sample and check if these findings can be verified.

Additionally, the current study is a “snapshot” analysis of the independence of aircraft accident investigation authorities, which effectively represents a detailed picture frozen in time. It may be helpful to implement the developed measuring index (4DMI) in such a way that it becomes dynamic, where it could be used as a self-assessment tool for accident investigation authorities in ICAO Member States.

Additional development could be to integrate the 4DMI measuring index presented in this research, or a modified version of it, with ICAO’s USOAP programme. ICAO could recommend using the measuring index developed in this research for self-assessment to States prior to the ICAO audit. This may allow States to see the goals that ICAO aim to achieve and allow the ICAO auditing team to probe deeper into the State’s accident investigation authority’s setup to better understand the situation.

Moreover, the measuring techniques introduced in this research were applied to each ICAO Member State separately. It may be worthwhile checking the possibility of applying, and modifying if required, the developed model to regional accident investigation organisations (RAIOs).



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## APPENDICES

### Appendix A Analysis of ICAO Annex 13-9<sup>th</sup> Edition

ICAO Annex 13 (9<sup>th</sup> edition) has been analysed to extract the most important elements of accident investigation independence.

#### A.1 Independence Elements

ICAO Annex 13 9<sup>th</sup> edition was analysed to extract the elements that are related to the independence of aircraft accidents and incidents investigation. Table A-1 shows the analysis and its results. Only the paragraphs most related to the independence of investigation were analysed.

The columns in the table represent the following:

**Annex 13 Item**: SARP paragraph from Annex 13 9<sup>th</sup> Ed.

**Affect by level of Independence**: Check if the SARP can be affected by the level of independence of the investigation.

**Can it be done without independence**: Can the SARP be complied with without being independent?

**Can it be used to Measure Independence?**: Can it be used as an indicator to measure investigation independence?

**Notes**: Notes.

**Classification**: The attribute(s) of independence impeded in Annex 13 SARPs.

Table A-1 ICAO Annex 13 9th Ed. Analysis

#	<i>Annex 13 Item</i>	<i>Affected by level of Independence?</i>	<i>Can it be done without independence?</i>	<i>Can it be used to Measure Independence?</i>	<i>Notes</i>	<i>Classification</i>
1	<p>OBJECTIVE OF THE INVESTIGATION</p> <p>3.1 The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability.</p>	Yes	Yes	Yes	Even without independent investigation body it is still possible to have a good investigation that does not apportion blame or liability.	Blame or liability
2	<p>Responsibility for instituting and conducting the investigation</p> <p>ACCIDENTS OR INCIDENTS IN THE TERRITORY OF A CONTRACTING STATE</p> <p>5.1 The State of Occurrence shall institute an investigation into the circumstances of the accident and be responsible for the conduct of the investigation, but it may delegate the whole or any part of the conducting of such investigation to another State by mutual arrangement and consent. In any event the State of Occurrence shall use every means to facilitate the investigation.</p>	Yes	Yes	Maybe	<p>Investigation could be safety or judicial investigation. Investigation body could be independent body or not.</p> <p>Delegation could be a problem if it is delegated to, for example, the State of manufacture (NTSB and Boeing). Independence may still work fine in this</p>	<p>Conduct of investigation (Article 26 to the Convention, no deviation)</p> <p>Delegation</p>

					example. This happened in Indonesia.	
3	5.1.1 Recommendation.— The State of Occurrence should institute an investigation into the circumstances of a serious incident. Such a State may <i>delegate</i> the whole or any part of the conducting of such investigation to another State by mutual arrangement and consent. In any event the State of Occurrence should use every means to facilitate the investigation.	Yes	Yes	Yes	Same as above but for serious incident (not accident)	Delegation
4	ACCIDENTS OR INCIDENTS IN THE TERRITORY OF A NON-CONTRACTING STATE State of Registry 5.2 Recommendation.— When the accident or the serious incident has occurred in the territory of a non-Contracting State which does not intend to conduct an investigation in accordance with Annex 13, the State of Registry or, failing that, the State of the Operator, the State of Design or the State of Manufacture should endeavour to institute and conduct an investigation in cooperation with the State of Occurrence but, failing such cooperation, should itself conduct an investigation with such information as is available.	Yes	Yes	Maybe	Not a standard	Conduct of investigation
5	ORGANIZATION AND CONDUCT OF THE INVESTIGATION RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION 5.4 The accident investigation authority shall have independence in the conduct of the investigation and have unrestricted authority over its conduct, consistent with the provisions of this Annex. The investigation shall include: a) the gathering, recording and analysis of all available information on that accident or incident;	Yes	No	Yes		Legal Framework

	<p>b) if appropriate, the issuance of safety recommendations;</p> <p>c) if possible, the determination of the causes; and</p> <p>d) the completion of the final report.</p> <p>When possible, the scene of the accident shall be visited, the wreckage examined and statements taken from witnesses.</p>					
6	<p>5.4.1 Recommendation.— Any judicial or administrative proceedings to apportion blame or liability should be separate from any investigation conducted under the provisions of this Annex.</p>	Yes	No	Yes	<p>Separation: financially, in effort, in time (Who goes first?)</p>	Separation of investigation
7	<p>Investigator-in-charge — Designation</p> <p>5.5 The State conducting the investigation shall designate the investigator-in-charge of the investigation and shall initiate the investigation immediately.</p>	Yes	Yes	Yes	<p>Initiating the investigation should be the choice of the indep body. Designating the investigator-in-charge should be done without pressure.</p>	Conduct of investigation
8	<p>Investigator-in-charge — Access and control</p> <p>5.6 The investigator-in-charge shall have unhampered access to the wreckage and all relevant material, including flight recorders and ATS records, and shall have unrestricted control over it to ensure that a detailed examination can be made without delay by authorized personnel participating in the investigation.</p>	Yes	Yes	Yes	<p>Judicial investigation wants to have access also. Investigator in charge should have the access first.</p>	<p>Access and control</p> <p>Legal framework</p>
9	<p>Flight recorders — Accidents and incidents</p> <p>5.7 Effective use shall be made of flight recorders in the investigation of an accident or an incident. The State conducting the investigation shall arrange for the read-out of</p>	Yes	Yes	Yes	<p>Flight recorders should be in the custody of the safety investigation. Where</p>	<p>Access and control</p> <p>Evidence</p>



	the flight recorders without delay.				it is read and who is there is important for indep.	
10	5.8 Recommendation.— In the event that the State conducting the investigation of an accident or an incident does not have adequate facilities to read out the flight recorders, it should use the facilities made available to it by other States, giving consideration to the following: a) the capabilities of the read-out facility; b) the timeliness of the read-out; and c) the location of the read-out facility.	Yes	Yes	Yes		Evidence
11	Medical examinations 5.9.1 Recommendation.— When appropriate, the State conducting the investigation should arrange for medical examination of the crew, passengers and involved aviation personnel, by a physician, preferably experienced in accident investigation. These examinations should be expeditious.	Yes	Yes	Yes	The crew intoxication could be perishable evidence. Influence from outside can cause delay. Independence here is important.	Evidence Legal framework
12	Coordination — Judicial authorities 5.10 The State conducting the investigation shall recognize the need for coordination between the investigator-in-charge and the judicial authorities. Particular attention shall be given to evidence which requires prompt recording and analysis for the investigation to be successful, such as the examination and identification of victims and read-outs of flight recorder recordings. Note 1.— The responsibility of the State of Occurrence for such coordination is set out in 5.1. Note 2.— Possible conflicts between investigating and judicial	Yes	No	Yes	Independent safety investigation should have access to evidence and witnesses first.	Coordination Evidence Legal framework

	authorities regarding the custody of flight recorders and their recordings may be resolved by an official of the judicial authority carrying the recordings to the place of readout, thus maintaining custody.					
13	<p>Informing aviation security authorities</p> <p>5.11 If, in the course of an investigation it becomes known, or it is suspected, that an act of unlawful interference was involved, the investigator-in-charge shall immediately initiate action to ensure that the aviation security authorities of the State(s) concerned are so informed.</p>	Yes	No	Yes	Just culture. Safety investigation (indep) will not apportion blame; however, will not cover up unlawful acts.	<p>Coordination</p> <p>Legal framework</p>
14	<p>Non-disclosure of records</p> <p>5.12 The State conducting the investigation of an accident or incident shall not make the following records available for purposes other than accident or incident investigation, unless the appropriate authority for the administration of justice in that State determines that their disclosure outweighs the adverse domestic and international impact such action may have on that or any future investigations:</p> <p>a) all statements taken from persons by the investigation authorities in the course of their investigation;</p> <p>b) all communications between persons having been involved in the operation of the aircraft;</p> <p>c) medical or private information regarding persons involved in the accident or incident;</p> <p>d) cockpit voice recordings and transcripts from such recordings; and</p> <p>e) opinions expressed in the analysis of information, including flight recorder information.</p>	Yes	No	Yes	if the appropriate authority always ask for the records to be disclosed, then it is not a measure for independence. They have the right according to 5.12	<p>Blame or liability</p> <p>Legal framework</p>
15	5.12.1 These records shall be included in the final report or its appendices only when pertinent to the analysis of the accident or incident. Parts of the records not relevant to the	Yes	No	Yes	If such information is distributed, it may, in the future, no longer	Blame or liability

	<p>analysis shall not be disclosed.</p> <p>Note.— Information contained in the records listed above, which includes information given voluntarily by persons interviewed during the investigation of an accident or incident, could be utilised inappropriately for subsequent disciplinary, civil, administrative and criminal proceedings. If such information is distributed, it may, in the future, no longer be openly disclosed to investigators. Lack of access to such information would impede the investigation process and seriously affect flight safety.</p>				<p>be openly disclosed to investigators. Lack of access to such information would impede the investigation process and seriously affect flight safety.</p>	<p>Legal framework</p>
16	<p><b>RESPONSIBILITY OF THE STATE OF REGISTRY AND THE STATE OF THE OPERATOR</b></p> <p>Flight recorders — Accidents and serious incidents</p> <p>5.16 When an aircraft involved in an accident or a serious incident lands in a State other than the State of Occurrence, the State of Registry or the State of the Operator shall, on request from the State conducting the investigation, furnish the latter State with the flight recorder records and, if necessary, the associated flight recorders.</p> <p>Note.— In implementing 5.16, the State of Registry or the State of the Operator may request the cooperation of any other State in the retrieval of the flight recorder records.</p>	Yes	Yes	Maybe	<p>For good investigation independence practice, the State of Operator &amp; State of Registry should not be involved in collecting evidence.</p>	<p>Evidence</p> <p>Cooperation</p>
17	<p>Organisational information</p> <p>5.17 The State of Registry and the State of the Operator, on request from the State conducting the investigation, shall provide pertinent information on any organization whose activities may have directly or indirectly influenced the operation of the aircraft.</p>	Yes	Yes	Maybe	<p>There is a better chance of "openness" when the investigation body is known to be independent.</p>	<p>Cooperation</p>
18	<p><b>PARTICIPATION IN THE INVESTIGATION</b></p> <p>Note.— Nothing in this Annex is intended to imply that the accredited representative and advisers of a State have to be</p>	Yes	Yes	Maybe	<p>Opposite of independence! Participation of</p>	<p>Participation : required by Article 26 to</p>

	<p>always present in the State in which the investigation is conducted.</p> <p>PARTICIPATION OF THE STATE OF REGISTRY, THE STATE OF THE OPERATOR, THE STATE OF DESIGN AND THE STATE OF MANUFACTURE</p> <p>Rights</p> <p>5.18 The State of Registry, the State of the Operator, the State of Design and the State of Manufacture shall each be entitled to appoint an accredited representative to participate in the investigation.</p> <p>Note.— Nothing in this Standard is intended to preclude the State that designed or manufactured the powerplant or major components of the aircraft from requesting participation in the investigation of an accident.</p>				<p>parties that have direct interest in the accident may influence the investigation.</p> <p>It can also be looked at as the "transparent" part of the independent investigation.</p>	<p>the Chicago Convention (Cannot deviate from it)</p>
19	<p>5.19 The State of Registry or the State of the Operator shall appoint one or more advisers, proposed by the operator, to assist its accredited representative.</p> <p>5.19.1 Recommendation.— When neither the State of Registry, nor the State of the Operator appoint an accredited representative, the State conducting the investigation should invite the operator to participate, subject to the procedures of the State conducting the investigation.</p> <p>5.20 The State of Design and the State of Manufacture shall be entitled to appoint one or more advisers, proposed by the organizations responsible for the type design and the final assembly of the aircraft, to assist their accredited representatives.</p> <p>5.21 Recommendation.— When neither the State of Design nor the State of Manufacture appoint an accredited representative, the State conducting the investigation should invite the organizations responsible for the type design and the final assembly of the aircraft to participate, subject to the</p>	Yes	Yes	Maybe	<p>Now the States are also involved in the investigation.</p> <p>Not good for independence, however, it keeps the investigators informed and gives them easier access to information needed.</p>	<p>Participation : required by Article 26 to the Chicago Convention (Cannot deviate from it)</p>

	procedures of the State conducting the investigation.					
20	<p>Obligations</p> <p>5.22 When the State conducting an investigation of an accident to an aircraft of a maximum mass of over 2 250 kg specifically requests participation by the State of Registry, the State of the Operator, the State of Design or the State of Manufacture, the State(s) concerned shall each appoint an accredited representative.</p> <p>Note 1.— Nothing in 5.22 is intended to preclude the State conducting an investigation from requesting the State that designed or manufactured the powerplant or major components of the aircraft to appoint an accredited representative whenever the former State believes that a useful contribution can be made to the investigation or when such participation might result in increased safety.</p> <p>Note 2.— Nothing in 5.22 is intended to preclude the State conducting an investigation from requesting the State of Design and the State of Manufacture to give assistance in the investigation of accidents other than those in 5.22.</p>	Yes	Yes	Maybe	This is an obligation that must be complied with. The States concerned would be more willing to send their accredited representatives before being requested, if the investigation body is known to be independent.	Participation
21	<p>PARTICIPATION OF OTHER STATES</p> <p>Rights</p> <p>5.23 Any State which on request provides information, facilities or experts to the State conducting the investigation shall be entitled to appoint an accredited representative to participate in the investigation.</p> <p>Note.— Any State that provides an operational base for field investigations or is involved in search and rescue or wreckage recovery operations may also be entitled to appoint an accredited representative to participate in the investigation.</p>	Yes	Yes	Maybe	<p>Why? (see note below)</p> <p>To ensure the accuracy of the information contained in the final report, and to ensure full cooperation and best coordination in the investigation.</p>	Participation Cooperation Coordination

22	<p>ENTITLEMENT OF ACCREDITED REPRESENTATIVES</p> <p>Advisers</p> <p>5.24 A State entitled to appoint an accredited representative shall also be entitled to appoint one or more advisers to assist the accredited representative in the investigation.</p> <p>Note 1.— Nothing in the above provisions is intended to preclude a State participating in an investigation from calling upon the best technical experts from any source and appointing such experts as advisers to its accredited representative.</p> <p>5.24.1 Advisers assisting accredited representatives shall be permitted, under the accredited representatives' supervision, to participate in the investigation to the extent necessary to enable the accredited representatives to make their participation effective.</p>	Yes	Yes	Maybe	If everybody is involved, how can it be an independent investigation?	Participation
23	<p>Participation</p> <p>5.25 Participation in the investigation shall confer entitlement to participate in all aspects of the investigation, under the control of the investigator-in-change, in particular to:</p> <ul style="list-style-type: none"> <li>a) visit the scene of the accident;</li> <li>b) examine the wreckage;</li> <li>c) obtain witness information and suggest areas of questioning;</li> <li>d) have full access to all relevant evidence as soon as possible;</li> <li>e) receive copies of all pertinent documents;</li> <li>f) participate in read-outs of recorded media;</li> <li>g) participate in off-scene investigative activities such as component examinations, technical briefings, tests and simulations;</li> <li>h) participate in investigation progress meetings including</li> </ul>	Yes	Yes	Maybe	There are still many States involved in the investigation. Opposite of independence.	Participation

	<p>deliberations related to analysis, findings, causes and safety recommendations; and</p> <p>i) make submissions in respect of the various elements of the investigation.</p> <p>However, participation of States other than the State of Registry, the State of the Operator, the State of Design and the State of Manufacture may be limited to those matters which entitled such States to participation under 5.23.</p>					
24	<p>Notes to 5.25 above</p> <p>Note 1.— It is recognized that the form of participation would be subject to the procedures of the State in which the investigation, or part thereof, is being conducted.</p> <p>Note 2.— The collection and recording of information need not be delayed to await the arrival of an accredited representative.</p> <p>Note 3.— Nothing in this Standard precludes the State conducting the investigation from extending participation beyond the entitlement enumerated.</p> <p>Note 4.— The pertinent documents referred to in subparagraph e) also include documents such as the reports on examinations of components or studies performed within the framework of the investigation.</p>	Yes	Yes	Maybe	Here are some controls to limit the involvement of others in the investigation.	Participation  Legal framework
25	<p>Obligations</p> <p>5.26 Accredited representatives and their advisers:</p> <p>a) shall provide the State conducting the investigation with all relevant information available to them; and</p> <p>b) shall not divulge information on the progress and the findings of the investigation without the express consent of the State conducting the investigation.</p> <p>Note.— Nothing in this Standard precludes prompt release of facts when authorized by the State conducting the</p>	Yes	Yes	Maybe	More controls to ensure independence, but do they work?	Cooperation  Coordination

	investigation, nor does this Standard preclude accredited representatives from reporting to their respective States in order to facilitate appropriate safety actions.					
26	<p>PARTICIPATION OF STATES HAVING SUFFERED FATALITIES OR SERIOUS INJURIES TO ITS CITIZENS</p> <p>Rights and entitlement</p> <p>5.27 A State which has a special interest in an accident by virtue of fatalities or serious injuries to its citizens shall, upon making a request to do so, be permitted by the State conducting the investigation to appoint an expert who shall be entitled to:</p> <p>a) visit the scene of the accident;</p> <p>b) have access to the relevant factual information;</p> <p>c) participate in the identification of the victims;</p> <p>d) assist in questioning surviving passengers who are citizens of the expert's State; and</p> <p>e) receive a copy of the Final Report.</p>	Yes	Yes	Maybe	The participation of this "expert" should not affect the independence of the investigation. The participation is limited to ensure the investigation is fair, transparent, independent, clear, ...etc.	Participation
27	<p>RESPONSIBILITY OF ANY STATE</p> <p>Release of information — Consent</p> <p>6.2 States shall not circulate, publish or give access to a draft report or any part thereof, or any documents obtained during an investigation of an accident or incident, without the express consent of the State which conducted the investigation, unless such reports or documents have already been published or released by that latter State.</p>	No	Yes	No	Whether the investigation is independent or not, the States will still receive a draft report but they are still not allowed to circulate it.	Cooperation Coordination
28	<p>RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION</p> <p>Consultation</p> <p>6.3 The State conducting the investigation shall send a copy of the draft Final Report to the State that instituted the</p>	Yes	Yes	Maybe	Opposite of independence!  Cannot release	Consultation



<p>investigation and to all States that participated in the investigation, inviting their significant and substantiated comments on the report as soon as possible. The draft Final Report of the investigation shall be sent for comments to:</p> <ul style="list-style-type: none"> <li>a) the State of Registry;</li> <li>b) the State of the Operator;</li> <li>c) the State of Design; and</li> <li>d) the State of Manufacture.</li> </ul> <p>If the State conducting the investigation receives comments within sixty days of the date of the transmittal letter, it shall either amend the draft Final Report to include the substance of the comments received or, if desired by the State that provided comments, append the comments to the Final Report. If the State conducting the investigation receives no comments within sixty days of the date of the first transmittal letter, it shall issue the Final Report in accordance with 6.4, unless an extension of that period has been agreed by the States concerned.</p> <p>Note 1.— Nothing in this Standard is intended to preclude the State conducting the investigation from consulting other States, such as those States which provided relevant information, significant facilities, or experts who participated in the investigation under 5.27.</p> <p>Note 2.— Comments to be appended to the Final Report are restricted to non-editorial-specific technical aspects of the Final Report upon which no agreement could be reached.</p> <p>Note 3.— When sending the draft Final Report to recipient States, the State conducting the investigation may consider using the most suitable and quickest means available, such as facsimile, e-mail, courier service or express mail.</p> <p>6.3.1 Recommendation.— The State conducting the investigation should send, through the State of the Operator,</p>				<p>report without consulting other States involved.</p> <p>However, it could be an advantage, if it does not influence the final results. It could be looked at as transparency.</p>	
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	<p>a copy of the draft Final Report to the operator to enable the operator to submit comments on the draft Final Report.</p> <p>6.3.2 Recommendation.— The State conducting the investigation should send, through the State of Design and the State of Manufacture, a copy of the draft Final Report to the organizations responsible for the type design and the final assembly of the aircraft to enable them to submit comments on the draft Final Report.</p>					
29	<p>Release of the Final Report</p> <p>6.5 In the interest of accident prevention, the State conducting the investigation of an accident or incident shall release the Final Report as soon as possible.</p>	Yes	Yes	Maybe	Release to public? Or to specified states only? (transparency)	Transparency
30	<p>Safety recommendations</p> <p>6.8 At any stage of the investigation of an accident or incident, the accident or incident investigation authority of the State conducting the investigation shall recommend to the appropriate authorities, including those in other States, any preventive action that it considers necessary to be taken promptly to enhance aviation safety.</p> <p>6.9 A State conducting investigations of accidents or incidents shall address, when appropriate, any safety recommendations arising out of its investigations to the accident investigation authorities of other State(s) concerned and, when ICAO documents are involved, to ICAO.</p>	Yes	Yes	Yes	Independent investigations should be able to issue any safety recommendations at any time without being influenced.	<p>Impartiality</p> <p>Cooperation</p> <p>Coordination</p> <p>Separation</p> <p>Transparency</p>
31	<p>RESPONSIBILITY OF A STATE RECEIVING SAFETY RECOMMENDATIONS</p> <p>Action on safety recommendations</p> <p>6.10 A State that receives safety recommendations shall inform the proposing State of the preventive action taken or under consideration, or the reasons why no action will be taken.</p>	Yes	Yes	Yes	"Other than safety recommendations", like what? Changing regulations? Blame? Proposal for new systems?	<p>Cooperation (with States)</p> <p>Transparency</p>

	Note.— Nothing in this Standard is intended to preclude the State conducting the investigation from making proposals for preventive action other than safety recommendations.				----- Independent investigation must not have the authority to force changes. It can only recommend.	
32	ADREP REPORTING PRELIMINARY REPORT RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION Accidents to aircraft over 2 250 kg 7.1 When the aircraft involved in an accident is of a maximum mass of over 2 250 kg, the State conducting the investigation shall send the Preliminary Report to: a) the State of Registry or the State of Occurrence, as appropriate; b) the State of the Operator; c) the State of Design; d) the State of Manufacture; e) any State that provided relevant information, significant facilities or experts; and f) the International Civil Aviation Organization.	No	Yes	No	Independent or not, a preliminary report will go out to all specified States.	N/A
33	ACCIDENT/INCIDENT DATA REPORT RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION Accidents to aircraft over 2 250 kg 7.5 When the aircraft involved in an accident is of a maximum	Yes	Yes	Maybe	If it is not an independent body that is conducting the investigation; will it send any data that	Impartiality  Cooperation

	<p>mass of over 2 250 kg, the State conducting the investigation shall send, as soon as practicable after the investigation, the Accident Data Report to the International Civil Aviation Organization.</p> <p>Additional information</p> <p>7.6 Recommendation.— The State conducting the investigation should, upon request, provide other States with pertinent information additional to that made available in the Accident/Incident Data Report.</p>				<p>"may" show the possibility of the regulator involvement? Is the data trusted?</p>	<p>Coordination</p> <p>Separation</p> <p>Transparency</p>
34	<p><b>ACCIDENT PREVENTION MEASURES</b></p> <p>Note.— The objective of these specifications is to promote accident prevention by analysis of accident and incident data and by a prompt exchange of information.</p> <p>Incident reporting systems</p> <p>8.1 A State shall establish a mandatory incident reporting system to facilitate collection of information on actual or potential safety deficiencies.</p> <p>8.2 Recommendation.— A State should establish a voluntary incident reporting system to facilitate the collection of information that may not be captured by a mandatory incident reporting system.</p>	Yes	Yes	Yes	<p>Specifically the voluntary incident reporting system will not work if the investigation body is not an independent one.</p> <p>The reports should only be used for the purpose of advancing safety and not to apportion blame and that can only be assured through the independence of the investigation body, which will invite the trust of the public and the industry, and their</p>	<p>Legal framework</p> <p>Impartiality</p> <p>Cooperation</p> <p>Blame and liability</p>

					confidence.	
35	<p>8.3 A voluntary incident reporting system shall be non-punitive and afford protection to the sources of the information.</p> <p>Note 1.— A non-punitive environment is fundamental to voluntary reporting.</p> <p>Note 2.— States are encouraged to facilitate and promote the voluntary reporting of events that could affect aviation safety by adjusting their applicable laws, regulations and policies, as necessary.</p> <p>Note 3.— Guidance related to both mandatory and voluntary incident reporting systems is contained in the Accident Prevention Manual (Doc 9422).</p>	Yes	Yes	Yes	See above	<p>Legal framework</p> <p>Blame and liability</p> <p>Cooperation (with industry)</p>
36	<p>Database systems</p> <p>8.4 Recommendation.— A State should establish an accident and incident database to facilitate the effective analysis of information obtained, including that from its incident reporting systems.</p> <p>8.5 Recommendation.— The database systems should use standardized formats to facilitate data exchange.</p>	Yes	Yes	Yes	When the aim is advancing safety only, the information can easily be shared and all related data can be transparent.	<p>Cooperation (with States)</p> <p>Transparency</p>
37	<p>Analysis of data — Preventive actions</p> <p>8.6 A State having established an accident and incident database and an incident reporting system shall analyse the information contained in its accident/incident reports and the database to determine any preventive actions required.</p> <p>Note.— Additional information on which to base preventive actions may be contained in the Final Reports on investigated accidents and incidents.</p> <p>8.7 Recommendation.— If a State, in the analysis of the information contained in its database, identifies safety matters considered to be of interest to other States, that State should</p>	Yes	Yes	Maybe	Independent setup can look at all possible causes, including the regulations, and be transparent about it. If the regulations need to be fixed, the independent setup can show this clearly. It is doubtful	<p>Cooperation (with States)</p> <p>Transparency</p> <p>Impartiality</p> <p>Depth of analysis (?)</p>

	forward such safety information to them as soon as possible. 8.8 Recommendation.— In addition to safety recommendations arising from accident and incident investigations, safety recommendations may result from diverse sources, including safety studies. If safety recommendations are addressed to an organization in another State, they should also be transmitted to that State's investigation authority.				that the regulator would criticise its own work.	
38	Exchange of safety information 8.9 Recommendation.— States should promote the establishment of safety information sharing networks among all users of the aviation system and should facilitate the free exchange of information on actual and potential safety deficiencies. Note.— Standardized definitions, classifications and formats are needed to facilitate data exchange. Guidance material on the specifications for such information-sharing networks will be provided by ICAO upon request.	Yes	Yes	Maybe	Independent investigation setup would want to promote safety and would want to be part of such network.	Cooperation (with States)  Transparency
39	FORMAT OF THE FINAL REPORT 2. ANALYSIS Analyse, as appropriate, only the information documented in 1. — Factual information and which is relevant to the determination of conclusions and causes. 3. CONCLUSIONS List the findings and causes established in the investigation. The list of causes should include both the immediate and the deeper systemic causes. 4. SAFETY RECOMMENDATIONS As appropriate, briefly state any recommendations made for the purpose of accident prevention and any resultant corrective action.	Yes	No	Yes	*cover up *blame *"..and the deeper systemic causes" this is the advantage of independence. *criticise regulator if need to. ----- List of deeper systemic causes is a direct result of	Blame and liability  Transparency

					independence in investigation.	
40	<p><b><i>These Attachments do not constitute a part of Annex 13</i></b></p> <p><b>GUIDELINES FOR FLIGHT RECORDER READ-OUT AND ANALYSIS</b></p> <p>Participation by the State of Manufacture (or Design) and the State of the Operator</p> <p>The State of Manufacture (or Design) has airworthiness responsibilities and the expertise normally required to read out and analyse flight recorder information. Since flight recorder information can often reveal airworthiness problems, the State of Manufacture (or Design) should have a representative present when the flight recorder read-out and analysis are being conducted in a State other than the State of Manufacture (or Design).</p> <p>The State of the Operator has regulatory responsibilities regarding the flight operation and can provide insights into operational issues which may be specific to the operator. Since flight recorder information can reveal operational problems, the State of the Operator should also have a representative present when the flight recorder read-out and analysis are being conducted.</p> <p>Recommended procedures</p> <p>The facility at which the flight recorders are read out for another State should be given an opportunity to comment on the Final Report in order to ensure that the characteristics of the flight recorder analysis have been taken into account.</p>	Yes	Yes	No	<p>This is not a requirement or recommendation. It is as stated not part of Annex 13.</p> <p>Participants are there to clarify things and help understand what happened. They must not influence the results of the investigation.</p> <p>Independent investigation can ensure this.</p>	<p>Coordination</p> <p>Cooperation</p>

From Table A-1, the following are ICAO Annex 13 Standards and Recommended Practices (SARPs) items that can be described as the "Elements" of independent accidents and incidents investigations that are impeded within the SARPs:

*Apportion blame or liability - Conduct of investigation - Delegation - Legal Framework - Separation of investigations - Access and control (accident site, evidence, wreckage, etc.) - Evidence - Participation (States, Reps, etc.) - Consultation - Transparency - Cooperation - Coordination*



## **Appendix B Ethics Proposal**

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### **Measuring Accident Investigation Independence - Ethics Committee Proposal**

**Researcher:** Sami Alsrinari  
**Thesis Supervisor:** Graham Braithwaite  
**Date of proposal:** 24 Sept 2011  
**Research period:** Sept – Dec 2011

#### **1. Background to the Research**

This research explores the principle of independence and its effect on accident investigation. Many have discussed the benefits and the need for the independence of aircraft accident investigations; however, no tool has been introduced to evaluate it. This study proposes a methodology for the first time to measure the independence of aircraft accident investigation in the International Civil Aviation Organization (ICAO) Member States. The proposed method brings together valuable insights from different disciplines about the meaning of independence and how to measure it. These insights are scattered in the literature of economic, legal, political science, and other disciplines.

Although ICAO imposes requirements to ensure investigation independence, it does not clearly define what independence is. The requirements for independence have been emphasised even more in the new 10<sup>th</sup> edition of ICAO Annex 13 published in July 2010. In order to come up with reasonable measures, a definition to clarify the meaning of independence in the context of accident investigation must be either introduced by this research or selected from the different definitions in the existing literature.

The overall objective of this research is to find a method to effectively measure the independence of aircraft accident investigation authorities in ICAO Member

States. Moreover, this research will provide information about these authorities' current positions and allow ICAO Member States to avoid future mistakes, and raise the level of the independence of their investigations for the sake of the ultimate goal – improving aviation safety.

## **2. Methodology for Data Collection and Analysis**

Because no other research has been done before with the proposed details to gather information about aircraft accident investigation authorities in ICAO Member States, the data this research attempts to gather are considered exploratory in nature and will form a good base and provide a better understanding for future researches. For this reason it has been decided that a detailed questionnaire is the best way to collect the needed data about aircraft accident investigation authorities.

## **3. Target Participants**

The target participants are those who are involved in aircraft accident investigations. The ideal participants would be the Heads of aircraft accident investigations because they are likely to be the most knowledgeable about their organisations. However, information from other investigators, operators, insurers, service providers, and others who are involved in aircraft accident investigations is also valuable, but has less credibility. For this reason, the questionnaire requires participants to provide their job titles or current positions, so that if there are different views for the same question they can be prioritised and guesswork can be removed. However, participation is voluntary and confidentiality guaranteed.

## **4. Information Being Sought from Participants**

This is an exploratory type of research. Participants, therefore, are asked to reply to questions about the current situation of the aircraft accident investigation authority in their own country. The questionnaire explores and attempts to collect data about different dimensions defining the independence of the civil aircraft accident investigation authorities around the world. The researcher realises that each country has its own legal system, financial

system, government structure, and its own understanding of the words “investigation independence.” This questionnaire attempts to capture the views of the participants with regard to these issues.

## **5. Addressing Ethics Issues**

There is no deception involved in this research; however, the idea of “measuring” independence was not made clear to the participants because the researcher thinks it may affect the responses of the participants. It is human nature to want to measure “better” when compared to others. Therefore, the general idea of the research was explained but not the attempt to establish a tool to measure the independence of each accident investigation authority in each ICAO Member State.

Participants are invited to participate in this questionnaire through faxes, emails, and personal contacts. Their participation is voluntary and there are no incentives or compensations given for participation in this research.

Information about the participants’ job titles are being collected, therefore, there is a slight potential of professional harm, especially for those who are in the chief inspectors’ or heads of the accident investigation authorities’ positions, who can easily be identified from their job titles when combined with names of their countries. The harm can be caused if the participants answer some of the difficult questions, such as those asking how satisfied the participants are with the budget of the authority, or if there are pressures from the political parties in their countries, or if politicians are trying to influence their decisions, ...etc.

To protect participants from any potential professional harm, the job title information will not be published and will be kept confidential. Moreover, the researcher will seek data from different participants about the same country’s aircraft accident investigation authority which will make it even more difficult to identify participants from the data collected.

After the completion of each questionnaire, the participants will be thanked for their assistance with the research and will be given the opportunity to print their

responses. The participants will be reminded of their right to withdraw their responses within two weeks from the date of submitting their information. The participants will also be reminded that their data will be held confidentially and anonymously.

The participants will be given the researcher's Cranfield University email address should they need to contact him after finishing the questionnaire for any reason.

The data provided by participants will not be shared with any person other than academic personnel directly involved with this project.

The procedures for handling, storage and use of the data will ensure the confidentiality of all information disclosed by participants. Completed forms will be stored in a locked secure location and will be de-identified and given random numbers when the data analysis phase begins (about two months from the end of the data collection phase).

There is no potential for perceived conflict of interest for this project.

After careful consideration, the researcher decided that there is no need for an "informed consent" form for this research. However, the following statements have been introduced as the cover page for the electronic questionnaire:

Cover Page

Dear Participant,

This survey is part of my PhD research and the results will be used for the final thesis. It is an attempt to describe a current situation in accident investigation authorities in ICAO Member States to inform future practice. The questionnaire explores and attempts to collect data about different dimensions defining current practices, methodologies, and level of resources available to the civil aircraft accident investigation authorities around the world.

I would be grateful if you could respond to as many questions as you can. Even if you must miss some out, the information that you do provide will contribute to a greater understanding of the current situation as well as providing a base-line for potential future studies, so do provide considered responses. Your individual contribution will not be divulged and will be treated in the strictest confidence.

There is no right or wrong answer. Please provide your *OWN VIEW* of the *CURRENT* situation in *YOUR COUNTRY*, not necessarily the situation you think is best. For the purpose of this research the accident investigation "agency" and the accident investigation "authority" mean the same thing and that is the body responsible for carrying out aircraft accident investigations in your State.

Any information you provide will be completely confidential and anonymous but will contribute to general statistics on the topic. Participants can stop participating in the survey at any time before submitting the questionnaire. However, once the questionnaire is submitted they can withdraw their responses from this survey within 2 weeks from the date of submission of their response by contacting the researcher. If you wish to withdraw your responses from this survey, please contact me on this email [s.m.alsrisari@cranfield.ac.uk](mailto:s.m.alsrisari@cranfield.ac.uk)

Any personal information that you provide (e.g. job title) will not be published without your consent and approval.

This survey has 6 pages as follows:

Page 1 : This page

Pages 2-5 : Questionnaire

Page 6 : Submission of your responses, "thank you" note and reminder of the researcher contact email

It is 'not possible' to return to a page once it has been completed.

When you arrive at the final 'thank you' page, you will know that your responses have been recorded on our database.

The surveys that are left incomplete until the end of this project will be deleted and will not be used in the project.

Please note that:

- Your participation is entirely voluntary
- Your participation is fully confidential and your anonymity is assured
- The survey records will be stored securely by the researcher where no other person can access them, and the information that you provide during the survey will not be shared with any party other than those directly involved in the research, being the researcher and Cranfield University academic supervisors.
- You will have the chance to print your responses when you finish this survey
- If need to, you can finish this survey in several sessions by clicking the "Finish Later" button.

By clicking "Continue>" you are consenting to participate in this survey.

Continue >

Figure B-1 A snapshot of the cover page for the survey

## **6. Acknowledgment**

### **I confirm that as part of the research activity described above:**

- I will ensure that no-one is coerced or compelled to participate in the research
- I will not use any inducements or incentives to secure participation
- I will not use any form of deception as part of the research method
- I will explain to participants the level of confidentiality which they can expect and will aim to maintain participant confidentiality wherever practicable
- I will design and execute the research in a way which protects participants from harm
- I will, prior to any data gathering activity, brief participants about the project and their rights
- I will, following any data collection activity, debrief participants by allowing them to print their responses at the end of the survey
- I will store any data I obtain in accordance with the Data Protection Act

### **I also confirm that:**

- The information I have provided on this form is accurate to the best of my knowledge and belief
- I have read the advice on research ethics contained in the document 'Basic Principles of Research Ethics for Studies Involving Human Subjects'
- The project described above will abide by the University's Ethics Policy
- There is no potential material interest that may, or may appear to, impair the independence and objectivity of researchers conducting this project
- Subject to research being approved, I undertake to adhere to the project description and statements provided above
- I undertake to inform SEREC of any significant changes to the research activity which might invalidate the statements made above
- I understand that the project, including research records and data, may be subject to inspection for audit purposes, if required in future
- I understand that personal data about me as a researcher in this form will be held by those involved in the ethics review procedure and that this will be managed according to Data Protection Act principles

## Appendix C Survey Questionnaire

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Dear Participant,

This survey is part of my PhD research and the results will be used for the final thesis. It is an attempt to describe a current situation in accident investigation authorities in ICAO Member States to inform future practice. The questionnaire explores and attempts to collect data about different dimensions defining current practices, methodologies, and level of resources available to the civil aircraft accident investigation authorities around the world.

I would be grateful if you could respond to as many questions as you can. Even if you must miss some out, the information that you do provide will contribute to a greater understanding of the current situation as well as providing a base-line for potential future studies, so do provide considered responses. Your individual contribution will not be divulged and will be treated in the strictest confidence.

There is no right or wrong answer. Please provide your "**OWN VIEW**" of the "**CURRENT**" situation in "**YOUR COUNTRY**", not necessarily the situation you think is best. For the purpose of this research the accident investigation "**agency**" and the accident investigation "**authority**" mean the same thing and that is the body responsible for carrying out aircraft accident investigations in your State. Any information you provide will be completely confidential and anonymous but will contribute to general statistics on the topic. Participants can stop participating in the survey at any time before submitting the questionnaire. However, once the questionnaire is submitted they can withdraw their responses from this survey within two weeks from the date of submission of their response by contacting the researcher. If you wish to withdraw your responses from this survey, please contact me on this email

[s.m.alsrisari@cranfield.ac.uk](mailto:s.m.alsrisari@cranfield.ac.uk)

Any personal information that you provide (e.g. job title) will not be published without your consent and approval.

This survey has 6 pages as follows:

Page 1 : This page

Pages 2-5 : Questionnaire

Page 6 : Submission of your responses, "thank you" note and reminder of the researcher's contact email.

It is **"not possible"** to return to a page once it has been completed. When you arrive at the final 'thank you' page, you will know that your responses have been recorded on our database. The surveys that are left incomplete until the end of this project will be deleted and will not be used in the project. Please note that:

- Your participation is entirely voluntary
- Your participation is fully confidential and your anonymity is assured
- The survey records will be stored securely by the researcher where no other person can access them, and the information that you provide during the survey will not be shared with any party other than those directly involved in the research, i.e. the researcher and Cranfield University academic supervisors. You will have the chance to print your responses when you finish this survey. If you need to, you can finish this survey in several sessions by clicking the **"Finish Later"** button.

By clicking **"Continue>"** you are consenting to participate in this survey.

\*\*\*\*\*



All questions about the civil aviation accident investigation authority in your country:

1. Please choose your country from the list
2. Please specify your Organization:
  - a. Accident investigation authority
  - b. Civil aviation authority
  - c. Insurance company
  - d. Manufacturer
  - e. Operator
  - f. Air traffic control
  - g. Ground support
  - h. Airport operator/authority
  - i. Other
    1. Job title
    2. Email
    3. Contact number (optional)
3. Does your State have a permanent accident investigation authority/body/agency?
  - a. Yes
  - b. No
    1. When was it established  
(several options, less than 1 to more than 12 years)
4. The aircraft accident investigation authority in your State is:
  - a. Specific to aviation
  - b. Multimodal
  - c. Multisector
  - d. Don't know
  - e. Other
5. How many air accident investigators does the accident investigation agency in your State have?  
(Optional questions about the number of full- and part-time investigators)
6. Is the accident investigation authority physically separate from the Civil Aviation Authority (Regulator)?
  - a. No, they are located in the same building
  - b. Yes, they are separated in different buildings
  - c. Don't know

**7. Is the accident investigation authority separate from the operation authority/authorities (airport, air navigation, air traffic controller)?**

- a. They are currently in the process of being separated
- b. No, they are not separate
- c. Yes, they are separated
- d. Don't know

If yes, select all that apply:

- 1. Functionally separated (the accident investigation authority doing its own function only)
- 2. Structurally separated (they are not in the same organisational structure)
- 3. Physically separated (located in separate buildings)
- 4. Physically separated (located in the same building but different floors)
- 5. other

**8. Are there any employees from the industry (e.g. manufacturers, operators, or others) on loan or who work part-time for the accident investigation authority?**

- a. Yes
- b. No
- c. Don't know

Please specify which of the following employees currently work for the accident investigation authority (select all that apply):

- 1. Full-time employees that only work for the accident investigation authority
- 2. Part-time employees that only work for the accident investigation authority
- 3. Part-time employees work for the authority and others
- 4. On loan employees from the industry (part-time or full-time)
- 5. Other (specify)

**9. Who decides on the agency's internal organisation (# of staff, levels of employees, etc)?**

- a. The agency only
- b. Both the agency and government

- c. Government only
- d. Don't know
- e. Other (please state)

**10. Who is responsible for the agency's personnel policy (hiring/firing staff, deciding on its allocation and composition)?**

- a. The agency only
- b. Both the agency and government
- c. Government only
- d. Don't know
- e. Other (please state)

**11. Where do the agency's full-time safety investigators come from?**

**Please choose all that are applicable:**

- a. The industry (airlines, manufacturer, etc.)
- b. Regulator
- c. University graduates
- d. Experts from other countries
- e. ICAO
- f. Don't know
- g. Other (please state)

**12. Does the State have a law or regulation to prevent the use of safety findings in a judicial inquiry?**

- a. Yes
- b. No
- c. Don't know
- d. Other (please state)

**13. What is the head of the accident investigation agency's term in office?**

- a. Fixed term same as term of minister
- b. Fixed term greater than term of minister
- c. Fixed term less than term of minister
- d. Permanent appointment or term not specified
- e. Don't know
- f. Other (please state)

**If term not permanent, is the head of the accident investigation agency's appointment renewable?**

- a. Yes, once only
- b. Yes, several times
- c. No, not renewable
- d. Don't know
- e. Other

**14. Who appoints the head of the accident investigation agency?**

- a. Head of State (President/King/etc.)
- b. One or two ministers
- c. Members of safety board
- d. Mix of parliament and government
- e. Don't know
- f. Other (please state)

**15. To whom does the head of the accident investigation agency report?**

- a. Minister of Transportation or equal level
- b. Congress/Prime Minister or equal level
- c. Head of civil aviation authority
- d. Don't know
- e. Other (please state)

**16. Is the independence of the agency formally stated (in the regulations or legislation)?**

- a. Yes
- b. No
- c. Don't know
- d. Other (please state)

**17. Does the accident investigation authority in your State have a board?**

- a. Yes
- b. No
- c. Other

**If yes, please choose all applicable statements that describe the Board members:**

- a. Must be from different political parties
- b. Can be from the same political party
- c. Are appointed by Head of State
- d. Have office terms longer than the government (ministers)
- e. Have office terms same as or shorter than government (ministers)
- f. Their appointment is renewable more than once
- g. Their appointment is renewable once only
- h. Their appointment is not renewable
- i. Their appointment is permanent or there is no provision for office term
- j. At least some of the board members are chosen based on their expertise in aviation (regulation, investigation, etc.)

**18. Can Politicians (government) decide which accidents are investigated by the accident investigation authority?**

- a. Yes
- b. No
- c. Don't know
- d. Other (please state)

**19. Can Politicians (government) stop an ongoing investigation?**

- a. **Yes**
- b. **No**
- c. **Don't know**
- d. **Other**

**20. Does the accident investigation agency have flight recorder read-out facilities?**

- a. Yes
- b. No
- c. Don't know
- d. Other (please state)

**21. Does the agency have material failure analysis facilities?**

- a. Yes
- b. No
- c. Don't know
- d. Other (please state)

**22. Does the agency have a voluntary incident reporting system?**

- a. Yes
- b. No
- c. Don't know
- d. Other (please state)

**23. Does the agency have a safety database (reports, safety studies, recommendations, etc.)?**

- a. Yes
- b. No
- c. Don't know
- d. Other (please state)

**If yes, are the data in this database available to others (e.g. independent investigation bodies, research institutes, manufacturers, etc.)?**

- 1. Yes
- 2. No
- 3. Don't know
- 4. Other

**Who pays for data collection for the safety database?**

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**24. Does the agency's investigation authority require the approval of another government official, body or agency to release a report?**

- a. Yes
- b. No, no approval needed
- c. Don't know
- d. Other (please state)

**25. Can the agency launch investigations without prior permission from anybody outside the agency?**

- a. Yes, always
- b. Sometimes
- c. No, it needs a permission
- d. Don't know
- e. Other (please state)

**26. How do you know if the agency' investigations are perceived by the public as being credible and impartial?**

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**27. Do the agency' safety investigators have immediate and unrestricted access to all relevant evidence WITHOUT prior consent from judicial bodies or other authorities?**

- a. Yes, always
- b. Yes, most of the times but not always
- c. No, always need consent
- d. Don't know
- e. Other

**28. Where are the agency' accident investigation procedures specified? (select all that apply)**

- a. Annex 13
- b. National legislation
- c. Regulations
- d. Currently not specified anywhere
- e. Don't know
- f. Other

**29. In general, would you say that the salaries offered by the accident investigation agency in your State are:**

- a. The best in the aviation industry and very attractive to experts
- b. Around the average of the aviation industry
- c. Below the average salaries in the industry
- d. Don't know
- e. Other (please state)

**30. According to the regulations in your State, determination of causation is the:**

- a. "main" purpose of the investigation
- b. "sole" purpose of the investigation
- c. Don't know

d. Other (please state)

**31. Are potential plaintiffs (e.g. family representatives, claimants' representatives) allowed to participate in the investigation and have the same level of access as the potential defendants (e.g. air operator, manufacturer)?**

- a. Yes, always
- b. Allowed only on certain cases
- c. Plaintiffs are not allowed to participate
- d. Don't know
- e. Other

**32. Is it clearly stated in the regulations that the agency investigators are precluded from testifying in courts in litigation processes growing from the agency's investigation reports?**

- a. Yes, clearly stated
- b. No, not stated
- c. Don't know
- d. Other (please state)

**33. Is the acceptance rate for the safety recommendations of the accident investigation authority in your State measured?**

- a. Yes
- b. No
- c. Don't know
- d. Other

**What is the acceptance rate for the safety recommendations of the accident investigation authority in your State?**

- a. 90% or more
- b. 80% to 90%
- c. 60% to 80%
- d. 40% to 60%
- e. 20% to 40%
- f. 20% or below
- g. Don't know
- h. Other (please state)



**34. Please put an 'X' only in the scale against each statement to give your opinion:**

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
a. The agency has ready access to sufficient funds to properly investigate accidents and serious incidents that fall within its area of responsibility						
b. Funding for the agency's investigations is independent of political pressure						
c. Funding for the agency's investigations is independent of other influences						
(35.a) The greater the independence of the accident investigation agency, the greater the <b>credibility</b> of the agency						
(35.b) The greater the independence of the accident investigation agency, the greater the <b>quality</b> of the investigation						
(35.c) Without investigation independence, there is no investigation <b>quality</b> at all						

(35.d) Without investigation independence, the investigation <u>quality</u> is affected for sure						
(35.e) Investigation independence is a good thing, however, it is separate from the investigation <u>quality</u>						

**35. See above.**

**36. Is there a law in place which forces the accident investigation agency to release its documents to the public?**

- a. Yes
- b. No
- c. Don't know
- d. Other (please state)

**37. Does the regulation specify the types of accidents and incidents that the investigation agency must investigate?**

- a. Yes
- b. No
- c. Don't know

**38. Can the investigation agency decide to investigate occurrences that it is not obligated to investigate?**

- a. Yes
- b. No
- c. Don't know

**39. Who determines the scope of the investigation?**

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**40. Who determines the method of the investigation?**

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**41. Who has the first access to witnesses?**

- a. The agency's safety investigators **always** have first access to witnesses by State law
- b. The agency's safety investigators **usually** have first access to witnesses but not always
- c. The judicial (police) investigators **always** have first access to witnesses by State law
- d. The judicial (police) investigators **usually** have first access to witnesses but not always
- e. Don't know
- f. Other (please state):

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**42. Does your State have regulations to protect the confidentiality of the witnesses?**

- a. Yes
- b. No
- c. Don't know
- d. Other (please state):

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**43. In the event of an accident, who speaks to the media on behalf of the accident investigation agency?**

- a. A spokesperson who works for the agency and speaks on behalf of the agency only
- b. A spokesperson who works for another agency (e.g. the legislator, regulator, operator, or other) and speaks on behalf of both
- c. Don't know
- d. Other (please state)

**44. Who controls/reviews the accident investigation agency's budget?**

- a. The executive (government/ministers) alone
- b. The agency alone
- c. Both executive and agency
- d. Don't know
- e. Other (please state)

**45. What is the source(s) of the accident investigation agency's budget? (list all)**

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**46. Is the investigation agency dependent on financial support from outside the agency to conduct its investigations?**

- a. Yes, there is always a need for financial support from outside the agency (the budget does not cover investigations)
- b. Sometimes there is a need
- c. No, the agency has enough budget and does not use any outside financial support
- d. Don't know
- e. Other (please state):

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**47. Do you consider budgetary resources of the agency as:**

- a. Sufficient
- b. Insufficient
- c. Don't know
- d. Other (please state):

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**48. In your opinion, what factors influence the independence of the accident investigation agency/authority?**

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**49. With regard to the requirements for the independence of aircraft accident investigations, would you say that ICAO documents are:**

- a. Very clear
- b. Clear but could be improved
- c. Not clear
- d. Confusing
- e. Don't know
- f. Other

**50. If you have anything else you want to add that might benefit this research, please add it here:**

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**Thank you for taking the time to answer this questionnaire.**



## **Appendix D Results of Applying 4DMI Measuring Tool**

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Questions and replies pertaining to the four dimensions are gathered together in a single datasheet shown in Figure D-1. The datasheet also shows “Total Score” and “RANK” for each of the total 68 participations.

The datasheet shows five major columns in the first row:

1. **#** : is the sequence number of the question
2. **Question**: the text or abbreviation of the text of the question
3. **Possible Responses & Notes**: these are the options available for respondents to select from, or a note when the question is an open-ended question. It also contains notes about some of the answers from the “Other” option.
4. **Score**: shows the number of points rewarded for that answer
5. **ID numbers**: these are the unique ID numbers for each participant

The rows are divided into a question, possible answers, and the points awarded to each answer. Under the ID number columns (68 participants), the score is shown for each answer. For example, if the participant answered option (b) for a question and the score for that answer is (0), a “zero” will be shown in the cell where that participant’s ID number intercepts with the selected answer. If the score for that answer is (1), then a “one” will be shown, and so on.

The bottom four rows show the results for each participant:

- **Don’t Know or missing data**: The total number of Don’t Know (or missing) answers.
- **Don’t Know (or missing) %**: The percentage of the total number of Don’t Know or missing answers.
- **Total Score (sum of all points) %**: The percentage of the sum of all points from each answer.
- **RANK according to Total Score (1 is highest independence)**: Rank in comparison to the rest of the participants’ scores where 1 represents the best score.

Note the following:

- 1- Apart from the first question, each participant can score up to one point maximum per question. The first question has a weight of five points. The reason for this is explained in the discussion section.
- 2- Q32 “Does the agency have a Board” has a negative scoring scheme. All answers other than “yes” are given one point to make sure that no country is penalised for not having a Board because this is not a measure of independence in itself. If the participant answers “yes” then he is directed to answer the question about “Board Members”, which describes/measures their independence.

The above is to make sure that when the percentage of Total Score is calculated (dividing by the number of questions), participants who said they do not have a Board will not lose a full point because of this answer. At the same time, participants who said they do have a Board will get the correct score from describing the Board Members.

- 3- Q3 “Agency (generally) separated from operation authorities”: if a participant answers “yes” to this question, he is directed to give more details about this separation. The points are given based on his selection. This is why the score cell shows the word “*below*”.
- 4- Q15 “Agency’s investigation procedures specified in”: the \* beside the scores indicates that the participants can select more than one answer to this question. The participants who select any one of the answers that have a \*, or more than one of them, will be given one score only (1).  
Also, the “other” option in this question is divided into two scores: a score of (1) for answers that says EU Regulations, and a score of (0) for others. This is based on discussions with an expert in this field of aviation accident investigations. When the scoring technique was verified by this expert he explained that EU Regulation should have the same score as the score given for national regulation (1).



#	Question	Possible Responses & Notes	Score	710189	710190	710191	710192	710193	710194	710195	710196	710197	710198	710199	710200	710201	710202	710203	710204	710205	710206	710207	710208	710209	710210	710211	710212	710213	710214	710215	710216	710217	710218	710219	710220		
1	State has permanent sec. Inv. agency?	Yes No	5 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
2	Agency (physically) separate from regulator	Yes, different buildings No, same building Don't know	1 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3	Agency (generally) separated from operation authorities	Yes (see next question for scoring) No Don't know	below 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Specific separations from Operation authorities	Agency (functionally) separate from operation Agency (structurally) separate from operation Agency (physically different buildings) separate from operation Agency (physically same buildings different floors) separate from operation Other	0.33 0.33 0.33 0.34 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4	Internal organization decided by:	Agency only Both Agency & Gov Government only Don't know Other (no agency) (part of CAA)	1 0.5 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5	Personnel policy (hire, fire, etc) decided by:	Agency only Both Agency & Gov Government only Don't know Other (no agency) (part of CAA)	1 0.5 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6	Is there a Law or Reg to prevent use of safety findings in judicial inquiry?	Yes, there is No, there is not Don't know Other (poor provisions in aviation act)	1 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7	Who appoints head of Agency?	Head of State (King, President, etc) One of two ministers Members of Safety Board Mx of Parliament & Government Head of CAA Don't know Other (selected by interview?)	1 0.5 0.5 0.75 0 0 0	0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8	Whom he reports to?	Minister of Transport or equal level Congress/Prime Minister or equal level Head of CAA Don't know Other	1 0 0 0 0	0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9	Independence of Agency formally stated?	Yes No Don't know	1 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10	Can politicians decide which accident to investigate?	Yes No Don't know Other	1 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
11	Can politicians stop on-going investigation?	Yes No Don't know Other	1 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
12	Does the Agency require approval to release report?	Yes No, no approval needed Don't know Other	1 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
13	Can Agency launch investigation without prior permission?	Yes, always Sometimes No, it needs permission Don't know Other	1 0.5 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
14	Investigators have immediate/unrestricted access to evidence WITHOUT prior consent?	Yes, always Yes, most of the times but not always No, always need consent	1 0.5 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
15	Agency's investigation procedures specified in:	Annex 13 National legislation Regulations Currently not specified Don't know Other	1 1* 1* 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
16	Agency has ready access to sufficient funds for proper investigations (within responsibilities of agency)?	Agree or Strongly agree Disagree or Strongly disagree Neutral Don't know	1 0 0.5 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
17	Funding for Agency's investigation is:	Agree or Strongly agree Disagree or Strongly disagree Neutral Don't know	1 0 0.5 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
18	Independent of other influences?	Agree or Strongly agree Disagree or Strongly disagree Neutral Don't know	1 0 0.5 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
19	Is there a law in place forcing Agency to release documents to public?	Yes No Don't know Other	1 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20	Regs specify types of accidents & incidents that must be investigated?	Yes No Don't know	1 0 0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
21	Can Agency decide to investigate occurrences outside its mandate?	Yes No Don't know	1 0 0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22	Who determines the scope of investigation?	Agency, IC, Head of office, Board, commissioner CAA or Minister of Trans. Don't know Other	1 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
23	Who determines the method of investigation	Agency, IC, Head of office, Board, commissioner Other	1 0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	Who has 1 <sup>st</sup> access to witnesses?	Agency's investigators ALWAYS 1 <sup>st</sup> by State's law Agency's investigators USUALLY 1 <sup>st</sup> but not always Police ALWAYS 1 <sup>st</sup> by State's law Police USUALLY 1 <sup>st</sup> but not always Don't know Other (Whoever is first to)	1 0.5 0 0.25 0 0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
25	State has regulations to protect witnesses' confidentiality?	Yes No Don't know	1 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
26	Who speaks to media in behalf of Agency?	Spokesperson works for agency & speaks on its behalf only Spokesperson works for another agency and speaks on behalf of both Don't know Other (agency not interested to communicate with media/IC from CAA/Minister of DOT)	1 0 0 0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27	Who controls/reviews Agency's budget?	Executive (Gov/Minister) alone Agency alone Both Gov and Agency Don't know Other (no agency)	0.5 1 0.5 0 0	0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
28	Agency is dependent on outside support to conduct its investigations?	Yes, always (budget does not cover investigations) Sometimes there is a need No, Agency does not use outside support Don't know	0 0.5 1 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29	Budgetary resources of Agency considered:	Sufficient Insufficient Don't know Other (no special budgetary) No data provided	1 0 0 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
30	Are there employees (from industry) on loan or work part time for the Agency?	Yes No Don't know	1 0 0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
31	Head of Agency term in office?	Fixed term same as minister in Government Fixed term longer than minister in Gov Fixed term shorter than minister in Gov Permanent appointment OR not specified Don't know Other	0.5 0.75 0.25 1 0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

#	Question	Possible Responses & Notes	Score	7.101109	7.465330	7.510909	7.294276	7.561808	7.487142	7.427596	7.464492	7.629632	7.433848	7.964938	7.296091	7.296596	7.604499	7.488163	7.674693	7.210331	7.914248	7.510851	7.438681	7.487483	7.974388	7.429600	7.966644	7.299971	7.477610	7.338299	7.461422	7.117900	7.123504	7.424508	7.291172	7.601145	7.120166					
32	Does the agency have a Board?	Yes	below																																							
		No	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
		Don't know	1																																							
		Other	0																																							
	Board Members:	Must be from different political parties	0.2																																							0.2
		Can be from same political party	0																																							0.2
		Are appointed by Head of State	0.2																																							0.2
		Have office terms longer than government	0.2																																						0.2	
		Have office terms same as Government	0																																						0.2	
		Have office terms shorter than government	0																																						0.2	
Renewable > since	Renewable > since	0.2																																							0.2	
	Renewable once only	0																																							0.2	
	Not renewable	0																																							0.2	
	Permanent/no provision	0.2																																							0.2	
	At least some of members chosen based on expertise in aviation	0.2																																							0.2	
	0.2																																								0.2	
33	Does Agency have: Flight Recorder readout facilities?	Yes	1				1								1	1		1	1	1	1					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
		No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Other	0																																						0	
34	Material failure analysis facilities?	Yes	1								1			1				1	1	1	1					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
		No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Don't know	0																																						0	
35	Voluntary incident reporting system?	Yes	1						1				1					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
		No	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Don't know	0																																						0	
36	Safety Database?	Yes	1				1									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
		No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Don't know	0																																						0	
37	Is data in this Database available to others?	Yes	1															1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
		No	0																																						0	
		Don't know	0																																						0	
38	Who pays for data collection for Database?	Other (partially)	0.5																																					0.5		
		The Agency	1				1										1																							1		
		CAA	0																																						0	
39	How do you know if Agency's investigations are perceived by public as credible and impartial?	Government	0.5																																					0.5		
		Don't know	0																																						0	
		No data (missing)	0																																					0		
40	Salaries of investigators are	Open question	Feedback (1), Other (0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Best in industry/attractive	1														1																								1	
		Around average	0.5																																					0.5		
		Below average	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Don't know	0																																						0	
41	According to regulations in your State, determination of causation is:	Other (no permanent employees/Assigned person by DOT/same salary)	0																																					0		
		"main" purpose of investigations	0.5																																					0.5		
		"sole" purpose of investigations	1	1																																				1		
		Don't know	0																																					0		
42	Regulations clearly state that investigators are not to testify in courts...?	Other	0																																					0		
		Yes, clearly stated	1																																					1		
		No, not stated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
43	Agency recommendations acceptance rate measured?	Don't know	0																																					0		
		Yes	1																																					1		
		No	0	0	0	1																																		0		
Don't know or missing data				1	8	2	14	1	4	0	6	3	7	9	8	24	3	19	7	14	0	0	2	0	0	3	5	13	0	2	10	3	1	0	6	0	0					
Don't know (or missing) %				2.33%	18.60%	4.65%	32.50%	2.33%	9.30%	6.80%	13.95%	6.90%	16.20%	26.93%	18.60%	55.81%	6.90%	44.19%	16.20%	32.50%	8.00%	8.00%	4.65%	6.80%	6.80%	6.90%	11.63%	30.23%	8.00%	4.65%	23.30%	6.90%	2.33%	8.00%	13.95%	8.00%	8.00%					
Total (sum of all points)				15.96%	15.96%	26.60%	30.85%	31.91%	33.19%	33.51%	34.21%	40.94%	42.02%	42.89%	43.62%	46.81%	53.70%	55.66%	56.91%	57.51%	58.15%	59.00%	59.74%	60.64%	61.87%	62.74%	63.53%	63.81%	64.53%	65.43%	65.49%	65.91%	65.91%	67.19%	67.72%	67.72%	68.60%	68.91%				
RANK according to the above Total				68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35					



#	Question	Possible Responses & Notes	Score	7332290	7333337	7432785	7662236	7673785	7880841	7979530	7897238	7705647	7433590	7976290	746986	7432620	7716905	7301523	788128	7303662	7433772	7306605	7433742	7353645	7331355	7306887	7334963	7322770	7301038	7426589	7291872	7322640	7291614	7302183	7322636	7306290	7301258					
32	Does the agency have a Board?	Yes	below																																							
		No	1	1			1		1					1	1	1											1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
		Don't know	1																																							
		Other	1																																							
	Board Members:	Must be from different political parties	0.2																																							
		Can be from same political party	0																																							
		Are appointed by Head of State	0.2		0.2	0.2																																				
		Have office terms longer than government	0.2																																							
		Have office terms same as Government	0																																							
		Have office terms shorter than government	0																																							
Renewable - since	Renewable - since	0.2																																								
	Renewable once only	0																																								
	Not renewable	0																																								
	Permanent/no provision	0.2																																								
	At least some of members chosen based on expertise in aviation	0.2																																								
	33	Flight Recorder readout facilities?	Doz Agency Answer:																																							
Yes			1			1	1	1																																		
No			0	0	0																																					
Other			0																																							
34	Material failure analysis facilities?	Yes	1	1			1	1																																		
		No	0		0																																					
		Don't know	0																																							
		Other (partially)	0.5		0.5																																					
35	Voluntary incident reporting system?	Yes	1																																							
		No	0		1																																					
		Don't know	0																																							
		Other (CAA has compulsory/poorly managed/at State level/within airlines)	0	0		0																																				
36	Safety Database?	Yes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		No	0																																							
		Don't know	0																																							
		Other (partially)	0.5		0.5																																					
37	Is data in this Database available to others?	Yes	1	1																																						
		No	0																																							
		Don't know	0																																							
		Other (partially)	0.5		0.5																																					
38	Who pays for data collection for Database?	The Agency	1																																							
		CAA	0																																							
		Government	0.5																																							
		Don't know	0	0																																						
39	How do you know if Agency's investigations are perceived by public as credible and impartial?	Open question																																								
		Feedback (L), Other (R)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
40	Salaries of investigators are	Best in industry/attractive	1																																							
		Around average	0.5																																							
		Below average	0	0	0																																					
		Don't know	0																																							
		Other (no permanent employees/Assigned person by DOT/same salary)	0																																							
41	According to regulations in your State, determination of causation is:	"sole" purpose of investigations	0.5																																							
		"sole" purpose of investigations	1	1			1	1																																		
		Don't know	0																																							
		Other	0		0																																					
42	Regulations clearly state that investigators are not to testify in courts-?	Yes, clearly stated	1			1	1	1																																		
		No, not stated	0	0																																						
		Don't know	0																																							
43	Agency recommendations acceptance rate measured?	Yes	1																																							
		No	0	0																																						
		Don't know	0																																							
		Other	0																																							
Don't know or missing data				1	2	1	0	2	2	4	1	1	0	0	0	0	2	1	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	4	1	1	0			
Don't know (or missing) %				2.33%	4.67%	2.33%	0.00%	4.67%	4.67%	9.30%	2.33%	2.33%	0.00%	0.00%	0.00%	0.00%	4.67%	2.33%	0.00%	2.33%	0.00%	0.00%	0.00%	0.00%	0.00%	2.33%	0.00%	2.33%	0.00%	0.00%	0.00%	0.00%	0.00%	9.30%	2.33%	2.33%	0.00%					
Total (sum of all points)				69.6%	70.2%	70.6%	71.7%	72.2%	72.8%	72.8%	73.17%	73.81%	74.11%	74.11%	74.45%	74.53%	74.68%	74.85%	75.30%	75.38%	75.51%	75.62%	75.7%	75.7%	75.7%	77.83%	78.28%	78.36%	78.70%	78.70%	79.77%	79.77%	79.77%	81.89%	82.43%	84.55%	85.38%	87.74%				
RANK according to the above Total				34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1					

Figure D-1 Datasheet for 4DMI showing scores and RANKs (the figure is divided into four pages)

