Comparative Analysis of Aviation Safety Information Feedback Systems

by

Yoshifuru Funahashi

Bachelor of Engineering in Aeronautics and Astronautics
University of Tokyo (2002)
Master of Engineering in Aeronautics and Astronautics
University of Tokyo (2004)

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Author ....
Engineering Systems Division
May 7, 2010

Certified by ....
R. John Hansman, Jr.
Professor of Aeronautics and Astronautics and Engineering Systems Division
Thesis Supervisor

Accepted by ....
Dava Newman
Professor of Aeronautics and Astronautics and Engineering Systems Division
Director, Technology and Policy Program

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Abstract

In the aviation system, there are several feedback systems to prevent an accident. First of all, the accident and serious incident reporting and investigation system is established by the Chicago Convention.

In general, once an accident or a serious incident occurs, it must be reported to the Investigation Authority in the state where the event occurred. The Investigation Authority which receives the report conducts the investigation of the event. Then, based on the probable causes identified, the Investigation Authority issues the recommendations to the Civil Aviation Authority. Next, the Civil Aviation Authority which receives the recommendations takes corrective actions, including rulemaking, to prevent the recurrence of the event. This feedback system ensures that an accident with the same causes will not occur again.

The feedback system described above can be considered a reactive approach. There are also proactive feedback systems to prevent an accident.

In order to identify hazards that could potentially lead to an accident, the contracting states of the Convention have mandatory reporting systems for incidents. In addition, some contracting states even have voluntary reporting systems for safety-related occurrences not limited to formally defined incidents. If these feedback systems are utilized to the full extent, they could help in reducing the accident rate.

This thesis, aiming at offering insights for responsible authorities in contracting states of the Chicago Convention to improve their aviation safety information feedback systems, conducted a comparative analysis of the feedback systems in four contracting states of the Chicago Convention: the United States, the United Kingdom, Australia and Japan.

This thesis examined both mandatory reporting systems and voluntary reporting systems in each state. Furthermore, this thesis examined the rulemaking process in each Civil Aviation Authority as part of the feedback systems.

This thesis identified several differences in the feedback systems in the four states. In particular, this thesis identified a relatively larger number of differences in voluntary reporting systems than in mandatory reporting systems. On the other hand, as regards the rulemaking process, this thesis showed that there are no substantial differences.

Thesis Supervisor: R. John Hansman, Jr.
Title: Professor of Aeronautics and Astronautics and Engineering Systems Division

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Yoshifuru Funahashi

Cambridge, Masachusetts

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Acronyms and Abbreviations

AAI	Office of Accident Investigation
AAIB	Air Accidents Investigation Branch
AAIC	Aircraft Accidents Investigation Commission
AC	Advisory Circular
ADREP	Accident/Incident Data Reporting
AFS	Flight Standard Services
AGNA	Advisory Group of National Authorities
Airprox	Air Proximity Hazard
ALPA	Air Line Pilots Association
AMC	Acceptable Means of Compliance
A-NPA	Advanced Notice of Proposed Amendment
ANPRM	Advanced Notice of Proposed Rulemaking
APA	Administrative Procedure Act
ARM	Office of Rulemaking
ASAP	Aviation Safety Action Program
ASIAS	Aviation Safety Information Analysis and Sharing
ASI-NET	Aviation Safety Information Network
ASRS	Aviation Safety Reporting System, Aviation Self Reporting Scheme
ATC	Air Traffic Control
ATEC	Association of Air Transport Engineering and Research
ATSB	Australian Transport Safety Bureau
BASIS	British Airways Safety Information System
BCC	Business Cost Calculator
CAA	Civil Aviation Authority
CAAP	Civil Aviation Advisory Publication

CAO	Civil Aviation Order
CASA	Civil Aviation Safety Authority
CAR	Civil Aviation Regulations 1988
CASR	Civil Aviation Safety Regulations 1998
CFR	Code of Federal Regulations
CHIRP	Confidential Human Factors Incident Reporting Programme
CRD	Comment Response Document
CS	Certification Specifications
DOT	Department of Transportation
DP	Discussion Paper
EASA	European Aviation Safety Agency
ECCAIRS	European Coordination Centre for Accident and Incident Reporting Systems
ERC	Event Review Committee
FAA	Federal Aviation Administration
FDAU	Flight Data Acquisition Unit
FDR	Flight Data Recorder
FOIA	Freedom of Information Act
FOQA	Flight Operational Quality Assurance
FMT	FOQA Monitoring Team
FSDO	Flight Standards District Office
GDRAS	Ground Data Replay and Analysis System
GGM	Group General Manager
GM	Guidance Material
GPWS	Ground Proximity Warning System
I&O Plan	Implementation and Operations Plan
ICAO	International Civil Aviation Organization
IIC, IiC	Investigator-in-Charge

JAA	Joint Aviation Authorities
JAPA	Japan Aircraft Pilot Association
JAXA	Japan Aerospace Exploration Agency
JCAB	Civil Aviation Bureau of Japan
JTSB	Japan Transport Safety Board
LIA	Legislative Instrument Act
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
MOD	Ministry of Defense
MOR	Mandatory Occurrence Reporting Scheme
MOS	Manual of Standards
MOU	Memorandum of Understanding
NAA	National Aviation Authority
NASA	National Aeronautics and Space Administration
NFC	Notice of Final Change
NFRM	Notice of Final Rule Making
NPA	Notice of Proposed Amendment
NPC	Notice of Proposed Change
NPRM	Notice of Proposed Rule Making
NMAC	Near Midair Collision
NTSB	National Transportation Safety Board
OBPR	Office of Best Practice Regulation
OIRA	Office of Information and Regulatory Affairs
OLDP	Office of Legislative Drafting and Publishing
OMB	Office of Management and Budget
OST	Office of the Secretary of Transportation
QAR	Quick Access Recorder
RA	Resolution Advisory

RAP	Regulatory Advisory Panel
RFA	Regulatory Flexibility Analysis
RIA	Regulatory Impact Analysis, Regulatory Impact Assessment
RIS	Regulatory Impact Statement
SARPs	Standards and Recommended Practices
SCC	Standards Consultative Committee
SDR	Service Difficulty Reporting
SIDD	Safety Investigation and Data Department
SOR	Summary of Responses
SNPRM	Supplemental Notice of Proposed Rulemaking
SRG	Safety Regulation Group
SSCC	Safety Standards Consultative Committee
TCAS	Traffic Alert and Collision Avoidance System
THREAT	The High Risk Events Analysis Team
ToR	Terms of Reference
TSI Act	Transport Safety Investigation Act 2003
TWA	Trans World Airlines
UKAB	United Kingdom Airprox Board
U.S.C.	United States Code
VDRP	Voluntary Disclosure Reporting Program

In this thesis, "Part XX of Title YY of the Code of Federal Regulations" is abbreviated as "YY CFR Part XX" and "Section XX of Title YY of the Code of Federal Regulations" is abbreviated as "YY CFR XX." Similarly, "Section XX of Title YY of the United States Code" is abbreviated as "YY U.S.C. XX."

Chapter 1

Introduction

1.1 Introduction

Over the decades since 1960, the accident rate of commercial jet aircraft has decreased steadily. However, over the last 20 years, the accident rate has leveled out at about 1 accident per million departures. This is shown in Figure 1-1.

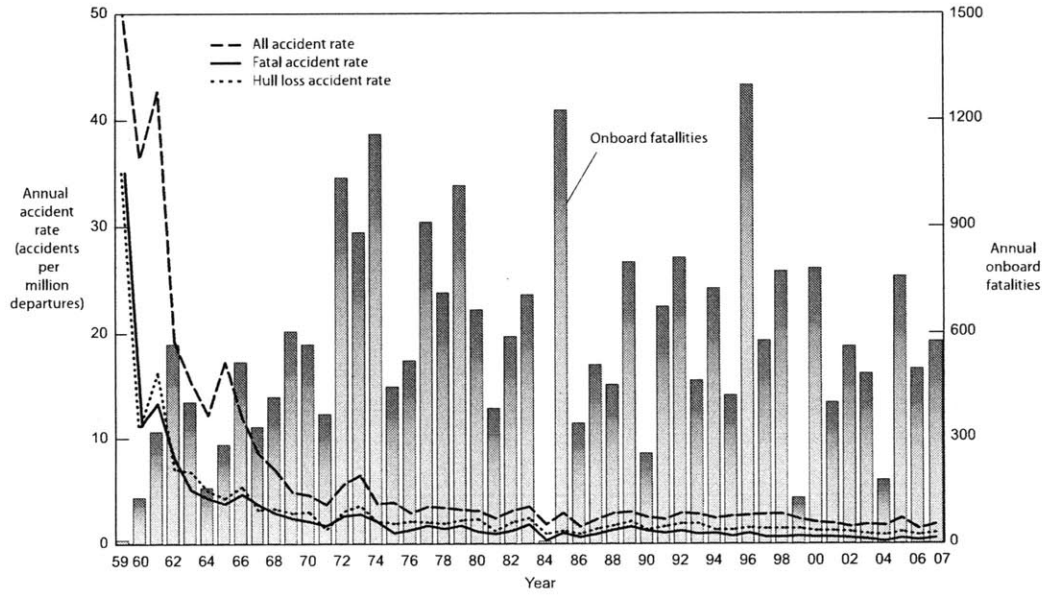


Figure 1-1: Accident rates and onboard fatalities of worldwide commercial jet fleet by year [19]

On the other hand, as shown in Figure 1-2, operations of commercial jet aircraft has

shown steady increase.

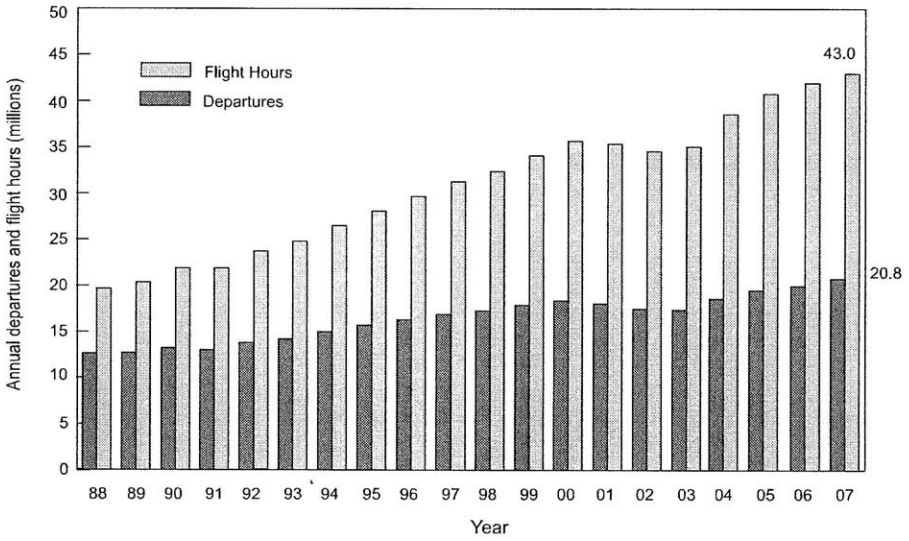


Figure 1-2: Worldwide operations of commercial jet fleet by year [19]

The demand of air transport is predicted to continue to grow. For example, Boeing forecasts that from 2008 to 2028 the average annual growth rate of airline traffic measured in Revenue Passenger-Kilometers (RPK)[a] is 4.9% [20]. Thus, without an improvement in the accident rate, the number of accidents will increase, and eventually, public confidence in air transport safety will be lost [26].

In the aviation system, there are several feedback systems developed to prevent accidents. Figure 1-3 shows the generic model of the safety feedback systems.

[a]The RPK is defined as the number of fare-paying passengers multiplied by the number of kilometers they fly.

[b]Management Organizations of voluntary reporting systems can be Investigation Authority or Civil Aviation Authority.

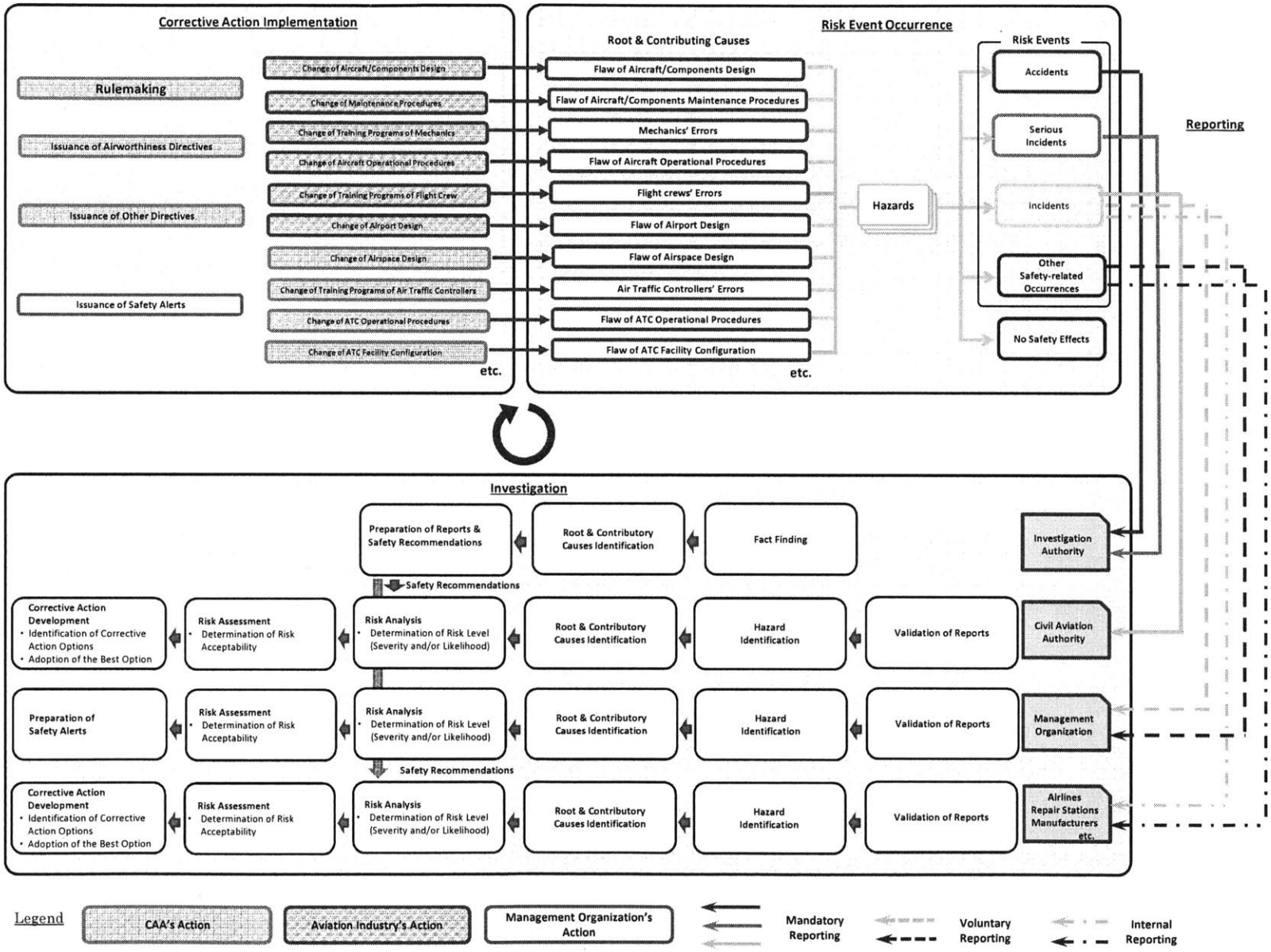


Figure 1-3: Generic Model of Aviation Safety Information Feedback Systems[b]

The large square in the top right of the figure shows how risk events occur. Following the common practice in the civil aviation [56], this thesis defines hazard as a set of conditions in the aviation system which could result in risk events. Hazards are created by one or several unsafe conditions, and the figure shows many of the initiating unsafe conditions as root causes and the unsafe conditions which follow the root causes as contributing causes.

Potential causes include: a flaw of aircraft or components design, a flaw of the maintenance procedures of aircraft or components, mechanic's errors, a flaw of operational procedures of aircraft, flight crews' errors, a flaw of airport design, a flaw of airspace design, Air Traffic Controller's errors, a flaw of operational procedures of Air Traffic Control (ATC), or a flaw of ATC facility configuration.

Hazards can result in the risk events with a certain likelihood with different levels of severity, and this thesis categorizes the risk events into accidents, serious incidents, incidents, and other safety-related occurrences. For example, International Civil Aviation Organization (ICAO) defines an incident as "an occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation." and defines a serious incidents as "an incident involving circumstances indicating that an accident nearly occurred." As will be discussed in subsequent chapters, accidents are also formally defined by ICAO and in the contracting states of the Chicago Convention. This thesis also categorizes the risk events which do not fall within the formally defined incidents as other safety-related occurrences. Hazards do not inevitably result in the risk events [56]. This is shown in the figure as "No safety effects."

The right side of the figure and the large square in the bottom of the figure show the systems in which how the risk events are reported and investigated. First of all, the accident and serious incident reporting and investigation system, which is established by the Convention on International Civil Aviation (also known as Chicago Convention), is shown in the first level of the large square in the bottom of the figure and the arrows which link the first level and the boxes of accidents and serious incidents.

In general, once an accident or a serious incident occurs, it must be reported to the Investigation Authority in the state where the event occurred. The Investigation Authority which receives the report conducts the investigation of the event.

The investigation starts with the fact finding. To find out what actually happened, for example, wreckages of the aircraft and traces on the ground are investigated, recording

devices such as the Cockpit Voice Recorder and Flight Data Recorder are analyzed, and survivors and eye-witnesses are interviewed. Based on the evidence acquired, the Investigation Authority identifies the root and contributing causes which led to the event. Then, the Investigation Authority issues safety recommendations to the Civil Aviation Authority (CAA).

Based on the safety recommendations, the CAA analyzes the risk. The CAA analyzes the likelihood that the same event will occur again in the future. Next, the CAA assesses the acceptability of the risk. If the risk is judged to be unacceptable, the CAA develops corrective actions to mitigate the hazard. The CAA identifies one or several corrective actions and adopts the best option among them, taking into account the technological feasibility and economic viability of such actions. These processes are shown in the left of the second level in the large square in the bottom of the figure.

The large square in the top left of the figure shows the corrective actions taken, responding to the unacceptable risk. The corrective actions which the CAA can take include the rulemaking and the issuance of Airworthiness Directives or other directives.

For example, if the causes of the risk event are a low design standard of the aircraft, the CAA develops a rule which sets the higher standard and requires aircraft manufacturers to modify the aircraft design to meed the new standard.

If the causes of the risk event are a flaw of design, maintenance procedures, or operational procedures, which is specific to the model of the aircraft involved, the CAA issues Airworthiness Directives which require airlines or aircraft manufacturers to modify the aircraft design or to change the maintenance procedures or operational procedures of the aircraft.

If the causes of the risk event are errors of flight crew or mechanics, the CAA issues other directives which require the airlines or repair stations to change their training programs of the flight crew or mechanics. In addition, if the causes of the risk event are a flaw of the airport design, the CAA issue other directives which require the owner or operator of the airport to change the airport design.

The CAA designs and designates the airspace and, in general, operates the Air Traffic Control service. Therefore, if the causes of the risk event are a flaw of the airspace design, the CAA changes the airspace design. Similarly, if the causes of the risk event are a flaw of operational procedures of Air Traffic Control or a flaw of Air Traffic Control configuration, the CAA changes them. In addition, if the causes of the risk event are errors of the Air

Traffic Controllers, the CAA changes their training programs of Air Traffic Controllers.

The Investigation Authority issues safety recommendations also to the organizations in aviation industry such as airlines, manufacturers of the aircraft, repair stations, and the owners or operators of the airports, if appropriate. The organizations which receive the safety recommendations from the Investigation Authority analyze and assess the risk, and if the risk is judged to be unacceptable, they develop and take corrective actions by themselves. For example, airlines change the operational procedures of the aircraft or their training programs of flight crew, manufacturers of the aircraft change the aircraft design, repair stations change the maintenance procedures of the aircraft or their training programs of mechanics, and the owners or operators of the airports change the airport design. This is shown in the left of the fourth level of the large square in the bottom of the figure.

This feedback system described above ensures that an accident or a serious incident with the same causes will not occur again. This feedback system is considered reactive approach. There are also proactive feedback systems to prevent an accident.

It is common that after an accident occurs, we find that we have missed a number of precursors that indicated the existence of hazard, and if we had recognized and appropriately managed the risk, we could have averted the accident. Recognizing and managing the risk before accidents actually occur offers an opportunity to improve safety.

In order to identify hazards that could potentially lead to an accident from these precursors, the CAA has a mandatory reporting and investigation system of incidents. This systems is shown in the second level of the large square in the bottom of the figure and the arrow which links the second level and the box of incidents.

In this system, incidents defined by regulations must be reported to the CAA. The CAA first validates the contents of the collected reports. Then, the CAAs identifies hazards which lead to the reported incidents, and then identifies the root and contributory causes of the identified hazards. Next, the CAA analyzes the level of the risk associated with the hazards. That is, the CAA analyzes the likelihood that the hazards can lead to the more severe risk events and their severities. Then, as described in the accident and serious incident reporting and investigation system, the CAA assesses the risk and develop corrective actions if the risk is judged to be unacceptable. Lastly, the CAA takes corrective actions.

Furthermore, some states even have voluntary reporting systems for incidents and other safety-related occurrences, in which persons involved in these kinds of risk events voluntarily

report them to the management organizations of voluntary reporting systems, be they government or non-government organizations. This systems is shown in the third level of the large square in the bottom of the figure and the arrows which link the third level and the boxes of incidents and other safety-related occurrences. As with the CAA, the management organizations of the voluntary reporting systems validate the collected reports, identify hazards and their root and contributory causes, and analyze and assess the risk.

However, the management organizations of the voluntary reporting systems, unless they are the CAA, have no authority to take corrective actions. Therefore, the the management organizations issue safety alerts to the relevant organizations, including the CAA, so that the relevant organizations can take corrective actions on a voluntary basis. These process taken by the management organizations of voluntary reporting systems are described in more detail in Chapter 2.

Lastly, some organizations in aviation industry, such as airlines, manufacturers of the aircraft and repair stations, have their own internal reporting systems. In particular, many airlines have such systems [68]. They collect reports of incidents and other safety-related occurrences from their employees, analyze the reports, and take corrective actions by themselves. This is shown in the fourth level of the large square in the bottom of the figure and the arrows which link the fourth level and the boxes of incidents and other safety-related occurrences.

If these kinds of feedback systems described above are utilized to the full extent, they could help in further reducing the accident rate.

1.2 Research Questions and Methodologies

As described above, the contracting states of the Chicago Convention have several feedback systems to prevent accidents. However, as far as the author knows, no previous research has been conducted which provides a comparative analysis of the feedback systems of the contracting states in a comprehensive manner.

Therefore, aiming at offering insights for responsible authorities in contracting states to improve their feedback systems, this thesis will examine the feedback systems established

in four contracting states, namely, the United States, the United Kingdom, Australia and Japan.

By conducting a comparative analysis of the feedback systems of these four contracting states, this thesis will try to answer the question whether there are any practices which should be learned by the responsible authorities in other contracting states.

This thesis will examine reporting and investigation systems in each state. More specifically, this thesis will examine mandatory reporting systems of the Investigation Authority and Civil Aviation Authority as well as voluntary reporting systems. Within these reporting systems, this thesis will examine how and what events are reported and how they are investigated and analyzed. Particularly, since the Chicago Convention leaves the establishment of voluntary reporting systems at contracting states' discretion, it is expected that there are a larger number of differences in voluntary reporting systems than in mandatory reporting systems among the four contracting states.

Furthermore, this thesis will examine how corrective actions are taken by the CAAs as part of the feedback systems. As mentioned in the previous section, the CAAs can take several kinds of corrective actions. However, this thesis will focus on rulemaking process among them because the rulemaking is considered to be the most significant and there exist common processes which the CAAs must follow for each rulemaking. In particular, this thesis will compare the two essential requirements in rulemaking: public consultation requirements and Regulatory Impact Analysis (RIA) requirements. Public consultation concerning proposed rules aims at ensuring transparency and fairness in rulemaking. It also aims at avoiding establishment of regulations that are inappropriate to the circumstances, poorly adhered to, or unnecessary [17]. On the other hand, by systematically assessing the potential impacts of new regulations, the RIA aims at improving the objectivity of the regulatory development process and at avoiding making rules which are too costly to comply with [81].

Resources utilized in this study will include the laws and regulations that define the systems and guidance materials issued or used by authorities in each contracting state.

1.3 Thesis Structure

Chapter 2 provides an overview of general characteristics of voluntary reporting systems. This chapter forms the basis for the discussion in subsequent chapters.

Chapter 3 gives a brief description of the International Civil Aviation Organization (ICAO), a specialized agency of the United Nations which adopts the international standards and recommended practices regarding civil aviation. Then, this chapter describes the international standards and recommended practices regarding reporting systems. Chapters 4 to 7 describe the aviation safety information feedback systems in each state. The structures of these chapters are as follows:

(1) Organizations

This section describes the Civil Aviation Authority (CAA) and the Investigation Authority. The CAA is responsible for implementing aeronautics law, which governs civil aviation activities within state's jurisdiction, whereas the Investigation Authority is responsible for accident and serious incident investigation. Although many contracting states delegate responsibility for accident and serious incident investigation to the CAA, this practice raises a potential conflict of interest whereby the investigators may be required to report on shortcomings in the state's safety oversight performance, and perhaps on even their own performance as regulators. Therefore, contracting states are increasingly creating the Investigation Authority independent of the CAA [68]. All of the four states studied in this thesis have an Investigation Authority which is independent of the CAA.

(2) Reporting and Investigation Systems

This section first describes mandatory reporting systems of the Investigation Authority and the Civil Aviation Authority. Then, this section describes voluntary reporting systems.

(3) Rulemaking Process

This section firstly describes a legal structure which governs civil aviation activities. Secondly, this section describes the persons responsible for rulemaking. Then, this section describes the public consultation requirements and Regulatory Impact Analysis (RIA) requirements which the CAA must follow in rulemaking. This section also

describes an annual regulatory plan, which some CAAs are required to make.

Next, Chapter 8 provides a comparative analysis of the feedback systems of the four states. Finally, Chapter 9 provides conclusions.

Chapter 2

Brief Overview of Voluntary Reporting Systems

As introduced in Chapter 1, the voluntary reporting systems aim at identifying hazards that could potentially lead to an accident from incidents and other safety-related occurrences, supplementing mandatory reporting systems.

This chapter first presents a conceptual model that helps in understanding the idea of voluntary reporting systems, and then describes the general characteristics of such systems.

2.1 Idea of Voluntary Reporting Systems

The modern aviation system is designed to ensure that no single machinery failure, operational error, or combination of a few of these failures and errors will not immediately result in an accident. It contains multiple layers of defenses and barriers to prevent an accident.

For example, as regards the design of aircraft, some system components may have one or a few identical or different components, which fulfill the same function as back-ups. Even when a redundancy breaks down, it is often designed to respond in a way that the failure will cause no harm, or at least a minimum of harm, to other systems. It may also issue an alert so that human operators can take recovery actions.

Reason, in his accident model, compared the layers of defenses to the layers of Swiss cheese slices with some holes [110].

In Figure 2-1, an initiating undesirable event may progress through one or two more layers of defense (through holes in the Swiss cheese slices), but usually another layer stops

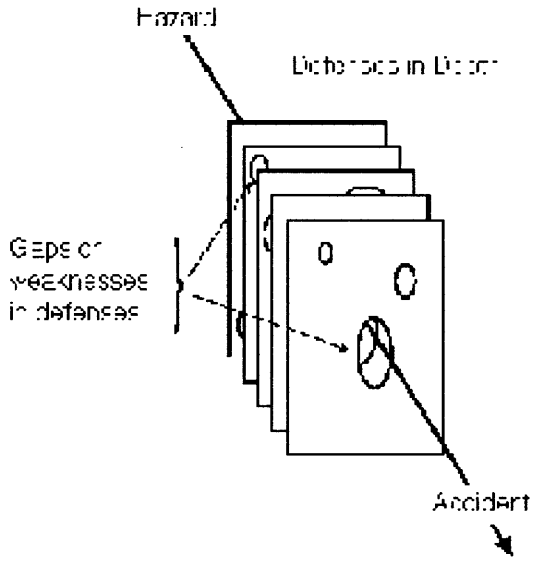


Figure 2-1: Reason's Swiss Cheese Model [56]

its progression. Accidents happen when all of these multiple layers of defenses break down (holes in all the Swiss cheese slices line up) in some way.

Following this model, incidents and other safety-related occurrences are a large number of outcomes of events which have had their progress toward accidents stopped by some layers of defense.

Heinrich, in his study of industrial accidents published in 1929, concluded that for every accident involving major injury, there were 29 accidents involving minor injury and 300 incidents involving no reportable injury. He also suggested that thousands of precursory occurrences were taking place as well [64]. This classic empirical law is commonly known as "Heinrich's Law," and often depicted as a pyramid as shown in Figure 2-2.

The idea of voluntary reporting systems is to collect reports of these abundant incidents or other safety-related occurrences and identify latent hazards, which could lead to an accident if undetected and thus uncorrected.

These hazards include, for example, poor equipment design, inappropriate operational instructions, ambiguously written maintenance procedures, and inadequate communications between management and line personnel [58].

Figure 2-2: Heinrich's Law (Adapted from [64])

2.2 Advantages of Voluntary Reporting Systems

Voluntary reporting systems have an advantage over mandatory reporting systems in that voluntary reporting systems are more likely to identify unknown hazards than mandatory reporting systems. The first reason for that is that, in voluntary reporting systems, the reportable occurrences are usually broadly defined and individuals are encouraged to report any occurrences which they perceive to have affected or could affect safety. On the other hand, in mandatory reporting systems, in general, the reportable occurrences are precisely defined. The broad definition of reportable occurrences in voluntary reporting systems enables the reporting of occurrences which cannot be captured by mandatory reporting systems [100].

The second reason is that, in voluntary reporting systems, reports usually describe not only what happened, but also the reason why a reporter believes the undesirable event happened. This is especially valuable in modern complex aviation systems, where human operators closely interact with machines as part of the system [102].

According to statistics compiled by the National Transportation Safety Board (NTSB) in the U.S., more than two-thirds of accidents involving Part 121 Operators are attributed to human error. This is shown in Figure 2-3.

Some sources of human errors contributing to the accidents can be further traced back, for example, to inadequate training or operating instructions. Understanding normal human

[a]Since each accident can have more than one cause identified, the sum of the causes exceeds 100%.

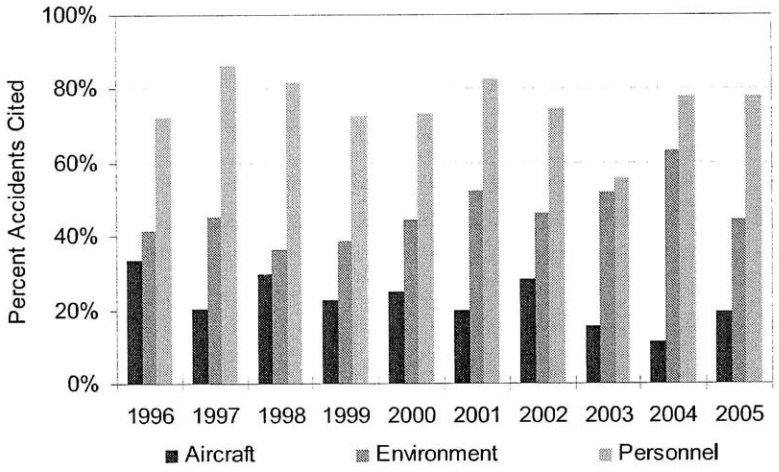


Figure 2-3: Broad causes/factors for accidents involving Part 121 Operators[a] [106]

performance capabilities, limitations, and behavior in the operational context is a key for accident prevention. The voluntary reporting systems afford valuable insights to understand these human factors in a system which are not available by other means [68].

2.3 Analysis of Reports

This section describes the way the reports that have been collected are analyzed and the risk associated with the identified hazard are analyzed and assessed, as commonly seen in many voluntary reporting systems.

Data validation

The analysis of reports starts with the validation of the contents of reports to the greatest extent possible. Thus, reporters may be contacted before there becomes no way to contact them.

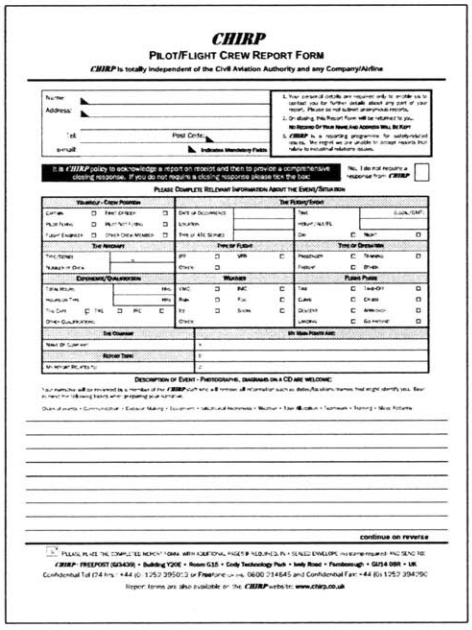
Furthermore, since voluntary reporting systems collect a wide range of incidents and other safety-related occurrences, it is also necessary to prioritize reports in order to identify reports that merit further analysis [101].

Identification of Hazards and their Root and Contributory Causes

The next step is the identification of hazards as well as the root and contributory causes which lead to them. Broadly speaking, there are two ways of analyzing reports to identify hazards. One way is a one-by-one analysis of reports, and another way is an analysis of aggregate data stored in the database.

To this end, reporting forms usually have two fields: a check form field which identifies the set of conditions in which the unsafe situation occurred, and a narrative field in which a reporter describes how and why the situation occurred.

The check form field aids in standardizing the data, whereas the narratives field aids in understanding the nature of hazards and human factors involved. After an analysis is conducted for each report, both the text narratives and the coded information are stored in the database to be used for later analyses. As an example, Figure 2-4 shows one of the report forms of CHIRP of the U.K.


CHIRP

PILOT/FLIGHT CREW REPORT FORM

CHIRP is totally independent of the Civil Aviation Authority and any Company/Airline

continue on reverse

Figure 2-4: CHIRP report form for pilot/flight crew

Care must be taken when conducting an analysis for hazard identification. First, since reports represent what reporters communicate they saw or experienced, subjectivity is inherent. For example, like pilots and air traffic controllers for a traffic conflict, different occupational groups see the same event differently, in terms of the interpretation of what

actually happened and the determination of what factors were important in the event. The reported facts are usually not investigated, and hence, the accuracy of the reported information is not fully verified.

Second, many factors can influence the decision to file a report, such as the lack of awareness of systems, the motivation to file a report, and the perceived severity of the event. Therefore, the number of reports describing similar events represent a portion of the total number of such events that could have been reported. Hence, fluctuations in the number of reports are not reliable indicators of changes in underlying safety conditions [43], [68], [100].

Risk Analysis

Once a hazard and its causes are identified, the next step is to analyze the risk associated with the hazard. One analytical tool which can be utilized for such an analysis is Probabilistic Risk Analysis (PRA) [101]. In the PRA, the risk has two characteristics: (1) the severity of adverse consequences and (2) the likelihood of occurrence of the adverse effects. The PRA identifies root causes which lead to the identified hazard and evaluates the risk associated with the hazard [97]. The analysis can be simple or complex, depending on the case [56].

There are several analytical methods used in the PRA, and the two most common methods are the Fault Tree Analysis (FTA) and the Event Tree Analysis (ETA) [97]. The FTA is used to model the possible ways in which an identified hazard could arise from causes in a system being studied, taking into account mitigations that could be used to prevent an occurrence of the hazard. On the other hand, the ETA is used to model the system state and the consequences of the hazard, taking into account mitigations that could be incorporated to break an accident sequence in the event the hazard occurs [56].

The approach to hazard analysis described above can be illustrated using a Bow-Tie Diagram. This diagram is useful in representing the link between causes, hazards, and consequences (effects). In Figure 2-5, the left-hand side of the diagram can be viewed as the FTA, while the right-hand side of the diagram can be viewed as the ETA [56].

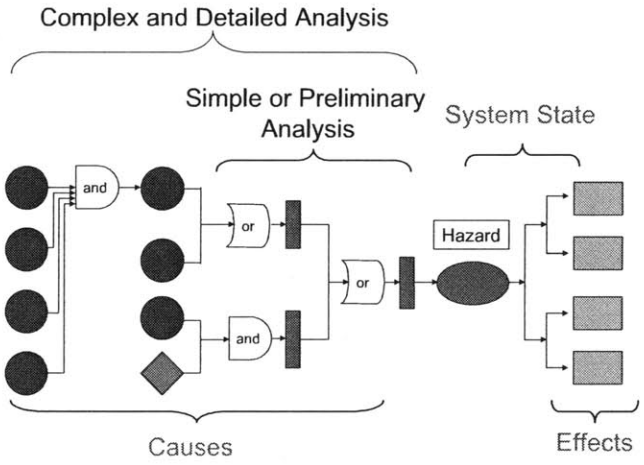


Figure 2-5: Bow-Tie Model [56]

Risk Assessment

After the risk is analyzed, it is compared to a risk acceptability matrix showing the likelihood versus severity of the risk. The likelihood and severity of the risk should be considered as those of the worst credible consequences from the hazard. Figure 2.3 shows an example of the risk acceptability matrix.

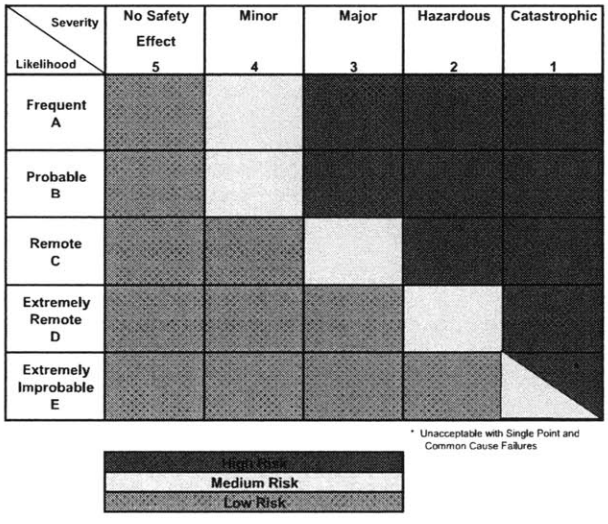


Figure 2-6: Risk Acceptability Matrix [56]

In Figure 2.3, "High Risk" is an unacceptable risk and corrective actions must be taken so that the risk is reduced to medium or low level. "Medium Risk" is an acceptable risk. Corrective actions do not have to be taken, but monitoring is needed. "Low Risk" is an acceptable risk without restriction [56].

2.4 Use of Information and Analytical Results

The management organizations of voluntary reporting systems use information and analytical results acquired by the system in several ways. The following are the ways as commonly seen in many voluntary reporting systems.

First, the management organizations issue safety alerts or recommendations to relevant organizations, including the Civil Aviation Authority, which can take a corrective action if they consider it necessary.

In some cases, the analysis of one report can trigger such an action. In other cases, the analysis of aggregate data can trigger such an action. As previously shown in Figure 1-3, the examples of these corrective actions include a change of aircraft or components design, a change of maintenance procedures and operational procedures, a change of training programs, and a change of Air Traffic Control facility configuration.

Second, the management organizations publish a safety bulletin which contains selected de-identified reports and suggestions to prevent a recurrence of the event. This allows individuals to learn from others' experiences.

2.5 Incentives for Reporting

In order to achieve the expected outcome, voluntary reporting systems need to collect a sufficiently large number of reports. However, there are several concerns among people that can deter reporting incidents or other safety-related occurrences which may involve their own errors.

Hart [63] summarized these concerns into four.

- Concern that the information may be used by a company management and/or regulatory authorities for punitive or enforcement purposes;
- Concern that the information may be used for a criminal prosecution;

- Concern that the information may be disseminated to the public or media; and
- Concern that the information may be used for a civil litigation.

Therefore, in order to address these concerns, voluntary reporting systems usually assure the confidentiality of the reporter. Furthermore, in order to encourage reporting, they usually afford immunity from enforcement actions by the Civil Aviation Authority against violations of regulations as an incentive as well. This will be further discussed in Chapter 8.

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Chapter 3

International Standards and Recommended Practices on Reporting and Investigation Systems

This chapter describes the international standards and recommended practices with regard to reporting and investigation systems. First, this chapter gives a brief description of the International Civil Aviation Organization (ICAO) and explains the Standards and Recommended Practices (SARPs) which ICAO adopts. Then, this chapter describes the SARPs with regard to reporting and investigation systems.

3.1 International Civil Aviation Organization (ICAO)

The International Civil Aviation Organization (ICAO) is a specialized agency of the United Nations headquartered in Montreal, Canada.

ICAO was founded in 1944 based on the Convention on International Civil Aviation (also known as Chicago Convention) signed by 52 member states in order to secure international cooperation in establishing uniformity in regulations and standards, procedures, and organization regarding civil aviation. As of 2009, the number of contracting states to the Convention is 190[66].

According to the Chicago Convention, the organization is made up of an Assembly, a Council and a Secretariat. The chief officers are the President of the Council and the Secretary General [66].

From a regulatory perspective, ICAO's role is to provide procedures and guidance for the safe conduct of international aircraft operations and to foster the planning and development of air transport. This is largely achieved by adopting and amending the Standards and Recommended Practices (SARPs) in accordance with Article 37, 54 and 90 of the Convention, which are designated as the Annexes to the Convention [68].

The SARPs cover all technical and operational aspects of international civil aviation, such as safety, personnel licensing, operation of aircraft, aerodromes, air traffic services, accident investigation, and the environment.

The uniform application by contracting states of the specifications contained in the Standards is recognized as necessary for the safety or regularity of international air navigation while the uniform application of the specifications in the Recommended Practices is regarded as desirable in the interest of safety, regularity or efficiency of the international navigation.

In the event of non-compliance with Standards, in accordance with Article 38 of the Chicago Convention, contracting states shall notify the Council of any differences. On the other hand, in the event of non-compliance with Recommended Practices, contracting states are invited to notify the Council of any differences. The differences to SARPs notified by contracting states are published in the Supplements to the Annexes [67].

3.2 ICAO SARPs on Reporting and Investigation Systems

3.2.1 Accident and Serious Incident Investigation System

Annex 13 to the Chicago Convention "Aircraft Accident and Incident Investigation" stipulates international requirements for accident and incident investigation and reporting. It defines the right and responsibilities of states such as the States of Occurrence, Registry, Operator, Design and Manufacture, the definitions of which are prescribed in the Annex.

To provide a guidance on accident and incident investigation and reporting, ICAO has published two materials, "Manual of Aircraft Accident and Incident Investigation" and "Accident/Incident Reporting Manual (ADREP Manual)."

Definitions

Annex 13 defines accident, incident, and serious incident as follows:

Accident. 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.

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

Serious Incident. An incident involving circumstances indicating that an accident nearly occurred.

Annex 13 also states that the difference between an accident and a serious incident lies only in the result, and it lists the examples of serious incidents as shown below.

Near collisions requiring an avoidance manoeuvre to avoid a collision or an unsafe situation or when an avoidance action would have been appropriate.

Controlled flight into terrain only marginally avoided.

Aborted take-offs on a closed or engaged runway.

Take-offs from a closed or engaged runway with marginal separation from obstacle(s).

Landings or attempted landings on a closed or engaged runway.

Gross failures to achieve predicted performance during take-off or initial climb.

Fires and smoke in the passenger compartment, in cargo compartments or engine fires, even though such fires were extinguished by the use of extinguishing agents.

Events requiring the emergency use of oxygen by the flight crew.

Aircraft structural failures or engine disintegrations not classified as an accident.

Multiple malfunctions of one or more aircraft systems seriously affecting the operation of the aircraft.

Flight crew incapacitation in flight.

Fuel quantity requiring the declaration of an emergency by the pilot.

Take-off or landing incidents. Incidents such as undershooting, overrunning or running off the side of runways.

System failures, weather phenomena, operations outside the approved flight envelope or other occurrences which could have caused difficulties controlling the aircraft.

Failures of more than one system in a redundancy system mandatory for flight guidance and navigation.

Annex 13 states that these incidents listed above are typical examples of incidents that are likely to be serious incidents, and the list is not exhaustive and only serves as guidance to the definition of serious incident.

Accident and Serious Incident Investigation

Annex 13 stipulates an accident investigation as a standard, whereas serious incident investigation as a recommended practice. The State of Occurrence has a primary responsibility for the investigation, yet it may delegate the whole or any part of the conducting of such investigation to another State.

Final Report

Annex 13 stipulates that the state conducted an accident or incident shall release the Final Report as soon as possible and if the accident or incident involved an aircraft of a maximum mass of over 5,700 kg, the state shall sent to ICAO a copy of the Final Report. In addition, the investigation authority of the state conducting the investigation shall make recommendations to the authorities such as civil aviation authorities and investigation authorities and to ICAO, when appropriate. A state that receives the safety recommendations shall inform the proposing State of the preventive action taken or under consideration, or the reasons why no action will be taken.

ADREP Reporting

ICAO operates a computerized database known as the Accident/Incident Data Reporting (ADREP) System, which facilitates the exchange of safety information among contracting states. Annex 13 stipulates that the State conducted an investigation of an accident involving an aircraft of maximum mass of over 2,250 kg or an investigation of an incident involving an aircraft of a maximum mass of over 5,700 kg, the state shall send the Data Report to ICAO.

3.2.2 Mandatory and Voluntary Incident Reporting Systems

As one of accident preventive measures, Annex 13 stipulates as a standard that contracting states shall establish a mandatory incident reporting system.

On the other hand, as regards the voluntary incident reporting system, Annex 13 leaves an establishment of such a system as a recommended practice. It also stipulates that, when contracting states establish a voluntary reporting system, it shall be non-punitive and afford protection to the sources of the information.

In addition, Annex 8 to the Chicago Convention "Airworthiness of Aircraft" stipulates the procedures for certification and continuing airworthiness of the aircraft.

Annex 8 stipulates that State of Registry shall ensure that, in respect of aeroplanes over 5,700 kg and helicopters over 3,175 kg maximum certificated take-off mass, there exists a system whereby information on faults, malfunctions, defects and other occurrences that cause or might cause adverse effects on the continuing airworthiness of the aircraft is transmitted to the organization responsible for the type design of that aircraft.

The Sate of Design must transmit to the State of Registry and other contracting states on request, any generally applicable information which it has found necessary for the continuing airworthiness of the aircraft, including its engines and propellers when applicable, and for the safe operation of the aircraft, and notification of the suspension or revocation of a Type Certificate. This information may take a form of Airworthiness Directive.

The State of Registry, upon receipt of the information from the State of Design, must adopt the information directly or assess the information and take corrective action.

Chapter 4

United States

4.1 Organizations

4.1.1 Civil Aviation Authority: Federal Aviation Administration (FAA)

The Federal Aviation Administration (FAA) is the organization responsible for the safety of civil aviation in the U.S.

From 1940 to 1958, two agencies within the Department of Commerce, the Civil Aeronautics Administration (CAA) and the Civil Aeronautics Board (CAB), regulated the civil aviation in the U.S. The CAA was responsible for air traffic control, airman and aircraft certification, safety enforcement, and airway development. The CAB was entrusted with safety rule-making, accident investigation, and economic regulation of the airlines. In 1958, Congress passed the Federal Aviation Act, which established a new independent agency under the name of the Federal Aviation Agency. The act transferred the functions of the CAA and safety rulemaking from the CAB to the agency. In 1966, the Congress authorized the creation of a cabinet department that would combine major Federal transportation responsibilities. In 1967, the Department of Transportation (DOT) began full operations. At the same time the Federal Aviation Agency became a part of the DOT and adopted its present name [35].

4.1.2 Investigation Authority: National Transportation Safety Board (NTSB)

The National Transportation Safety Board (NTSB) is an independent Federal agency, charged with investigating civil aviation accidents and serious incidents. It also conducts

investigation of marine accidents, railroad accidents, highway accidents, pipeline accidents, and hazardous material accidents.

The Board derives its authority from Title 49 of the United States Code (U.S.C.), and the rules of the Board are stipulated in Chapter VIII of Title 49 of the Code of Federal Regulations (CFR).

The NTSB was established by statute in 1967, taking over the accident investigation function from the CAB. Although independent, the NTSB relied on the DOT for funding and administrative support. In 1975, the NTSB was reestablished as an independent agency by the Independent Safety Board Act [108].

The Board consists of 5 Members appointed by the President with the advice and consent of the Senate. In the year 2007, the Board had 378 staff members [59].

4.2 Reporting and Investigation Systems

In the U.S., other than an accident and serious incident reporting and investigation system by the NTSB, the FAA has a mandatory incident reporting system. In addition, the FAA has a separate reporting and investigation system for Near Midair Collisions.

As regards the voluntary reporting systems, there are three systems: Aviation Safety Reporting System (ASRS), Aviation Safety Action Program (ASAP), and Voluntary Disclosure Reporting Program (VDRP). The ASAP is managed by NASA, and the ASAP and the VDRP are managed by the FAA. Lastly, Flight Operational Quality Assurance (FOQA) program is also discussed.

4.2.1 Accident and Serious Incident Reporting and Investigation System

Definitions

Section 830.2 of 49 CFR defines aircraft accident and incident as follows:

Aircraft accident means 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 and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.

Incident means an occurrence other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations.

Reporting Requirements to the NTSB

Section 830.5 of 49 CFR stipulates that the operator of aircraft shall immediately notify the NTSB when

(a) An aircraft accident or any of the following listed incidents occur:

(1) Flight control system malfunction or failure;

(2) Inability of any required flight crewmember to perform normal flight duties as a result of injury or illness;

(3) Failure of structural components of a turbine engine excluding compressor and turbine blades and vanes;

(4) In-flight fire; or

(5) Aircraft collide in flight.

(6) Damage to property, other than the aircraft, estimated to exceed $25,000 for repair (including materials and labor) or fair market value in the event of total loss, whichever is less.

(7) For large multiengine aircraft (more than 12,500 pounds maximum certificated takeoff weight):

(i) In-flight failure of electrical systems which requires the sustained use of an emergency bus powered by a back-up source such as a battery, auxiliary power unit, or air-driven generator to retain flight control or essential instruments;

(ii) In-flight failure of hydraulic systems that results in sustained reliance on the sole remaining hydraulic or mechanical system for movement of flight control surfaces;

(iii) Sustained loss of the power or thrust produced by two or more engines; and

(iv) An evacuation of an aircraft in which an emergency egress system is utilized.

(b) An aircraft is overdue and is believed to have been involved in an accident.

The operator of aircraft shall also file a report within 10 days after an accident, or after 7 days if an overdue aircraft is still missing. A report on an incident for which immediate notification is required shall be filed only as requested (Section 830.15). The NTSB notifies the FAA immediately when it receives notification of an aircraft accident or incident from a non-FAA source [53].

Categories of Investigation Level

The every NTSB accident or incident investigation falls within one of five categories below [96].

Major Investigation

This investigation usually entails an accident involving a commercial airliner or cargo aircraft. The headquarters of the NTSB in Washington D.C. dispatches a "Go Team" of investigators to investigate such an accident.

Major Investigation, regional office

This investigation is for a less serious accident in which significant safety issues have been identified. Some nonfatal airline accidents and most small commuter airline accidents fall into this category. The investigation is handled by one of the NTSB's six regional offices, at least at the outset.

Field Investigation

This investigation is for an airline accident or incident with no fatalities such as an incident involving air turbulence or a General Aviation accident. The investigation is conducted by the nearest regional office and at least one investigator goes to the site of the accident.

Limited Investigation

This investigation is conducted subsequent to an event involving General Aviation aircraft, and sometimes called a "desk investigation." This investigation is carried out by U.S. mail or over the telephone.

Delegated Investigation

This investigation is delegated to the FAA. Details are included in Subsection 4.2.1.

Delegation of Certain Accident Investigations to the FAA

Certain aviation accident investigations may be conducted by the FAA, pursuant to a "Request to the Secretary of the Department of Transportation to investigate Certain Aircraft Accidents" (Section 831.2). Based on the request, on behalf of the NTSB, the FAA investigates the facts, conditions, and circumstances surrounding the civil aircraft accidents involving rotorcraft, aerial application, amateur-built aircraft, restricted category aircraft, and fixed-wing aircraft which have a certificated maximum gross takeoff weight of 12,500 pounds or less with some exceptions.

After the investigation, the Secretary sends a report containing the identified facts, conditions, and circumstances surrounding an accident to the Board, from which the Board may determine the probable cause. The Board still assumes the full responsibility for the investigation of the accident. The request to the Secretary is due to the insufficient funds available to the Board to provide adequate facilities and personnel to investigate all accidents involving civil aircraft.

Party System

One of the characteristics of the NTSB investigation is its party system.

When the NTSB receives a notification of a major accident, the Director or Deputy Director of the Office of Aviation Safety (OAS), in consultation with the Chairman and/or Executive or Managing Director of the Board, decides whether to launch a "Go Team," which is comprised of three or four to more than a dozen NTSB investigators.

The NTSB designates the Investigator-in-Charge (IIC) for the Go Team from the Major Investigations Division (AS-10). The IIC organizes, conducts, controls, and manages the field phase of the investigation. Divisions of the OAS and the Office of Research and Engineering (ORE) provide specialists and laboratory support.

The IIC designates parties to participate in the investigation. By regulation, parties are limited to those persons, government agencies, companies, and associations whose employees functions, activities, or products were involved in the accident and who can provide suitable qualified technical personnel actively to assist in the investigation. The IIC typically confers party status to the operator, aircraft and component manufacturers, and labor organizations [93].

Except for the FAA, which is allowed to participate in every investigation by statute (49 U.S.C. 1132), party status is a privilege, and not a right [96]. In addition, any person who also represents claimants or insurers or those occupying a legal position may not participate in the investigation. Participants in the investigation must be responsive to the NTSB representatives (49 CFR 831.11).

The NTSB Go Team forms discipline-oriented working groups, led by the NTSB senior investigator as a group chairman, and overseen by the IIC. Party representatives are assigned to the appropriate working groups and help in developing the findings relevant to their areas of expertise. They are expected to remain with the investigation until it is completed or until released by the group chairman or the IIC [96].

The NTSB party system has both advantages and disadvantages. One advantage is that it allows the NTSB to utilize the party's technical expertise in aircraft design, airline operations, functioning of flight systems, and other domains, which would not otherwise be available. One disadvantage is that it presents inherent conflicts of interest for entities in an investigation that may be involved in related litigation.

In order to ensure that the parties conduct investigation solely for fact-finding purposes, the regulation stipulates that the participants may lose their status if they do not comply with their assigned duties and activity proscriptions or instructions, or if they conduct themselves in a manner prejudicial to the investigation. Furthermore, all party representatives other than the ones of the FAA are required to sign the "Statement of Party Representatives to NTSB Investigation," which states, "participation is not for the purposes of preparing for the litigation." (49 CFR 831.11)

Nevertheless, a full disclosure of relevant information by parties during major investigations to avoid liability has not always been assured. For example, a case was reported in which one party representative in the investigation of an accident attempted to remove parts from the wreckage reconstruction site. In addition, critics of the party system are pointing out the possibility of willfully providing misinformation by one party to thrust future liability to another party [96].

Investigative Priority

The NTSB provides for the participation by other Federal agencies in accident or incident investigation. However, any investigation conducted by the NTSB has priority over all other

investigations of such accident conducted by other Federal agencies. In addition, those participating agencies may not participate in the NTSB's determination of the probable cause of the accident or incident.

In cases of suspected criminal activity, the Federal Bureau of Investigation (FBI) may participate in the investigation. As the result of recent legislation, if the Attorney General, in consultation with the Chairman of the NTSB, determines and notifies the NTSB that the circumstances reasonably indicate that the accident may have been caused by an intentional criminal act, the NTSB will relinquish investigative priority to the FBI. The relinquishment of investigative priority by the NTSB must not otherwise affect the authority of the NTSB to continue its investigation (49 U.S.C 1131).

FAA Participation in the NTSB Accident Investigation

As mentioned above, by statute, the FAA has a right to participate in every accident investigation.

When an accident occurs, either the Flight Standards District Office (FSDO) with jurisdiction in the accident area or the Accident Investigation Division (AAI-100) at the Office of Accident Investigation (AAI) designates the IIC, who is responsible for the overall FAA investigation and is a principal contact for all aspects of the investigation. The "Go Team", a team of technical specialists, is also designated as necessary.

The FAA IIC will conduct an investigation of all accidents regardless of whether the NTSB conducts an on-scene investigation. In the absence of the NTSB, the FAA IIC has the same authority and responsibility as the NTSB.

In addition to assisting the NTSB to identify facts, conditions, and circumstances leading to an accident, the FAA will determine whether -

- Performance of FAA facilities or functions was a factor.
- Performance of non-FAA owned and operated ATC facilities or navigational aids was a factor.
- Airworthiness of FAA-certificated aircraft was a factor.
- Competency of FAA-certificated airmen, air agencies, commercial operators, or air carriers was involved.

- Federal Aviation Regulations were adequate.
- Airport certification safety standards or operations were involved.
- Airport security standards or operations were involved.
- Airman medical qualifications were involved.
- There was a violation of Federal Aviation Regulations [53].

The FAA has its own Safety Recommendation Program, under which the FAA inspectors can submit safety recommendations to the FAA headquarters based on the findings in the investigation.

When an FAA inspector finds the deficiencies of design, operation, or maintenance practices or of established standards, procedures, or policies as a result of the accident investigation, the FAA inspector, FAA manager, or any other FAA employees prepare a memorandum which includes a description of the accident and the deficient areas, followed by safety recommendations. If possible, the recommendation should specify how it will resolve the identified safety problem.

The memorandum is sent to the Recommendation and Analysis Division (AAI-200) at the AAI. AAI-200 reviews each recommendation and forwards the recommendation to the FAA action office, which must respond to the recommendation.

The FAA action office has 90 days to evaluate the recommendation and forward its response to AAI-200. The response must include one of the following elements:

- Reasons if the office rejects the recommendation.
- An implementation plan of corrective action and/or a description of corrective action which has been already done if the office accepts the recommendation.

A Safety Recommendation Review Board (SRRB) chaired by a representative of AAI-200 and composed of a minimum of two other technically qualified persons reviews all responses from the FAA action offices. Following the final decision of the SRRB, a memorandum accepting or rejecting the recommendation will be forwarded to the originator of the recommendation.

In addition, the FAA will take corrective actions. For example, the FAA suspends or revokes the certification when an investigation reveals actual or suspected deficiencies related to the competency of an FAA-certified airman [53].

Final Report and Safety Recommendations

After the accident investigation, the NTSB publishes a report. Specifically, the NTSB publishes a detailed narrative accident report in connection with the investigation into those accidents which the NTSB determines to warrant such a report. The report will set forth the facts, conditions and circumstances relating to the accident and the probable cause thereof, along with any appropriate recommendations (49 CFR 845.40).

When the NTSB submits a recommendation to the Secretary of Transportation, the Secretary gives a formal written response to each recommendation not later than 90 days after receiving the recommendation (49 U.S.C. 1135).

Such a response must indicate whether the Secretary intends -

(1) to carry out procedures to adopt the complete recommendation;

(2) to carry out procedures to adopt a part of the recommendation; or

(3) to refuse to carry out procedures to adopt the recommendation.

When the Secretary intends to carry out procedures to adopt the complete or a part of the recommendation, the response must include a copy of a proposed timetable for completing the procedures. When the Secretary intends to refuse to carry out procedures to adopt the complete recommendation or a part of it, the response must detail the reasons for the refusal.

Furthermore, each year, the Secretary is required to submit a report to Congress and to the NTSB describing the regulatory status of each recommendation that is on the most wanted list of the NTSB. The Secretary must continue to report on the regulatory status of each such recommendation in subsequent years until final regulatory action is taken on that recommendation, or until the Secretary or an Administration within the DOT determines and states in such a report that no action should be taken (49 U.S.C. 1135).

In the FAA, the AAI serves as the FAA's focal point for receiving, processing, managing, and tracking NTSB safety recommendations. The AAI assigns action to the appropriate

program offices having subject matter responsibility for the NTSB safety recommendations. Next, the program offices to which a safety recommendation action is assigned conduct a technical evaluation of each safety recommendation to determine the feasibility of implementing the recommendation or alternative actions needed to respond to the safety recommendation issue. Then, the offices prepare proposed responses to the safety recommendations and submit them to the AAI. The AAI reviews and evaluates the proposed responses submitted from program offices for adequacy, accuracy, and appropriateness in resolving the safety issues addressed, and prepares the FAA responses to the NTSB.

All NTSB safety recommendations are considered active and subject to priority attention until appropriate action has been completed and the safety recommendations have been classified as "closed" by the NTSB [50].

4.2.2 Incident Reporting and Investigation System

In the U.S., incidents such as runway incursions, emergency evacuations, and maneuvers by pilots due to an emergency and/or Traffic Alert and Collision Avoidance System (TCAS) Resolution Advisory (RA) that results in the loss of separation are reported by Air Traffic Control (ATC) facilities to the appropriate FAA offices such as the FSDO and the Washington Operations Center [53]. The incident investigation is usually conducted by the FSDO or the Flight Standard Services (AFS) [54].

The FAA has another incident reporting system called the Service Difficulty Reporting System. Service Difficulty Reporting System collects incidents which arise from a failure, malfunction, or defect of aircraft or its components.

Part 121, 125, and 135 of 14 CFR stipulate that aircraft operators certified under each part shall submit a report of an occurrence or a detection of a failure, malfunction, or defect to the FAA. Title 14 CFR Part 145 imposes the similar requirements on the repair station (refer to Appendix B, Section B.1, Subsection B.1.1).

Additionally, Part 21 of 14 CFR stipulates that the holder of a Type Certificate, a Supplemental Type Certificate, a Parts Manufacturer Approval, or a Technical Standard Order or licensee of a Type Certificate and a Supplemental Type Certificate shall report any failure, malfunction, or defect in any product, part, process, or article manufactured by it that has resulted in the occurrences listed in the regulation. It shall also report any defect in any product, part, or article manufactured by it that has left its quality control system

and that it determines could result in the regulation. (For the list of the occurrences, refer to Appendix B, Section B.1, Subsection B.1.1.)

The data derived from the reports are encoded and entered into the database at the Aviation Standards National Field Office. The SDR system is primarily used to detect short-term safety problems. The SDR system automatically tracks trends in reports according to aircraft and component type. If the monthly or annual trend in reports exceeds a preset value, then the system alerts the analysts at the office. The Airworthiness Directive or safety alerts are issued when the trend alert proves serious [127].

4.2.3 Near Midair Collision (NMAC) Reporting and Investigation System

The Near Midair Collision (NMAC) should be reported to the FAA, which has a separate reporting system for the NMAC. In the U.S., the NMAC is defined as "an incident associated with the operation of an aircraft in which a possibility of collision occurs as a result of proximity of less than 500 feet to another aircraft, or a report is received from a pilot or a flight crew member that a collision hazard existed between two or more aircraft" [40].

Under the system, pilots and/or flight crew are responsible for determining whether an NMAC actually occurred, and if so, should report the incident immediately to the nearest Air Carrier District Office (ACDO) or FSDO of the FAA. However, there is no regulatory or legal requirement that they report an NMAC, although they are encouraged to do so [46].

Investigation

All NMAC reports are throughly investigated by the FAA Flight Standards inspectors. In investigations, existing radar, communication, and weather data are examined in the conduct of the investigation. When possible, all flight crew members are interviewed regarding factors involving the NMAC. Air traffic controllers are also interviewed in cases where one or more of the involved aircraft was provided ATC service. Both flight and ATC procedures will be evaluated [40]. The investigation should be completed in 90 days [54]. The FAA inspectors determine the probable causes, classify the events, and create a final report and classify the degree of risk of NMAC into three categories, as shown in Table 4.1 [55].

Table 4.1: NMAC risk categories [55]

Category	Definition
Critical	A situation in which collision avoidance was due to chance rather than a pilot's act. Less than 100 feet of aircraft separation is considered critical.
Potential	A situation which would probably have resulted in a collision if no action had been taken by either pilot. Less than 500 feet of aircraft separation is usually required in this case.
No Hazard	A situation in which direction and altitude would have made a midair collision improbable regardless of evasive actions.

The number of NMACs reported to the FAA is shown in Figure 4-1. In particular, the number of NMACs involving Part 121 Operator which are reported to the FAA is shown in Figure 4-2.

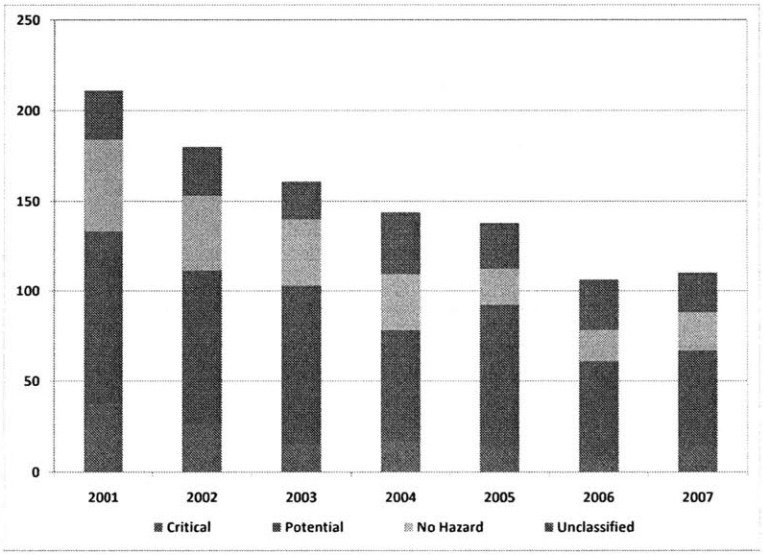

Figure 4-1: Number of NMACs reported to the FAA per year (*Data Source*: [22])

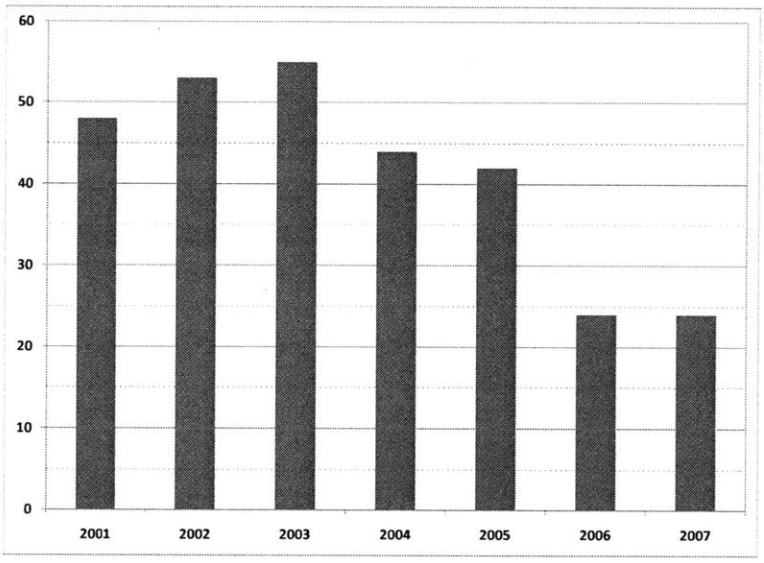

Figure 4-2: Number of NMACs involving Part 121 Operators which are reported to the FAA per year[b] (*Data Source*: [22])

After the investigation, the final reports are submitted to the FAA Headquarters, where they are compiled and analyzed, and the programs, policies, and procedures aiming at reducing the occurrences of NMACs are developed. Although the NMAC reporting is voluntary, when the investigation reveals a violation of regulations, enforcement action will be pursued [40].

4.2.4 Aviation Safety Reporting System (ASRS)

The Aviation Safety Reporting System (ASRS) is a voluntary, confidential and non-punitive reporting system.

The purposes of the ASRS are:

- Identify deficiencies and discrepancies in the National Aviation System.
- Support policy formulation and planning to improve the National Aviation System by providing data.
- Enhance the foundation of human factors research [103].

[b]No data is available on risk categories.

History

The ASRS was established in 1976 under a Memorandum of Agreement between the FAA and National Aeronautics and Space Administration (NASA) and was designed and developed by NASA.

The accident of the Trans World Airlines (TWA) Flight 514 in 1974 triggered the establishment of the ASRS. On December 1, 1974, the TWA Flight 514 was inbound through cloudy and turbulent skies to Dulles Airport in Washington, DC. It descended below the minimum safe altitude for the area it was flying through and collided with a Virginia mountain top. All passengers and the flight crew were killed.

The NTSB accident investigation revealed that the flight crew had misunderstood ATC approach instructions and descended prematurely to the final approach altitude, and they also misinterpreted an approach chart in the process.

During the investigation, another disturbing and provocative finding emerged: six weeks prior to the accident, a United Airlines flight crew had experienced a similar misunderstanding but had narrowly escaped the same fate during a nighttime approach at the same location. They discovered their mistake after landing. They reported the incident to their company's new internal reporting system, and a cautionary notice was issued to all United Airlines pilots about the potential hazard. Unfortunately, however, at the time there existed no methods to share this knowledge with other operators and the crew of the TWA 514 was unaware of the hazard. This case led to the determination that such safety information must be shared with the aviation community and an idea of a national aviation incident reporting system was born [102].

Management

The FAA recognizes that its regulatory and enforcement roles would discourage the aviation community from trusting and using the ASRS if the FAA were to operate the system. Therefore, although most of the funding for the ASRS is provided by the FAA, the ASRS is administered by NASA, which sets its policies independently. NASA, a research organization with no regulatory or enforcement role, is afforded an opportunity to enhance its research capability through access to the human factors data generated by the ASRS [102].

A NASA ASRS Advisory Subcommittee, composed of representatives from the aviation

community, including the Department of Defense, NASA, and the FAA, advises NASA on the conduct of the ASRS. The subcommittee conducts periodic meetings to evaluate and ensure the effectiveness of the reporting system [36].

In addition, to avoid conflicts of interest, ASRS analysts, researchers, and management personnel are not permitted to have ongoing employment relationships with the FAA, airlines, or similar organizations [92].

Reports

Pilots, flight engineers, air traffic controllers, cabin crew members, maintenance technicians, dispatchers, ground personnel, and others involved in aviation operations can submit reports to the ASRS.

Currently, the ASRS receives 3,300 reports per month on average, and the cumulative incident reports received so far have exceeded 700,000 since 1976 [103]. Figure 4-3 shows the number of reports submitted to the ASRS as well as its reporter distribution.

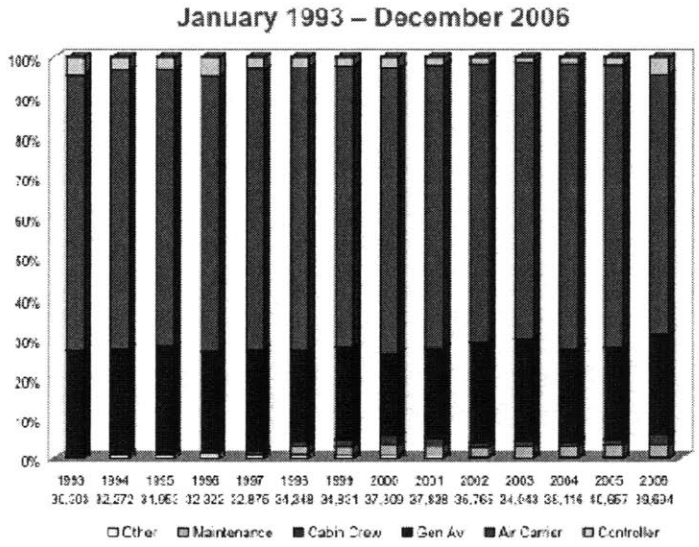

Figure 4-3: Number of reports submitted and reporter distribution of the ASRS [103]

Analysis

The ASRS Expert Analyst staff, composed of pilots, air traffic controllers, mechanics, researchers, system experts, and managers, identify any hazards in the reports and flag that

information for immediate action. A minimum of two analysts read each report received [103].

The Expert Analysts first classify reports by their safety significance. Potentially significant events are further classified as urgent situations that require immediate intervention or as events that warrant in-depth analysis.

These analysts identify accident precursors both by examining critical incidents in detail and by noticing patterns in the data. Further, after an aircraft accident, they routinely search the database for near accidents that occurred under similar conditions. After identifying a critical near accident, they scan the database to formulate hypothesis about potential accident precursors [100].

Confidentiality

Each report form has a tear-off portion which contains the information on the identity of a reporter. This identification strip section provides the staff with the means by which the reporter can be contacted, in case additional information is sought in order to understand completely the content of the report.

After the clarification of the content, the tear-off portion is removed and returned to the reporter. It will provide the reporter with proof of having filed a report on a specific incident or other safety-related occurrence.

Except in the case of reports describing accidents or criminal activities, no copy of an ASRS form's identification strip is created or retained for ASRS files. Prompt return of identification strips is a primary element of the ASRS's report de-identification process and ensures the reporter's anonymity [36].

Some reports are entered into the ASRS database together with the observations of the ASRS Expert Analyst staff. The reports that are entered into the database are less than 20 percent of the reports submitted because of resource constraints [42],[101].

Before the data is entered into the database, all information that might assist in establishing the identification of persons filing ASRS reports and parties named in those reports are deleted with the exception of reports containing information on accidents or criminal offenses. Even dates, times, and related information are either generalized or eliminated if they could be used to infer an identity. This de-identification is accomplished normally within 72 hours after NASA's receipt of the reports.

Furthermore, it is assured that the FAA will not seek, and NASA will not release or make available to the FAA, any report filed with NASA under the ASRS or any other information that might reveal the identity of any party involved in an occurrence or incident reported under the ASRS [36].

In this way, the ASRS protects the identities of the reporter and all other parties involved in an occurrence. To date, no reporter's identity has never been breached [92].

Immunity

Reports may include violations of the Federal Aviation Regulations. However, the FAA considers the filing of a report to be indicative of a constructive attitude and such an attitude will tend to prevent future violations; hence, the FAA provides limited immunity from regulatory enforcement action to reporters [36].

Section 91.25 of 14 CFR stipulates that the FAA shall not use reports submitted to NASA under the Aviation Safety Reporting Program, or information derived therefrom in any enforcement action except information concerning criminal offenses or accidents.

Here, any reports containing information regarding criminal offenses are forwarded to the FAA and the Department of Justice and any reports containing information regarding aviation accidents are forwarded to the NTSB [42].

FAA Advisory Circular AC No.00-46D [36] lays down other conditions to meet so that neither a civil penalty nor certificate suspension will be imposed although a finding of violation may be made.

These conditions are:

- The violation was inadvertent and not deliberate.
- A reporter filed a report within 10 days of incident.
- The action does not involve an action which discloses a lack of qualification or competency of the certificate holder.
- A person has not been found in any prior FAA enforcement action to have committed a violation of 49 U.S.C. Subtitle VII "Aviation Programs," or any regulation promulgated there for a period of five years prior to the date of occurrence.

Issuance of Alerting Messages

The ASRS has no direct operational authority of its own, hence, it issues alerting messages to the appropriate FAA offices or other aviation authorities so that they can evaluate the information and take needed corrective actions.

As a Federal agency, NASA is well positioned to disseminate safety alerts to key organizations and stakeholders throughout the national aviation system. The ASRS has issued more than 4,000 alerting messages since 1976. Alerting messages are issued on subjects that include airport facilities, airspace design, aircraft design, navigation aids, charting, procedures, and other conditions and situations that might compromise safe flight [102]. Table 4.2 shows the number of alerting messages issued by year.

Table 4.2: Number of alerting messages issued by year (*Data Source*: [25])

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average
-	154	250	282	213	214	304	208	192	342	239.9

Further, twice a month the ASRS has teleconferences with the FAA Office of Safety on the most important alerting items seen in its recent report flow [102].

Database Utilization

The public can directly access the database on-line and can download reports. In addition, on requests from individuals and organizations, including aircraft manufacturers, airlines and academies, who wish to acquire data on a particular subject, the ASRS will search its database, download relevant reports, and send them to the requester at no cost under the Freedom of Information Act (FOIA) provisions [102]. The ASRS has responded to over 7,000 Search Requests since 1976 [103].

In cases when government organizations such as the FAA, the NTSB, and the U.S. Congress need data for rulemaking, airspace design, accident investigation or other circumstances in a short time, the ASRS responds to the requests in "Quick Response". The ASRS analyzes relevant incident data and provides a data synopsis within a brief period (1 to 2 weeks) [102].

The ASRS also conducts research. Research agendas are developed in collaboration with government and industry safety organizations. As of the end of 2009, the ASRS had

published 63 research studies, most of which examined human performance issues in real world operations.

Publication of Safety Bulletins

The ASRS publishes a monthly safety bulletin named "CALLBACK" and a safety journal named "ASRS Directline."

The purpose of CALLBACK is to educate a broad aviation audience in safety issues. In addition to excerpts from ASRS incident reports with supporting commentaries, it contains occasional summaries of ASRS research efforts and related aviation safety information. The CALLBACK is distributed throughout the U.S. and to the international community.

The ASRS Directline is published to meet the needs of the operators and flight crews of airlines. Articles focus on subjects of special interest to the group, such as pilot-ATC issues, factors associated with altitude deviations, confusing call sign problems, and other issues deemed important by the ASRS analysts. Its distribution is directed to operational managers, safety officers, training organizations, and publications departments [102].

4.2.5 Aviation Safety Action Program (ASAP)

The Aviation Safety Action Program (ASAP) is a voluntary reporting system jointly established by the FAA and the aviation industry. The objective of the ASAP is to encourage employees of the airlines authorized to operate under 14 CFR Part 121 and employees of the repair stations which hold certificates under 14 CFR Part 145 to voluntarily report safety issues to company management and to the FAA for resolution. Enforcement-related incentives have been designed into the program so that the employees are willing to report safety issues without fear that the FAA will use reports accepted under the program to take a legal enforcement action against them, or that companies will use such information to take a disciplinary action [37].

History

The first ASAP began in 1994 when representatives of the Southwest Region of the FAA Flight Standards Division joined the pilots' association and management of American Airlines to promote the confidential disclosure and correction of potentially dangerous conditions [60],[100].

Over the past several years, the number of ASAP programs has increased steadily. In 2000, to encourage wider participation in the ASAP, President Clinton announced that ASAP would be a part of a national effort to reduce aviation accidents [101]. Currently, 73 operators have 169 programs covering pilots, mechanics, cabin crew members, and dispatchers [44]. Additionally, ground service personnel, air traffic controllers, and Technical Operations (FAA-Air Traffic Organization) personnel may be included in the future [41].

Establishment of a Program

The ASAP program is based on a safety partnership that includes the FAA, a certificate holder, and usually a third party representing employees, such as labor organization. Participation from various employee groups, such as pilots, mechanics, cabin crew members, and dispatchers is encouraged under the program [37]. Although the ASAP is company-oriented, the programs must adhere to federal guidelines.

In order to establish an ASAP program, a certificate holder should develop a Memorandum of Understanding (MOU) including the certificate holder, applicable employee unions, and the FAA, which outlines the program's purpose, terms, administrative procedures, and reporting process. The employee unions can be a union of pilots, mechanics, cabin crew members, and dispatchers; most of the current MOUs for ASAP are established with a union of pilots [45].

The FAA Certificate Holding District Office (CHDO) and the certificate holder jointly review the MOU to ensure that it satisfies FAA guidelines before it is signed by all parties. The CHDO manager, with the authorization of the Director of Flight Standards Service (AFS-1), signs the MOU on behalf of the FAA.

Certificate holders must initially develop a separate demonstration program for each employee group. Its objective is to measure its effectiveness and ensure that it meets the safety objective of the specific ASAP. The duration of the initial demonstration program should be no longer than 18 months. At the conclusion of the initial demonstration program, all parties review the program. After a demonstration program is reviewed and determined to be successful by the parties to the agreement, it may be accepted as a continuing program, subject to review and renewal every two years by the FAA. The Director of AFS-1 authorizes the final acceptance of a program. Renewals of continuing programs may be accomplished by the CHDO manager [37].

It should be noted that most ASAP MOUs include provisions for submitting events reported under the ASAP to the ASRS. This is partly because the ASRS can provide a reporter with eligibility for a waiver of the imposition of sanctions from FAA enforcement action in the event that a report is excluded from the ASAP program [51]. In fact, at least 60 percent of ASRS reports received from airline employees are ASAP reports [45].

In the FAA, the Voluntary Safety Programs Branch (AFS-230) at the Headquarters manages the ASAP. (The branch also manages the Voluntary Disclosure Reporting Program (VDRP) and the Flight Operational Quality Assurance (FOQA) program, which will be discussed in the subsequent sections.) The branch reviews program implementation and collects data and feedback from ASAP participants.

Analysis

Under the ASAP, employees report safety violations to the certificate holder's ASAP manager, who then forwards the report to the Event Review Committee (ERC). The ERC is comprised of representatives from each party to the MOU. Usually a representative from the FAA is a specifically qualified FAA inspector from the CHDO.

The ERC reviews and analyzes the submitted reports and determines whether they are accepted into the ASAP. The ERC recommends any needed corrective actions for actual or potential problems identified in the analysis. The ERC also works with the certificate holder to develop appropriate corrective actions and conducts follow-up assessment to determine whether they have been satisfactorily implemented. Here, corrective action may involve joint or individual action by the parties to the ASAP MOU [37], [101].

There are some requirements regarding the ERC decision. When deciding whether a report is accepted into the program and when deciding on corrective action recommendations including any FAA administrative action, the ERC must reach a consensus of all representatives. Further, the FAA requires certificate holders to complete corrective actions that are acceptable to all members of the ERC to resolve any safety deficiencies. Otherwise, the FAA can terminate the participant's ASAP [37].

Confidentiality

Although under the ASRS, all information that can be used to derive the identity of the reporter is removed from a report before it is entered into the database, only the employee's

name is redacted from a report entered into a database under the ASAP. One of the reason is that the ASAP values the capacity to retain more specific information on individual events for better analysis of the event. Another reason is that under ASAP an employee must complete the corrective action to the satisfaction of all members of the ERC if the ERC determines that the corrective action is required to resolve a safety issue [51].

A significant impediment to the sharing of ASAP information with the FAA is an aviation industry's concern over public disclosure of the information, and, if disclosed, the potential for it to be used for purposes other than safety enhancement [51].

Therefore, at present, all ASAP data reside in computers at certificate holders' offices and the FAA cannot directly access the database [45], [51].

In order to address the concern and encourage persons to provide the information to the FAA, the information received from ASAP is protected from public disclosure.

Section 40123 of 49 U.S.C. stipulates that voluntarily-provided safety and security related information is protected from disclosure if (1) the disclosure of the information would inhibit the voluntary provision of that type of information and that the receipt of that type of information aids in fulfilling the FAA's safety and security responsibilities; and (2) withholding such information from disclosure would be consistent with the FAA's safety and security responsibilities.

The section also stipulates that the FAA shall issue regulations to carry out the section, and Part 193 of 14 CFR is the regulation which carries out the section.

Part 193 of 14 CFR stipulates that if the FAA issues an order designating information as protected under 49 U.S.C. 40123, that information will not be disclosed under the Freedom of Information Act (5 U.S.C. 552) or other laws, except as provided in Part 193 of 14 CFR and in the order designating the information as protected.

The FAA has determined that without the disclosure protections, certificate holders will not voluntarily release ASAP information from their premises to the FAA. Therefore, by FAA Order 8000.82, the FAA designated the ASAP information as protected in accordance with the provisions of 14 CFR Part 193. The FAA Order is also applicable to any other government agencies that receive such information from the FAA.

By this order, much of the information acquired from the ASAP is protected, for example, the name of the reporter, the identity of the certificate holder, and the statistical analysis and trend information. In cases when the disclosure is necessary such as when the

FAA has to explain the need for changes in FAA policies, procedures, and regulations or has to advise other people of the problem to take corrective actions, the FAA may disclose de-identified (no operator or employee identity), summarized information derived from the ASAP. The FAA may release the name of an airline or repair station that has an ASAP that has been accepted by the FAA [51].

Immunity

Under the ASAP, safety issues are resolved through corrective actions rather than through punishment or discipline. To encourage employees to voluntarily report safety issues even though they may involve an alleged violation of 14 CFR, enforcement-related incentives have been designed into the program. The program assures that lesser enforcement action will be used to address certain alleged violations of the regulation [37].

FAA Advisory Circular AC 120-66B states that the following criteria must be met in order for a report involving a possible violation to be covered under ASAP [37].

(1) The employee must submit a report in a timely manner. In order to be considered timely, a report must be submitted either within a time period following the event that is defined in the MOU, such as within 24 hours of the end of the duty day in which the event occurred, or within 24 hours of the employee's having become aware of possible noncompliance with 14 CFR.

(2) The alleged regulatory violation must be inadvertent, and must not appear to involve an intentional disregard for safety.

(3) The reported event must not appear to involve criminal activity, substance abuse, controlled substances, alcohol, or intentional falsification.

Sole source reports are the reports which first identified or described all evidence of the event available to the FAA or the certificate holder. Sole-source reports that meet the second and the third acceptance criteria will be accepted even if they are not submitted in a timely manner [37]. Unlike the ASRS, the ASAP currently accepts reports related to accidents [45].

The reported events that are excluded from the ASAP will be referred to the FAA for possible enforcement action and/or re-examination under Subtitle VII "Aviation Programs"

of 49 U.S.C. Furthermore, the FAA may refer reports that appear to involve possible criminal activity, substance abuse, controlled substances, alcohol, or intentional falsification to law enforcement agencies, if applicable [37].

Employees submitting reports that are accepted may be subject to the FAA administrative actions and the certificate holder's corrective actions depending on whether all evidence of the event available to the FAA outside of ASAP are discovered by or otherwise described on the reports (Sole source reports) or the information about the event in question is known by individuals other than just the ASAP reporter (Non-sole source reports), as shown below [37],[45],[70].

Sole source reports:

These reports will be closed by the FAA without administrative action. Similarly, the certificate holder may not use the information obtained in this way to initiate disciplinary action against the employee.

Non-sole source reports:

When there is sufficient evidence to support a violation of 14 CFR, these reports will be closed by the FAA with administrative action. There are two types of administrative actions: Warning Notice or a Letter of Correction. Both of them are expunged from the FAA files after two years. When there is not sufficient evidence, these reports are closed with a FAA Letter of No Action, which is expunged from the FAA files after 30 days.

Although the certificate holders may not use information obtained through the ASAP report to take disciplinary actions against an employee, they may require corrective actions including additional training for employees who the reports demonstrate lack qualification.

The ERC representative from the FAA CHDO is empowered to complete ASAP investigations and is responsible for coordinating all corrective and administrative actions [37]. Since the ERC members have the authority to pardon violations of 14 CFR, the impartiality of the ERC members must be ensured [45].

Publication of Safety Bulletins

Depending on the program, the ERC publishes newsletters or safety bulletins to participating employee groups. Unlike the ASRS, under the ASAP, the direct access to the database is unavailable for the public.

Compilation of Data

At present, the FAA does not receive and does not anticipate receiving ASAP reports for retention in the files or database of the FAA [51]. The FAA only has access to the ASAP reports on a periodic basis during the ERC meetings.

Based on the information acquired from the ERC meetings, the CHDOs compile quarterly reports of safety enhancements achieved by ASAP program of each certificate holder and submit them to the Voluntary Safety Programs Branch at the Headquarters. The branch is supposed to determine whether the program is achieving safety objectives. However, it has been pointed out that these quarterly reports do not provide sufficient details about events or corrective actions. Furthermore, the FAA has not yet developed a database or a method to identify safety trends at the national level.

The FAA is missing an opportunity to make use of these data for policy development or to disseminate the collective data to FAA inspectors and other participants [45].

4.2.6 Voluntary Disclosure Reporting Program (VDRP)

While the ASRS and the ASAP are aimed at employees, the Voluntary Disclosure Reporting Program (VDRP), established in 1990, is a voluntary reporting system which is mainly aimed at organizations (companies' management) [61].

By forgoing civil penalty, the VDRP provides incentives for airlines, repair stations, qualified fractional ownership programs, Production Approval Holders (PAHs), or other eligible FAA-regulated entities (hereafter referred to as regulated entities) to voluntarily identify, report, and correct instances of regulatory noncompliance. The FAA issues a letter of correction to the regulated entities in lieu of civil penalty for covered instances of noncompliance that are voluntarily disclosed to the FAA.

Because the VDRP identifies and corrects instances of regulatory noncompliance of which the FAA may be otherwise unaware, the program offers a potential for enhancement

of safety. Receipt of this otherwise unavailable information would also provide the FAA with an improved basis for modifying procedures, policies, and regulations to improve safety and efficiency. Unlike the ASRS and the ASAP, the VDRP does not apply to violations by individuals with a few exceptions [39].

Acceptance Criteria

The FAA accepts the voluntary disclosure when all of the following criteria are met:

- The regulated entity has notified the FAA of the apparent violation immediately after detecting it and before the agency learned of it by other means.
- The apparent violation is inadvertent.
- The apparent violation does not indicate a lack, or reasonable question, of qualification of the regulated entities.
- Immediate action, satisfactory to the FAA, was taken upon discovery to terminate the conduct that resulted in the apparent violation.
- The regulated entity has developed or is developing a comprehensive fix and schedule of implementation that is satisfactory to the FAA. The fix must include a follow-up self-audit, in addition to any FAA audits.

The FAA ordinarily does not forgo legal enforcement action if the regulated entity informs the FAA of the apparent violation during, or in anticipation of, an FAA investigation/inspection or in association with an accident or incident.

There are two exceptional cases to the above in which a voluntary disclosure can still be accepted [39].

- The FAA has already learned of the violation from an ASAP report.
- The violation is discovered during a joint audit (inspection) between the regulated entities and the FAA, to which the regulated entities voluntarily agreed.

Relationship with the ASAP

The ASAP provides protection to the employees whereas the VDRP provides protection to the companies' management. In some cases, an ASAP report triggers a VDRP report by

a company's management. As described above, the VDRP report can still be accepted by the FAA, even though the FAA has already learned of the violation from the ASAP report.

In other cases, an VDRP report triggers an ASAP report by an employee. If a company files a report under the VDRP that identifies a possible regulatory violation by its employee, the employee may receive a Letter of Investigation from the FAA. Therefore, it is advisable for the company's management to notify and encourage the employee to submit an ASAP report. If the employee files an ASAP report within the prescribed time frame of the applicable ASAP MOU and all other conditions are met to be accepted, the violation will be handled in accordance with the ASAP MOU. Such a report is considered as a non-sole source report even if the information has been already provided to the FAA under the VDRP. When an ASAP program is not available to the employees, it is advisable for them to submit a report to the ASRS [41].

How the VDRP Works

Typically, the VDRP follows the following stages [39].

Stage I: Notification to the FAA of an apparent violation.

The regulated entity must notify the appropriate Principal Inspector of the FAA of the apparent violation. The initial notification should be accomplished on a timely basis, ordinarily within 24 hours of the discovery of the apparent violation. The notification must contain items such as a brief description of the apparent violation, verification of the cessation of noncompliance, and a brief description of the immediate action.

Stage II: FAA response to the regulated entity.

The Principal Inspector reviews the submission and judges if it meets the requirements of acceptance. Once the Principal Inspector completes the review of the voluntary disclosure submission, he/she makes a determination to accept the disclosure, return it for editing, or find it invalid. For the disclosure by the airlines, the Office Manager will review the Principal Inspector's determination.

Stage III: Written report of regulated entity's apparent violation.

The regulated entity should submit the written report of the apparent violation to the Principal Inspector within 10 working-days from the date the disclosure was submitted to the FAA. This report must contain a detailed description of the proposed fix,

outlining the planned corrective steps, the responsibilities for implementing those corrective steps, and a time schedule for completion of the fix.

Stage IV: Written report review by the FAA.

The FAA works with the regulated entity to ensure that it has identified any root causes and systematic issues which led to the apparent violation. In this stage, the Principal Inspector is also tasked with completing a Risk Assessment Matrix to aid in evaluating the significance of the event and the proposed comprehensive fix.

Stage V: Implementation of the comprehensive fix and FAA surveillance.

During the implementation period, the FAA and the regulated entity should continue to work together. The FAA monitors the implementation of the corrective steps and may advise and assist the regulated entity. The FAA also assesses the pertinent regulated entity's corrective efforts and top management's awareness of these efforts throughout the implementation period. Upon determining that the implementation of the comprehensive fix is satisfactory, the Principal Inspector issues a letter of correction. If, during this period, the FAA determines that the steps taken by the entity are not those documented in the comprehensive fix and acceptable corrective action by the regulated entity is not forthcoming, the letter of correction may be rescinded, and appropriate legal enforcement action initiated.

Stage VI: Inspector signoff.

At the conclusion of the implementation period, the Principal Inspector will make a final assessment. For the disclosure by the airlines, the concurrence of the Office manager is also needed to close the case.

Confidentiality

The FAA believes that the regulated entities would be reluctant to participate in the VDRP unless the FAA could assure that the information derived from the VDRP would not be disclosed. Therefore, in the same way as the ASAP, the FAA designated by FAA Order 8000.89 the information received from VDRP as protected from public disclosure in accordance with the provisions of 14 CFR Part 193. The order is also applicable to any other government agencies that receive such information from the FAA.

This order protects the information such as that contained in an initial notification to the FAA, that contained in a detailed written report, and the FAA generated documentation and electronic information that is directly associated with an accepted VDRP submission.

In cases in which the disclosure is necessary, such as when the FAA has to explain the need for changes in FAA policies, procedures, and regulations or has to advise other people of the problem to address, the FAA may disclose summary information which has de-identified the identity of the source of the information and the names of the certificate holder, employees, and other persons as well as any other information that could be used to ascertain the identity of the submitter. The FAA may also disclose de-identified aggregate statistical information concerning VDRP submissions [52].

4.2.7 Flight Operational Quality Assurance (FOQA) Program

The Flight Operational Quality Assurance (FOQA) program is a voluntary safety program in which the airlines routinely collect and analyze the digital flight data gathered during normal operations. Therefore, it is different in characteristics from the voluntary reporting systems described so far, to which persons voluntarily report the events they saw or involved in.

However, the FAA policy to implement the FOQA program by industry's voluntary initiative offers the Civil Aviation Authorities in other states valuable insights for implementing their policies in the future, therefore, the program is specifically discussed here.

Overview

As stated, the FOQA program is a voluntary safety program in which the airlines routinely collect and analyze the digital flight data gathered during normal operations. The program mainly aims at airlines that operate under Part 121 or Part 135, yet it may be applicable to operators under other parts [38].

Although the FOQA program is a voluntary program, airlines that seek the protection from the FAA's enforcement actions based on the FOQA data must gain approval of the program from the FAA. Further, the FOQA rule requires airlines with an FAA-approved FOQA program to inform the FAA of adverse safety trends revealed by their programs, as well as corrective action undertaken. The rule also requires the airline to provide the FAA with aggregate FOQA data in a form and manner acceptable to the FAA administrator.

The value of FOQA programs is the early identification of adverse safety trends by using objective flight data as well as the application of corrective action and follow-up monitoring to assure that unsafe conditions are effectively mitigated.

The corrective actions taken under the FOQA range from the revision of the aircraft operating procedures, air traffic control procedures, flight crew training programs, and maintenance procedures to the redesign of the aircraft and the airport facilities [38].

History

The FOQA program has its origin in the use of the Flight Data Recorder (FDR), which is commonly referred to as the black box, as mandated by the U.S. Civil Aeronautics Administration in 1958. The first FDRs captured only six parameters - time, airspeed, heading, altitude, vertical acceleration, and time of radio transmission, but they were a valuable tool for reconstructing what had occurred preceding an accident.

In 1962, British Airways started a program using data from FDRs to validate airworthiness criteria. In the late 1960s, TWA began a program to monitor a limited number of the parameters related to approaches and landings as FDRs received periodic maintenance. Over the decades since then, technologies have advanced and enabled the collection and processing of a wider range of data. With the rapid growth of data-collection and data-processing capabilities, flight-data analysis have evolved rapidly [60].

FOQA-type programs were first established in Europe and Asia, and only within the past few years some U.S. airlines have begun adopting such programs on a trial basis [60]. Figure 4-4 shows the number of airlines with flight data monitoring programs worldwide.

In 1995, the FAA initiated a FOQA demonstration project to promote the voluntary implementation of the FOQA programs by U.S. airlines and to assess the costs, benefits, and safety enhancements associated with such programs [60]. In 2001, the FAA issued a final rule regarding FOQA programs (14 CFR 13.401) .

FOQA as a Voluntary Program

By allowing airlines and pilots to share de-identified aggregate information with the FAA, the FOQA programs enable the FAA to monitor national trends in aircraft operations and target its resources to address operational risk issues. While it is a fact that the partnership among the FAA, airlines and pilots plays a crucial role in the FOQA programs, the FOQA

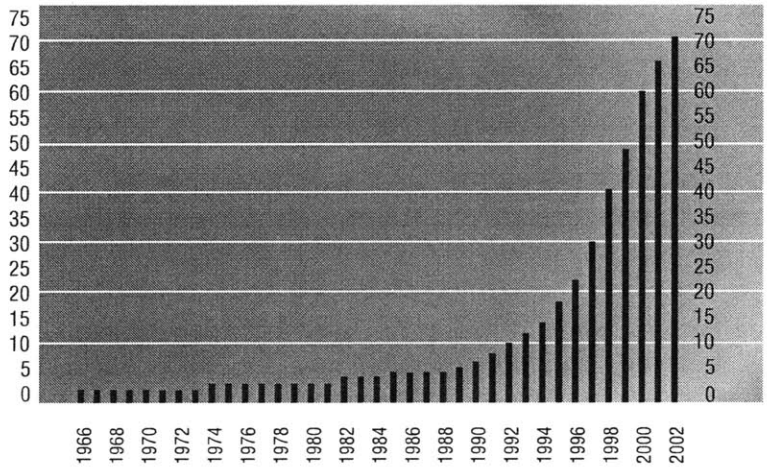

Figure 4-4: Number of airlines with flight data monitoring programs worldwide [112]

programs still premise that airlines have a primary responsibility for continuously monitoring and ensuring that their operations are safe and in compliance with their operating standards and the regulations [38].

The FAA believes that the safety goals of the FOQA programs are better served if the programs remain voluntary. Therefore, although Part I of Annex 6 to the Chicago Convention requires as a Standard that operators of an aeroplane of a maximum certificated take-off mass in excess of 27,000 kg establish and maintain a flight data analysis program as part of their safety management system, the FAA has no plans to implement the Standard. Hence, no airlines are required to have a FOQA program and no airlines that conduct a FOQA program are required to obtain FAA approval of its program.

So far, the FAA has been able to achieve wide participation in the FOQA program by major U.S. airlines on a voluntary basis. As of April 2004, there are 13 U.S. airlines with FAA-approved FOQA programs [70].

Differences from Voluntary Reporting Systems

There is a fundamental difference in characteristics that distinguishes the FOQA programs and other voluntary reporting systems such as the ASAP. The FOQA programs provide precise quantitative data on how the aircraft actually performed during flights, and the data can be used to help in evaluating objectively a wide range of safety-related issues. On

the other hand, the voluntary reporting systems rely on subjective reporting of unsafe events perceived by pilots or other persons, yet provide insights into the causation of the events. In other words, the FOQA data tells what happened to the aircraft whereas the voluntary reporting systems are more likely to tell why something happened [60]. The FOQA and the ASAP are complementary programs for airlines, and nearly all FOQA participating U.S. airlines also participate in the ASAP [70].

Safety Benefits and Economical Benefits

Airlines have reported that they have used FOQA analysis to identify a variety of potential safety problems and take corrective actions to resolve or mitigate them.

One airline found through its FOQA program that more exceedances occurred during visual flying than during instrument flying. This finding prompted the airline's flight-training managers to reconsider the relative emphasis given visual and instrument flying in the airline's training programs.

Another airline confirmed that the incidence of descent rate exceedances during approaches was significantly higher at a particular runway at a U.S. airport than at other runways. After investigating the problem, the airline concluded that the air traffic control approach had been set too high, requiring pilots to descend more steeply than usual during their final approach. When the airline shared its findings with the FAA management, the approach was modified to correct this potential problem [60].

In addition, some U.S. airlines have used the FOQA data to better understand where risks are more prominent than other locations. For example, they have used FOQA data to identify every airport in the world to which they fly at which unstable approaches and/or Ground Proximity Warning System (GPWS) warnings on approach have occurred with frequency. They also have aggregated their FOQA data on the frequency and location of the TCAS RA and documented a growing risk of a midair collision at certain locations [70].

The benefits of the FOQA programs are not limited to the aircraft operation. They are also utilized for improvement of aircraft design or manufacturing process. For example, the FOQA data has been used to document anomalies specific to particular makes, models, and series of aircraft, and that information has been provided to manufacturers. The manufacturers have used the data as a basis for developing advisories and/or engineering solutions to those issues [70].

The FOQA data is also utilized for maintenance of aircraft and its engines. For example, the FOQA programs will help airlines determine the necessity of maintenance and the level of maintenance required when a hard landing occurred or an engine overheated. Prior to the FOQA programs, airlines generally had to rely on pilots' judgment for the determination in both cases. However, in the case of a hard landing, the FOQA programs can provide better information on the amount of force the aircraft experienced during landing. Similarly, in the case of an engine overheating, the FOQA programs can provide precise data on exceedances in engine temperatures and the duration of overheating. This information enables maintenance managers to make more informed decisions about whether the aircraft needs to be inspected for structural damage or whether an engine needs to be overhauled [60].

Finally, it should be pointed out that the FOQA programs can help airlines reduce fuel consumption. For example, in a similar way to its use in improving flight safety, the FOQA programs can identify flights with climb and descent profiles depicting higher fuel consumption than necessary. With this information, the airlines can take corrective actions such as the revision of Standard Operational Procedures (SOPs) to achieve optimal fuel consumption [57].

Cost-Benefit Study

As mentioned, in addition to enhancing operational safety, the FOQA programs enable the airlines to save costs by avoiding unnecessary engine maintenance and reducing fuel consumption. Therefore, the airlines can benefit financially from the implementation of a FOQA program [60]. Table 4.3 summarizes one cost-benefit study of the FOQA programs.

Implementation and Operations Plan (I&O Plan)

Although the FOQA program is a voluntary program, airlines that seek the protection from the FAA enforcement actions must obtain approval of their FOQA Implementation and Operations Plan (I&O Plan) from the FAA. The I&O Plan specifies the technology, policies,

[c]Fuel savings are based on estimates of one-half percent reduction in fuel consumption. Engine savings are based on estimates of one percent reduction in engine maintenance costs. Safety savings are based on hypothetical one percent reduction in the annual costs incurred from accidents, of which calculation is based on the loss rate of two aircraft per million departures at a cost of $150 million for each loss. For other assumptions, refer to [60].

Table 4.3: Estimated annual net savings from a FOQA program by fleet size[c] [60]

	15 aircraft	50 aircraft	100 aircraft
Equipment costs	$95,500	$259,000	$492,000
Personal costs	$385,000	$500,000	$775,000
Total annual costs	**$483,500**	**$759,000**	**$1,267,000**
Fuel savings	$145,800	$486,000	$972,000
Engine savings	$300,000	$1,000,000	$2,000,000
Safety savings	$49,500	$165,000	$330,000
Total annual savings	**$495,300**	**$1,651,000**	**$3,302,000**
Net annual savings	**$11,800**	**$892,000**	**$2,035,000**

procedures, and operational processes used by an airline for its program. In accordance with the regulations, I&O Plans shall include:

- A description of the operator's plan for collecting and analyzing flight recoded data from line operations on a routine basis, including identification of the data to be collected.
- Procedures for taking corrective action that analysis of the data indicates is necessary in the interest of safety.
- Procedures for providing the FAA with aggregate FOQA data.
- Procedures for informing the FAA as to any corrective action being undertaken.

At the FAA, the Voluntary Safety Programs Branch (AFS-230) is responsible for the management of the FOQA program. The AFS-230 and the Principal Operations Instructor (POI) assigned to the airline will jointly evaluate the I&O Plan based on the adequacy of the proposed means and methods identified for collection and analysis of data, as well as procedures for taking corrective actions. The joint evaluation by the AFS-230 and the POI will allow the FAA to maintain standardization and continuity throughout the industry while accommodating airline-specific organization and resource differences best understood by the POI. Once the AFS-230 and the POI concur that the plan should be approved, the airline will receive an approval letter with the signatures of the POI and the manager of AFS-230.

While an ASAP is subject to review and renewal every two years by the FAA, once an I&O Plan is approved by the FAA, the airline's FOQA program may continue for an indefinite period, unless the airline elects to terminate the FOQA program or the FAA withdraws its approval [38].

Program Management in an Airline

A typical FOQA program is managed and operated by a FOQA Program Manager, one or more analysts, and a FOQA Monitoring Team (FMT). The FOQA Program Manager is responsible for the overall management, administration, security, and maintenance of the FOQA program. The FMT is a group comprised of representatives from the pilot group, if applicable, and the airline. This group is responsible for reviewing and analyzing flight and event data and identifying, recommending, and monitoring corrective actions. Among the FMT members, a gatekeeper, who is responsible for the security of the identified data, is selected. The gatekeeper is the individual who can link FOQA data to an individual flight or crewmember. The gatekeeper is typically a line captain designated by the airline's pilot association [38].

Program Components

The primary components of a FOQA program include the following [38].

1. Airborne Data Recording Systems.

   These systems acquire and capture the necessary in-flight information. They include specific aircraft data input sources and the equipment to record and store the collected data. Other airborne equipment can be used to process the collected data, display the data to pilots during flight or on the ground, and transmit data to a Ground Data Replay and Analysis System (GDRAS).

2. Ground Data Replay and Analysis System (GDRAS).

   These systems are software applications designed to

   - Transform airborne-recorded data into a usable form for analysis
   - Process and scan selected flight data parameters
   - Compare recorded or calculated values to predetermined norms using event algorithms

- Generate reports for review

3. Air/Ground Data Transfers.

   One of the most labor intensive and costly aspects of a FOQA program is determining and implementing the process of getting the data from the aircraft onboard recording system to the GDRAS for analysis. There are several methods for transferring the data to the GDRAS. Two typical methods are a manual retrieval of the physical storage media and a wireless data transmission, and the former will normally require close coordination of the airline's maintenance control and line maintenance departments regarding scheduling of the retrieval so that it can be included in the regular maintenance check.

How the FOQA Program Works

The FOQA program involves capturing, recording, transferring, and analyzing the flight data and formulating and taking corrective actions.

Data Capture and Recording

Data originating from the sensors and systems throughout the aircraft are received by a device called Flight Data Acquisition Unit (FDAU). The FDAU formats the data for output to the FDR or to a Quick Access Recorder (QAR).

The FDAU can also provide data and predefined reports to the cockpit printer, or directly to Aircraft Communications Addressing and Reporting System (ACARS) for transmittal to the ground, and can display data for flight crew [38].

By regulation, the FDR must record at least 88 parameters such as time, altitude, airspeed, heading, and aircraft attitude. In addition, some FDRs can record the status of more than 1,000 other in-flight characteristics that can aid in the accident investigation. The FDR is designed to withstand the forces of a crash [107].

On the other hand, the QAR is designed to provide quick and easy access to a removable medium on which flight information is recorded. QARs may also store data in solid-state memory that is accessed through a download reader. QARs have now been developed to record an expanded data frame, sometimes supporting over 2,000 parameters at much higher sample rates than the FDR. The expanded data frame increases the resolution and accuracy

of the ground analysis programs. Sampling rate varies depending on the parameters, yet most parameters are sampled once per second [38].

Data Transfer

Using one of several available transmission methods, data are periodically retrieved and sent to the GDRAS. One way is a frequent manual retrieval and return of physical media to and from a recorder on the aircraft in order to transfer the data to GDRAS. Retrieval could take three to four days depending on the location of the aircraft and the number of multiple outstations, and will be done every one to five days, depending on airline requirements. The retrieval usually takes place during maintenance checks.

Another way is an automatic wireless transmission, which is done when the aircraft is at the gate after landing. The transmission takes about 15 to 30 minutes and eliminates the need for maintenance involvement [112].

Data Analysis

The GDRAS transforms the raw airborne data into an appropriate format for analysis and generate reports and visualizations to assist personnel in analyzing the collected data. The GDRAS also conducts the de-identification of pilot and specific flight information.

In terms of determining the root causes of systematic problems that need correction, aggregate FOQA data of multiple flights on adverse safety trends have been proven to be of greater value than detailed parameter data gathered during a single flight. Two types of analysis techniques can be applied to FOQA data.

(a) Exceedance Analysis.

The GDRAS detects events that exceeds the certain predetermined values for a particular parameter. For example, a parameter might be the descent rate during approach. Several levels of exceedance can be programmed for particular events based on the airline's risk assessment to assist in focusing resources on implementing corrective action on the highest perceived operational risk area.

This data can be trended over multiple flights to determine the number of exceedances occurring per flight segment. The data can also be trended to determine in which phases of flight, airports, or runways the exceedances occur.

The FMT, with an assistance from the FOQA analyst, investigates each exceedance case provided to determine what occurred. An analyst will review the parameter values surrounding the event and other information to determine if the exceedance was valid. The FMT, through the gatekeeper, may choose to contact the crew to gather further information. After investigating the situation to determine the cause of the exceedance, the FMT will determine any necessary corrective action.

(b) Statistical Analysis.

Statistical analysis is a tool to look at the total performance of an airline's operation, and is used to create profiles of flight, maintenance, or engineering operational procedures. A series of data distributions will show a picture of how all flights are performing, and enable an airline to determine risk without focusing on a specific event exceedance.

The FMT determines corrective action based on the investigation of a specific event exceedance or the performance of all flights. The continued monitoring of trends will tell the airline if the corrective action taken has been effective or whether additional measures are needed [38],[60].

Information Sharing

The sharing of FOQA information between airlines can provide benefits to an airline's overall safety program. This sharing can be accomplished through industry associations or directly between airlines depending on the scope of the issue. Issues such as ATC or issues specific to a particular aircraft type they have in common are examples of subjects that can be shared between operators. Maintaining confidentiality of the information between airlines is important in providing a cooperative environment.

In addition, the airline should establish regular briefings with the FAA Certificate Management Office (CMO) or the Flight Standards District Office (FSDO) to review the data trend analysis and corrective action plans. Normally, the briefing takes place on the airline's property and does not include the physical exchange of data [38]. As with the ASAP, quarterly reports of safety enhancements achieved by each certificate holder's FOQA program are compiled and submitted to the Voluntary Safety Programs Branch at the Headquarters [54].

Besides, the airlines are required by 14 CFR 13.401 to provide the FAA with aggregate FOQA data. The means of compliance with this section is currently being developed, hence, at present, the airlines are tentatively supposed to provide the FAA with at least quarterly briefings on observed trends at the location the FAA will specify. For the purpose of these briefings, the airlines may provide the aggregate data in oral, written, graphical or digital format [38].

Immunity

As with voluntary reporting systems such as ASAP, there was a concern that the information gathered and provided to the FAA under a FOQA program would be used for enforcement actions. To address such a concern, the FAA issued the rule 14 CFR 13.401, which stipulates that while the operator with a FAA-approved FOQA program provides the FAA with aggregate FOQA data, the FAA will not use an airline's FOQA data or aggregate FOQA data in an enforcement action against the operator or its employees. The section also stipulates that a criminal acts or deliberate acts are exceptions for immunity from the enforcement actions.

In addition to the concern that the FAA would use the FOQA information for enforcement actions, there was another concern among pilots that the airline manger could use the information to discipline the pilots. Therefore, the agreement between the management and the pilot association is usually concluded and its copy is included in the I&O Plan. If a pilot association agreement is not applicable to the airline, a corporate policy statement should be included in the I&O Plan that establishes protective provisions to its pilots against disciplinary action from the airline [38].

Confidentiality

In order to secure the confidentiality of the flight crew member, data that could be employed to determine flight crewmember identity are removed from a view in the electronic record as part of the initial processing of the airborne data. At the same time, in order to enable follow-up inquiry with the specific flight crew associated with a particular FOQA event, a gatekeeper of the FMT is provided with a secure means of determining identifying information for a limited period of time. Such contact is usually limited to situations when further insight into the circumstances surrounding an event is needed. To initiate a follow-up with

an individual pilot concerning FOQA events, the concurrence of the gatekeeper is required, and the follow-up inquiries will normally be accomplished by the gatekeeper. De-identified flight data stored in the GDRAS is periodically deleted. Furthermore, in general, prior to leaving the airline premises, the information that could identify the submitting airline is stripped from aggregate FOQA data which is provided to the FAA [38].

Not only that the information that could help in identifying pilots and airlines is removed from the data before the data is provided to the FAA, the data is also protected from the FOIA requests to the FAA. In the same way as the ASAP and VDRP, the FAA designated by FAA Order 8000.81 the data received from the FOQA as protected from public disclosure in accordance with the provisions of 14 CFR Part 193. As with the ASAP and VDRP designation, the order permits the FAA to release de-identified and summarized information to explain the rationale for policy or rulemaking [70].

4.3 Rulemaking Process

4.3.1 Legal Structures

Federal Aviation Act of 1958

The Federal Aviation Act of 1958 is the top level public law that governs the activities of the FAA. All FAA operating procedures must be in accordance with this Act. The Act may be amended by Congress, however, if a compelling need for such an amendment exists.

Most of the FAA operations are covered under Title VI, "Safety Regulation of Civil Aeronautics." Section 601 of this Title gives the FAA administrator the power and duty to prescribe and revise the minimum standards and rules and regulations governing, among other things, "the design, material, workmanship, construction, and performance of aircraft, aircraft engines, and propellers as may be required in the interest of safety." Therein lies the basis for the Federal Aviation Regulations [47].

Federal Aviation Regulations

Federal Aviation Regulations[d] are issued by the FAA Administrator to implement the provisions of the Federal Aviation Act. The regulations are part of Title 14 of the CFR. A wide variety of activities are prescribed in detail, such as the aircraft registration, certification of the aircraft, airworthiness standards, noise standards, certification of airmen, air traffic rules, and airport design [47].

Special Federal Aviation Regulations (SFARs)

Special Federal Aviation Regulations (SFARs) are temporary rules that address a temporary situation. For example, an SFAR is used to prohibit certain flights over a specific country during a military conflict. In the CFR, SFARs are located at the most relevant CFR part.

An SFAR usually includes an expiration date, generally no more than 3 years from its effective date. An SFAR must be renewed thorough the rulemaking process, or the SFAR automatically ineffective on the expiration date. An SFAR is subject to all the requirements and procedures of Federal rulemaking [49].

Advisory Circulars (ACs)

The FAA issues Advisory Circulars (ACs) to inform the public of non-regulatory material of interest. Unless incorporated into a regulation by reference, the contents of an AC are not binding on the public. Among other things, ACs are used to demonstrate a method acceptable to the FAA, but which may not be the only method, for complying with a related CFR. The ACs are developed by the FAA office having primary responsibility for the subject of the AC [47].

4.3.2 Main Participants in Rulemaking Process

Administrator

The Administrator sets overall policy and direction for regulatory development activities and approves all proposed and final rules [49].

[d]Federal Aviation Regulations are commonly abbreviated as "FARs." However, it is not appropriate to use the acronym "FARs" to refer to the "Federal Aviation Regulations" in legal citation. In fact, the acronym belongs to the "Federal Acquisition Regulations," which are used in procurement [49].

Office of the Chief Counsel

The Office of Chief Counsel (AGC) provides legal support for the FAA regulatory program. The Chief Counsel is responsible for determining the legal adequacy of FAA's actions related to rules and regulations and acting as a liaison between FAA and the Office of the General Counsel of the DOT. The AGC provides an attorney for each rulemaking team [49].

Office of Rulemaking

The Office of Rulemaking (ARM) provides overall management for the FAA's regulatory program and drafts rulemaking documents. The ARM provides a rulemaking analyst for each rulemaking team [49].

Office of Aviation Policy and Plans

The Office of Aviation Policy and Plans (APO) provides economic analysis support for the FAA's regulatory program and estimates the economic effects of proposed regulations. The APO provides an economist for each rulemaking team [49].

Program Offices

Program offices initiate a rulemaking process that falls within its jurisdiction. Examples of program offices which are frequently involved in rulemaking include the Office of Flight Standards and the Office of Aircraft Certification. They provide a team leader and staff for each rulemaking team [49].

Rulemaking Team

The rulemaking team usually consists of one or more representatives from a relevant program office, a rulemaking analyst from the ARM, an attorney from the AGC, and an economist from the APO [49].

Office of Management and Budget (OMB)

The Office of Management and Budget (OMB) is part of the Executive Office of the President, and assists the President in overseeing the preparation of the federal budget and supervises its administration in Executive Branch agencies [95].

The Office of Information and Regulatory Affairs (OIRA) is an office within OMB. OIRA reviews a proposed or final rule and its economic assessment before its publication if it is considered "significant" [49].

Office of the Secretary of Transportation (OST)

The Office of the Secretary of Transportation (OST) reviews a proposed or final rule and its economic assessment if it is considered "significant," and forward them to OMB after approval [49].

Aviation Rulemaking Advisory Committee (ARAC)

The Federal Advisory Committee Act (FACA) requires an agency to establish a formal committee when it seeks a consensus recommendation from a group including more than one person from outside the government.

The Aviation Rulemaking Advisory Committee (ARAC) is a formal advisory committee consisting of aviation associations and industry, public interest groups, and interested individuals. Established in 1991, the ARAC provides information, advice, and recommendations regarding FAA rulemaking activities. Through the ARAC, the FAA obtains information and insight from those parties most affected by existing and proposed regulations.

In conducting its activities, the ARAC complies with the FACA and the direction of the FAA. The FACA requires the FAA to review the ARAC charter every two years to determine the need to continue the ARAC. The Secretary of Transportation and the General Services Administration must approve each new ARAC charter [48], [49].

Aviation Rulemaking Committee (ARC)

The FAA is authorized to establish Aviation Rulemaking Committee (ARC) that is exempt from the FACA requirements. The FAA establishes an ARC instead of assigning a task to the ARAC for several reasons, such as when the issue area is not covered by the ARAC and when the FAA wants to limit the membership [48].

4.3.3 Public Consultation Requirements

The Administrative Procedure Act (APA) stipulates the rulemaking procedural requirements the Federal agencies must follow. In particular, Section 553 of the APA sets forth

the "informal rulemaking"[e] requirements, which apply to most legislative rulemaking [90].

Part 11 of 14 CFR stipulates the detailed requirements for the issuance, amendment, and repeal of any regulation for which the FAA follows public rulemaking procedures under the APA.

The FAA follows the APA procedure for these common types of rules: (1) Rules found in the CFR, (2) Airworthiness Directives and (3) Airspace Designations. In general, the FAA follows the same procedures stipulated in 14 CFR Part 11 for all types of rules.

Notice of Proposed Rulemaking (NPRM)

For informal rulemaking, Section 553 of the APA requires that "general notice of proposed rulemaking shall be published in the Federal Register." It also requires that the agency shall give interested persons an opportunity to participate in the rule making through submission of written data views or arguments" after the notice.

However, the APA does not specify a minimum period for comment. Executive Order 12866 provides that most rulemakings should include a comment period of not less than 60 days. Furthermore, DOT Order 2100.5 provides for a comment period of at least 60 days on significant[f] regulations and at least 45 days for non-significant regulations unless the rulemaking document states the reasons for a shorter time period.

The issuance of the NPRM needs approval from the Administrator. When the proposed rule is significant, after the approval of the Administrator, the FAA must send the economic assessment with an NPRM to the Office of the Secretary of Transportation (OST) for approval. Occasionally, the OST also requests a informal review of the non-significant proposed rules. The scheduled time frame for OST approval is 30 days.

After the OST approval, the OST forwards the economic assessment with an NPRM to OIRA at OMB [49]. Executive Order 12866 requires OIRA to waive the review or notify the agency of the results of its review within 90 calender days in general cases.

After all approval processes are completed, the NPRM is published in the Federal Register. The preliminary Regulatory Impact Analysis are included in the preamble to the NPRM [49]. Particularly, DOT Order 2100.5 requires that Economic Assessment shall be

[e]The process of "notice and comment" rulemaking is referred to as "informal rulemaking." When rules are required by statute "to be made on the record after opportunity for an agency hearing", the process is referred as "formal rulemaking." The formal rulemaking is a trial type procedure and rarely used [124].

[f]The definition of "significant" is explained in Subsection 4.3.4.

published, be it a Regulatory Analysis or a Regulatory Evaluation.

After the comment period closes, the FAA reviews and disposes of public comments. Before the rulemaking team prepares the final rule, the disposition of comments are subject to review by the Rulemaking Management Council, which is chaired by the Director of the ARM. The disposition of comments are included in the preamble to the final rule.

Section 106 of 49 U.S.C. requires the FAA to issue a final rule or take other final action not later than 16 months after the last day of the public comment period for an NPRM [49].

Advanced Notice of Proposed Rulemaking (ANPRM)

The FAA may issue an Advanced Notice of Proposed Rulemaking (ANPRM) to obtain information from the public that will assist the FAA in either developing an NPRM or determining that rulemaking is not appropriate. An ANPRM tells the public that FAA is considering rulemaking on a specific subject matter and requests written comments on the appropriate scope of the rulemaking or on specific topics. Particularly, the FAA expects to

-

- Identify entities that may be affected;
- Identify unique procedures;
- Assess the issues and potential public impact; and
- Gather technical or economic data that do not exist within the FAA.

An advance notice of proposed rulemaking may or may not include the text of potential changes to a regulation.

Section 106 of 49 U.S.C. requires the FAA to issue a final rule or take other final action not later than 24 months after the date of publication of an ANPRM in the Federal Register [49].

Supplemental Notice of Proposed Rulemaking (SNPRM)

After the issuance of the NPRM, the FAA may issue a Supplemental Notice of Proposed Rulemaking (SNPRM) if it -

- Needs more information on an issue.

- Decides to take a different approach.

- Considers following a commenter's suggestion that goes beyond the scope of the original NPRM.

In some cases, the the FAA includes responses to comments received on the original NPRM in the SNPRM. Section 106 of 49 U.S.C. requires the FAA to issue a final rule or take other final action not later than 16 months after the date of publication of a SNPRM in the Federal Register [49].

Final Rule

A final rule sets out new or revised requirements or removes requirements. The issuance of a final rule needs approval from the Administrator.

When the final rule is significant, after the approval of the Administrator, the FAA must send the economic assessment with a final rule to the OST at the DOT for approval. Occasionally, the OST also requests a informal review of the non-significant final rules. The scheduled time frame for OST approval is 30 days.

After the OST approval, the OST forwards the economic assessment with a final rule to OIRA at OMB. In general cases, OIRA has 90 calender days to complete its review, but if it has previously reviewed the supporting information and there has been no change in the circumstances or facts pertaining to the rule, the review period is 45 days. After all approval processes are completed, the final rule is published in the Federal Register. The preamble to a final rule includes following:

- Effective date of the rule.

- Final Regulatory Impact Analysis.

- A summary of comments received on the NPRM when final rule was preceded by an NPRM.

- The FAA's disposition of those comments [49].

Section 533 (d) of the APA requires the Federal agency to publish a final rule not less than 30 days before its effective date. The FAA publishes all final rules in Federal Register.

Direct Final Rule

A direct final rule is a process used to expedite the issuance of rules without first issuing an ANPRM or NPRM when the rules are not controversial [124].

Section 553(b)(3)(B) of the APA authorizes the Federal agencies to dispense with the notice-and-comment requirements when the agencies, for good cause, finds that those procedures are "impracticable, unnecessary, or contrary to the public interest." Whatever the agency's basis for the claimed good cause, the agency must articulate its finding and a brief statement of reasons in the rules issued. Use of the exception is subject to judicial review [90].

The FAA uses a direct final rule when it has found the public comment procedures to be "unnecessary" because it does not expect to receive adverse comments. For example, the issuance of a minor rule or amendment in which the public is not particularly interested corresponds to such a case.

The FAA publishes a direct final rule in the Federal Register with a statement that unless adverse comment or a notice of intent to file an adverse comment is received within a certain time period, the rule will become effective on a specified date: generally, 60 days after the publication of the direct final rule. The FAA sets the comment period to end before the effective date.

An adverse comment is a comment that explains why a rule would be inappropriate, or would be ineffective or unacceptable without a change. It may challenge the rule's underlying premise or approach.

If the FAA has not received an adverse comment or notice of intent to file an adverse comment, it publishes a confirmation document in the Federal Register, generally within 15 days after the comment period closes. The confirmation document tells the public the effective date of the direct final rule (14 CFR 11.31).

If the FAA has not received an adverse comment or notice of intent to file an adverse comment, it publishes a Notice of Withdrawal in the Federal Register before the effective date of the direct final rule. The document may withdraw the direct final rule in whole or in part. The FAA may incorporate the commenter's recommendation into another direct final rule, or it may publish an NPRM with a new comment period [49].

Final Rule with Request for Comments

A final rule with request for comment is a rule that the FAA issues a final rule with an effective date that invites public comment on the rule. Section 533 (d) of the APA requires the Federal agency to publish a final rule not less than 30 days before its effective date. However, the section also allows the agency to avoid the requirement when it found a "good cause" to do so. This discretionary exception enables the agency to take care of cases in which the public interest requires the agency to act immediately or within a period less than 30 days. For example, the FAA issues a final rule with request for comment when it has learned from accident investigation that it has a need to issue or amend certain rules without delay for the safety of flying public. Again, the FAA must provide a rationale for its determination of using the exception in the rule, and it is subject to judicial review.

The FAA often sets the comment period to end after the effective date of the rule. Once the comment period closes on the rule, the FAA reviews and disposes of the comments. The FAA must publish a disposition of the comments in the Federal Register. In case the public comments persuade that the FAA needs to change the rule, the FAA may issue a revised final rule [49].

Notice of Withdrawal

The FAA issues a Notice of Withdrawal to withdraw an ANPRM, NPRM, SNPRM, or any other type of proposal. The FAA also issues it to withdraw a direct final rule before it becomes effective. Once a final rule becomes effective, however, the FAA cannot withdraw it. The FAA can only undertake a new rulemaking to remove it.

The text of the notice includes a response to the extent necessary to show the FAA's rationale for withdrawal of the proposal. The withdrawal of the proposal does not preclude the FAA from issuing another notice on the subject matter in the future or committing the FAA to any future course of action.The FAA publishes all Notice of Withdrawal in the Federal Register [49].

4.3.4 Regulatory Impact Analysis Requirements

Economic Assessment

Executive Order 12866 sets forth regulatory philosophy and principles to which each Federal Agency should adhere. They include requirements to regulate in the "most cost-effective manner," to make "a reasoned determination that the benefits of the intended regulation justify its costs," and to develop regulations that "impose the least burden on society" [124].

The Executive Order requires that the Federal Agency provide a Regulatory Analysis of a "significant regulatory action" to OIRA at OMB for review. The Executive Order defines "significant regulatory action" as any regulatory action that is likely to result in a rule that may

(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local or tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs, or the rights and obligations of recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set force in this Executive Order.

Additionally, the FAA is required by DOT Order 2100.5 to prepare and submit a Regulatory Analysis to the OST at the DOT for approval by the Secretary for regulations that

(1) Will result in an annual effect on the economy of $100 million or more;

(2) Will result in a major effect on the general economy in terms of costs, consumer prices, or production;

(3) Will result in a major increase in costs or prices for individual industries, levels of government, or geographic regions;

(4) Will have a substantial impact on the United States balance of trade; or

(5) The Secretary or head of the initiating office determines deserves such analysis.

For regulations that do not meet the above criteria, the FAA is required to prepare a Regulatory Evaluation, which omits the requirement of economic analysis of policy alternatives from a full Regulatory Analysis requirement.

Although both the Executive Order and the DOT Order prescribes what kinds of assessments must be included in the analysis, most of them are duplicative. Therefore, when conducting a Regulatory Analysis of the proposed or final rule, the FAA includes the following items in it [49], [125]:

- A statement of the problem and the issues that make the rule significant;
- A description of the major alternatives the FAA considered for dealing with the problems;
- An analysis of the economic and any other relevant consequences of each of these alternatives; and
- A detailed explanation of the reasons for choosing one alternative over the others;

When conducting a Regulatory Evaluation of the proposed or final rule, the FAA includes the following items in it [49]:

- An evaluation of the proposed regulations, quantifying its estimated cost to the private sector, consumers, and Federal, State, and local governments; and
- The anticipated benefits and impacts of the rule.

If the expected impact is so minimal that the proposed or final rule does not warrant a full evaluation, the DOT Order requires that a statement to that effect, including the basis of the statement, must be included in the public consultation documents.

Regulatory Flexibility Analysis

When a Federal agency is required by the APA to publish an NPRM, the Regulatory Flexibility Act (Section 601 to 612 of 5 U.S.C.) requires the agency to prepare and publish a

Regulatory Flexibility Analysis (RFA) if the rulemaking could "have a significant" economic impact on a substantial number of small entities [124].

When conducting an RFA of proposed or final rule, the FAA includes the following items in it [49]:

- The reasons why the FAA is considering the rulemaking action;
- The objectives of the rule;
- A description of and, if possible, an estimate of the number of small entities the rule would apply to.
- A description of the reporting, recordkeeping, and other compliance requirements of the rule;
- Identification of all Federal rules that may duplicate, overlap, or conflict with the rule; and
- A description of significant alternatives that would minimize the significant economic impact of the rule on small entities.

If an RFA is not required, the Act requires that the agency must certify in the rulemaking document that the rulemaking will not "have a significant economic impact on a substantial number of small entities. The agency must provide a factual basis for any certification, not just the reasons.

Additionally, Executive Order 13272 requires that Federal agencies must notify the Small Business Administration's Office of the Chief Counsel for Advocacy (Advocacy) of draft rules that may have a significant economic impact on a substantial number of small entities when the draft rule is submitted to OIRA under Executive Order 12866 or, if submission to OIRA is not required, "at a reasonable time prior to publication of the rule.

Advocacy is authorized to submit comments on the draft rule, and agencies must give "every appropriate consideration" to any Advocacy comments on a draft rule [124].

International Trade Impact Assessment

In accordance with the Trade Agreement Act of 1979, the FAA conducts an International Trade Impact Assessment, which considers the effects of proposed or final rule on interna-

tional trade [49].

An International Trade Impact Assessment contains an assessment of whether -

- The rule would create unnecessary obstacles to U.S. foreign commerce;
- There are legitimate domestic objectives, such as safety, that are not considered unnecessary obstacles; and
- International Standards exist that should be the basis for U.S. standards.

Unfunded Mandates Assessment

Unfunded Mandate Reform Act of 1995 requires that the Federal agency must prepare an Unfunded Mandates Assessment, which considers the effect of proposed or final rule on State, local, and tribal governments, and the private sector, if the rule includes a Federal mandate resulting in the expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of $100 million or more in any one year.

Such an assessment contains a description of the -

- Authority under which the rule is being put into action;
- Costs and benefits to State, local, and tribal governments;
- Effect of the rule on the national economy; and
- FAA's consultation with elected representatives of the affected State, local, and tribal governments, a summary of the comments and concerns presented by those groups, and a summary of the FAA's evaluation of those comments and concerns [49].

Other Analysis Requirements

In addition to the requirements of regulatory impact analysis from economic perspective described above, depending on proposed rules, the FAA may be required to conduct one or more of the analysis and to prepare the statements such as

- Paperwork Reduction Act Statement
- National Environmental Policy Act Review
- Energy Impact Statement

- Federalism Statement
- Statement on Regulations Affecting Intrastate Aviation in Alaska
- International Compatibility Statement [49]

4.3.5 Annual Regulatory Plan

Executive Order 12866 [126] requires agencies to participate in the Unified Regulatory Agenda by periodically publishing on all regulations under development or review.

In particular, as part of the Unified Regulatory Agenda, the Executive Order requires that each agency shall prepare a Regulatory Plan of the most important significant regulatory actions that the agency reasonably expects to issue in proposed or final form in that fiscal year or thereafter, and shall forward it to OIRA by June of each year for review.

In addition, the Executive Order prescribes that the Regulatory Plan developed by the agency shall be published annually in the October publication of the Unified Regulatory Agenda.

At the same time, DOT Order 2100.5 [125] requires the FAA prepares a Semiannual Regulations Report summarizing each proposed and each final regulations that the FAA is considering for issuance and publication in the Federal Register during the succeeding 12 months or such longer period as may be anticipated. The Report is submitted to the Department Regulations Council, which is chaired by the Deputy Secretary. The General Counsel's Office at the Department consolidates the Regulations Reports submitted by the agencies in the DOT, and prepares a semi-annual Department Regulations Agenda. This agenda is incorporated into the Unified Regulatory Agenda [49].

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Chapter 5

United Kingdom

5.1 Organizations

In the U.K., civil aviation activities are governed by the two Civil Aviation Authorities: the European Aviation Safety Agency (EASA) and the Civil Aviation Authority (CAA). EASA is an agency of the European Union (EU), based in Cologne, Germany, whereas the CAA is a public corporation of the U.K. As described below, the rulemaking and oversight responsibility for aviation safety in the U.K. has been transferred from the CAA to EASA since 2003.

5.1.1 Civil Aviation Authority: European Aviation Safety Agency (EASA)

EASA was established in 2003 by Regulation (EC) No. 1592/2002 of the European Parliament and of the Council of the European Union in order to establish and maintain a high uniform level of safety and environmental protection in civil aviation in Europe. Currently, 27 EU Member States and 4 non-EU states are members of EASA [28].

The EASA Management Board, which brings together representatives of the Member States and the European Commission, is responsible for defining the Agency's priorities, establishing the budget, and monitoring the Agency's operation. The Management Board also appoints the Executive Director.

The EASA Advisory Board assists the Management Board in its work. It is comprised of organizations representing aviation personnel, manufacturers, commercial and general aviation operators, maintenance industry training organizations, and air sports [27].

The Joint Aviation Authorities (JAA) is an associated body of the European Civil Aviation Conference (ECAC) representing the civil aviation authorities of a number of European states. Since 1970, the JAA has developed and implemented common safety regulatory standards and procedures in Europe. However, the functions which the JAA once fulfilled has been transferred to EASA [87].

There is a difference between the JAA and EASA in establishing regulations common to the Member States. The JAA has no delegation of legal powers; hence, Joint Aviation Regulations (JAR), the regulations the JAA adopts, must be transposed to the national legislation of the Member States to become legally binding. On the other hand, EASA has legal regulatory authority within the EU through the enactment of its regulations by the European Commission, the Council of the European Union, and the European Parliament.The enacted regulations are directly applicable to the Member States and replace the national legislation [89].

Currently, EASA develops safety and environmental rules, and is undertaking the tasks of type-certification of aircraft and components, as well as the approval of organizations involved in design, manufacture and maintenance of aeronautical products. EASA also monitors the implementation of standards through inspections in the Member States and provides the necessary technical expertise, training and research.

The Agency's responsibilities are growing, and in the future this will include legally binding rules for flight operations, the licensing of flight crews and the safety approval of non-European airlines [33]. The Agency will also be responsible for safety regulations regarding airports and air traffic management systems [28].

The National Aviation Authorities of the EASA Member States still continue to carry out some operational tasks, such as certification of individual aircraft and licensing of pilots [28].

5.1.2 Civil Aviation Authority: Civil Aviation Authority (CAA)

The CAA was established by Parliament in 1972. The main Act of Parliament regulating civil aviation in the U.K. is the Civil Aviation Act 1982, and the CAA regulates all aspects of aviation in the U.K., such as safety regulations, economic regulations, and consumer regulations. The Civil Aviation Act 1982, the Airport Act 1986, and the Transport Act 2000 govern its constitution and functions.

As a National Aviation Authority, the CAA still has a statutory authority to exercise rulemaking and oversight responsibility for all aspects regarding aviation safety not being adopted by EASA. For example, the CAA conducts the regulatory oversight of production and maintenance organizations [115].

The U.K. Government requires that the costs of the CAA be met entirely from its charges to those whom it regulates. Unlike many other States, there is no direct government funding of the CAA's work.

The Chairman and the Board members are appointed by the Secretary of State for Transport. The Chairman is responsible to the Secretary of State for the overall direction and the management of the CAA within the policy framework set by the Secretary of State. The Board is fully responsible for all of the activities of the CAA [121].

5.1.3 Investigation Authority: Air Accidents Investigation Branch (AAIB)

The Air Accidents Investigation Branch (AAIB) is one of the three accident investigation branches of the Department for Transport (DfT), each of the other two branches investigates marine and railroad accidents. The authority for the AAIB to investigate accidents and incidents originates from the Civil Aviation Act and the Civil Aviation (Investigation of Air Accidents and Incidents) Regulations.

Although the AAIB is a part of DfT and receives a budget from it, the branch is functionally independent. The Chief Inspector of the AAIB directly reports to the Secretary of State for Transport on any safety matters [123]. In the year 2008, the AAIB had 45 staff members [59].

5.2 Reporting and Investigation Systems

In the U.K., other than an accident and serious incident reporting and investigation system by the AAIB, the CAA has a mandatory reporting system of incidents and other safety-related occurrences, called the Mandatory Occurrence Reporting (MOR) Scheme. In addition, the U.K. has a separate Airprox reporting and investigation system managed by the United Kingdom Airprox Board (UKAB), a specialized organization for Airprox investigation.

As regards the voluntary reporting systems, there is the Confidential Human Factors

Incident Reporting Programme (CHIRP), which is managed by the CHIRP Charitable Trust. The CAA also has its own confidential/voluntary reporting systems. However, they differ in characteristics from other voluntary reporting systems, and are rarely used.

The EU Member States exchange the safety information with each other. This will also be discussed in this section.

5.2.1 Accident and Serious Incident Reporting and Investigation System

European Union Council Directive 94/56/EC establishes the fundamental principles governing the investigation of civil aviation accidents and incidents.

Article 3 of the Directive defines the accident, incident, and serious incident as follows:

(a) 'accident' means 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:

1. 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
2. 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, tyres, brakes, fairings, small dents or puncture holes in the aircraft skin;

3. the aircraft is missing or is completely inaccessible;

(j) 'incident' means an occurrence, other than an accident, associated with the operation of an aircraft which affects or would affect the safety of operation;

(k) 'serious incident' means an incident involving circumstances indicating that an accident nearly occurred.

The Directive prescribes a list of examples of serious incidents in the Annex. (Refer to Appendix B, Section B.2, Subsection B.2.1.) Both the definitions of accident, incident and serious incident and the list of examples of serious incidents follows those of Annex 13 to the Chicago Convention.

The Directive stipulates that every accident or serious incident shall be the subject of an investigation, yet it leaves the extent of investigations and the procedure to be followed at the discretion of the investigative authority of each Member State (Article 4).

The Directive also stipulates that the investigation shall be conducted by the permanent investigative authority independent from the national aviation authority (Article 6). Further, it stipulates that when the investigation authority issues the accidents and incident reports, the authority shall forward copies to the European Commission (Article 9).

In the U.K., the Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996 defines accidents, incidents, and serious incidents in almost the same text as the Directive (Refer to Appendix B, Section B.2, Subsection B.2.2.), and stipulates that accidents and serious incidents shall be immediately reported to the AAIB. Then, the AAIB immediately passes the details of reported accidents and serious incidents to the CAA [116].

In addition to accidents and serious incidents, the AAIB may carry out an investigation into incidents other than serious incidents if the AAIB expects to draw air safety lessons from the investigation (Regulation 8).

Investigation

The AAIB responds to the notification of an accident or a serious incident in accordance with the following guidelines [122].

Major Aviation Disasters

The AAIB Chief Inspector appoints the Investigator-in-Charge (IiC) among the Principal Inspectors to lead a team of Inspectors. Outside specialists may be called on.

Other accidents or serious incidents involving commercial aircraft

The AAIB forms a small AAIB Field Investigation Team.

Fatal accidents involving light aircraft or microlight aircraft

The AAIB forms a small AAIB Field Investigation Team.

Non-fatal accidents involving light aircraft or microlight aircraft

The AAIB does not normally deploy a team of Inspectors. The Inspectors usually investigate accidents through correspondence and telephone calls.

Accidents involving a glider, hang glider, or paraglider

The investigation of the fatal accidents in this category may be carried out by the AAIB Inspectors who may visit the scene. The investigation team may be augmented by a member of the relevant sporting association. The investigation of non-fatal accidents may be carried out by the AAIB or relevant sporting association. The AAIB Inspectors are unlikely to visit the scene.

Party System

The AAIB may call on outside specialists to assist in particular aspects of specific investigations. These personnel can be selected from the airline involved, the manufacturers of aircraft, its engines or equipment, and other government agencies. The IiC will decide which specialist working groups are required and will direct the groups [122].

Investigative Priority

The Regulations states that the AAIB Inspectors must perform their statutory duties in cooperation with the authorities responsible for judicial inquiry (Regulation 9). To this end, the AAIB makes every effort to establish and maintain a good liaison and cooperation with the police throughout the technical investigation. Conflicts such as the one over access to accident site, access to witnesses, and retention of evidence are resolved on-site through explanation, cooperation and negotiation [122].

Final Report and Safety Recommendations

After the investigation, the AAIB publishes a report, and may issue safety recommendations to relevant organizations, including the National Aviation Authorities. The organization

that received the recommendations must give a written response to the Secretary of State for Transport without delay (Regulation 13 and 14).

Such a response must contain the following:

(1) full details of the measures, if any, it has taken or proposes to take to implement the recommendation and, in a case where it proposes to implement measures, the timetable for securing that implementation; or

(2) a full explanation as to why the recommendation is not to be the subject of measures to be taken to implement it.

5.2.2 Mandatory Occurrence Reporting (MOR) Scheme

Commission Regulation (EC) No. 2042/2003 stipulates that those who maintain the aircraft, including the approved maintenance organizations, shall report any identified condition of an aircraft or component that hazards seriously the flight safety to the competent authority, the State of Registry, the organization responsible for the type design or supplemental type design, and, if applicable, the Member State of operator. When those who maintain the aircraft are contracted by an owner or an operator to carry out the maintenance, they shall also report to the owner, operator, or the continuing airworthiness management organization (Part-145, 145.A.60 and Part-M, M.A.202).

Second, Commission Regulation (EC) No.8/2008 stipulates that the commander or the operator of an aircraft shall report to the authority of any incident that endangers or could endangers the safety of operation (EU OPS 1, OPS 1.420).

Lastly, Commission Regulation (EC) No.1702/2003 stipulates that the holder of a Type Certificate, restricted Type Certificate, Supplemental Type Certificate, European Technical Standard Order authorisation, major repair design approval or any other relevant approval shall report to EASA any failure, malfunctions, defect or other occurrence which has resulted in or may result in an unsafe condition (Part 21, 21A.3).

Directive 2003/42/EC of European Parliament and Council of the European Union stipulates the obligations of the Member States regarding the incident reporting system, and it lists in its annex the examples of reportable occurrences related to operations, maintenance, repair, and manufacturing. In addition, AMC 20-8 "Occurrence reporting" provides guidance for the reporting requirements above.

In accordance with the Directive, the CAA has a scheme called Mandatory Occurrence Reporting (MOR) Scheme to collect the safety information, which was introduced in 1976 [117]. Article 142 of Air Navigation Order 2005 and the Air Navigation General Regulations 2006 stipulate the scheme and CAP 382 "The Mandatory Occurrence Reporting Scheme" [116] provides information and guidance. Under the MOR Scheme, any organization concerned with the operation, manufacture, repair, and maintenance of aircraft and aircraft components, pilots, air traffic controllers, air traffic engineers, mechanics, and ground-handling personnel are required to report the information on occurrences to the CAA. They must comply with both the requirements of the MOR Scheme and the EASA regulations, and in any case, the more restrictive requirements must be applied [117]. CAP 382 lists in its appendix the examples of reportable occurrences related to operations, maintenance, repair, and manufacture, which are based on the list of Directive 2003/42/EC. (Refer to Appendix B, B.2, Subsection B.2.3.)

The number of reports submitted under the MOR Scheme is shown in Figure 5-1.

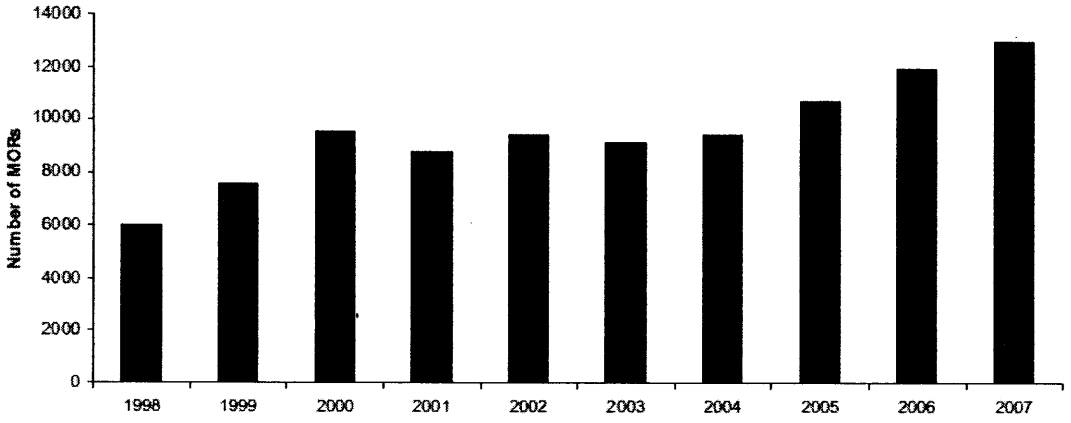

Figure 5-1: Number of reports submitted under the MOR Scheme [119]

All reports received under the MOR Scheme are processed by the Safety Investigation and Data Department (SIDD), the Safety Regulation Group (SRG) of the CAA. The SIDD analyzes the report to establish trends and to determine corrective actions, and provides the selected safety information to the industry on request. Reports are directed from the SIDD to the appropriate departments within the CAA for any necessary follow-up action. Every month, the SIDD publishes summaries of all occurrences for the industry and for the

general aviation community [117].

The data of all reports collected under the MOR Scheme are stored in the database. The details of the accident and serious incident passed by the AAIB are also included into the database to maximize analytical and statistical benefits. The SIDD extracts the information for dissemination within the CAA as well as to the aircraft industry and other interested parties [116].

The SIDD also exchanges the data with the Member States of the EU, as stipulated by Article 6 of Directive 2003/42/EC of the European Parliament and of the Council and Article 142 of Air Navigation Order 2005, which will be discussed in Subsection 5.2.6 [117].

The use of MOR data as a part of the CAA Safety Risk Management Process

The CAA has developed the Safety Risk Management Process and continues to update it. The CAA Risk Management Process consists of three levels in the form of pyramid.

At the highest level, the Accident Analysis Group (AAG) identifies the foremost risks to large public transport aeroplanes through analysis of fatal accidents. Since such fatal accidents are rare events in the U.K., the AAG conducts an analysis of fatal accidents worldwide. During the analysis, each accident is assigned a primary causal factor, other causal factors, circumstantial factors, and consequences [120]. Unlike other studies that only reviewed accidents with sufficient information, the AAG analyzes all worldwide fatal accidents in order to avoid bias in the analysis toward accidents that had occurred in nations with more developed accident investigation processes [118].

At the next level, The High Risk Events Analysis Team (THREAT) analyzes non-fatal accidents, serious incidents, and other high risk incidents collected under the MOR Scheme, involving U.K.-registered or -operated public transport aeroplanes. THREAT was established in 2007, and a number of generic observations on potential ongoing safety risks yielded by the THREAT's initial analysis have been fed into the CAA safety planning process.

At the lowest level, "Fishbone groups" analyzes the data collected under the MOR Scheme on main risks identified from the AAG and THREAT. "Fishbone" refers to the structured analysis method that these groups use to search for any safety weaknesses that could contribute to the specified risk. In addition to the data stored in the MOR database, the Fishbone groups make use of the data acquired from the Flight Data Monitoring [120].

5.2.3 Airprox Reporting and Investigation System

The Airprox should be reported by pilots or air traffic controllers on a special form to the United Kingdom Airprox Board (UKAB). In the U.K., the Airprox is defined as "a situation in which, in the opinion of a pilot or an air traffic controller, the distance between aircraft as well as their relative positions and speed, had been such that the safety of the aircraft involved was or may have been compromised" [69].

The Airprox reporting to the UKAB is not mandatory. Although pilots and air traffic controllers may well be required to submit an occurrence report under the MOR Scheme, the reporter can decide whether to classify such a report as an Airprox [69]. The CAA ensures that the report is incorporated into the MOR scheme, hence duplication of reporting is not needed [116].

Airprox Board Constitution

The UKAB is an independent body formed in 1999. It is sponsored jointly and funded equally by the CAA and the Ministry of Defense (MOD) of the U.K. The UKAB is comprised of two main sections, a Secretariat and a Board. The role of the Secretariat is to conduct investigations and to support the Board, whereas the role of the Board is to determine probable causes of Airprox and to assess its degree of risk based on the investigation.

At present, the Secretariat is comprised of four Airprox Inspectors and two administrators. Two Airprox Inspectors have civilian backgrounds, and the other two have military backgrounds. One of the civilian inspectors has a background in air traffic control, and the other in flight operations. The two inspectors with military backgrounds mirror this arrangement.

The Board is similarly comprised of civilian and military members, with backgrounds in air traffic control or flight operations. The majority of Board members are nominated either by civilian organizations or the MOD. The Board members are expected to serve as experts in their own right and not to represent any group or organization [69].

Investigation

The UKAB receives approximately 200 Airprox reports each year, about 90% of which results in full investigation (the other 10% of reports is withdrawn by the reporter).

The investigation is directed by the Airprox Inspectors. For the particularly serious situations, the AAIB may also elect to conduct an investigation. In such cases, the UKAB will work in parallel and in cooperation with the AAIB.

During the investigation, as with the NMAC investigation by the FAA, radar recordings, communication data and other relevant data are investigated, and the cockpit crew members and air traffic controllers involved are interviewed. Further investigation is carried out either by staff from the SRG of the CAA and/or by their counterparts from the Ministry of Defence (when a military aircraft is involved) and/or by Airprox Inspectors from the UKAB.

When the investigation phase is completed, a comprehensive report is presented to the Board. The Board determines causal factors and assesses the degree of risk at a Board meeting based on the report presented, and may make recommendations [69].

Ensuring impartiality is believed to be essential in the UKAB. Therefore, it is incumbent on Board members always to attend Board Meetings so that the balance of Board membership remains equally weighted among civil/military and pilot/air traffic controller. Expert Advisors may be invited to the Board meetings by the Chairman to advise the Board on specialist aspects of particular incidents [69]. The Board classifies the degree of risk into four categories as shown in Table 5.1 [119].

Table 5.1: Airprox risk categories [119]

Category	Name	Definition
A	Risk of collision	An actual risk of collision existed.
B	Safety not assured	The safety of the aircraft was compromised.
C	No risk of collision	No risk of collision existed.
D	Risk not determined	Insufficient information was available to determine the risk involved, or inconclusive or conflicting evidence precluded such determination.

The number of Airprox investigated by the UKAB is shown in Figure 5-2. In particular, the number of Airprox involving commercial aircraft and investigated by the UKAB is shown in Figure 5-3.

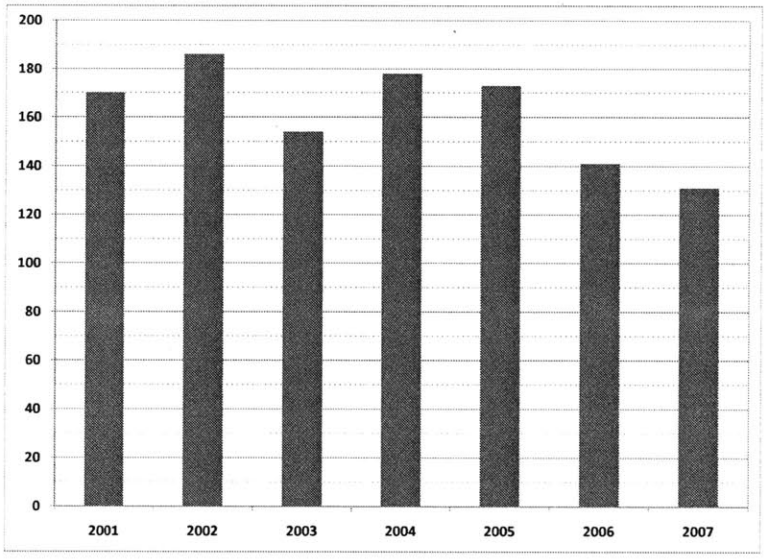

Figure 5-2: Number of Airprox investigated by the UKAB per year[a] (*Data Source*: [119])

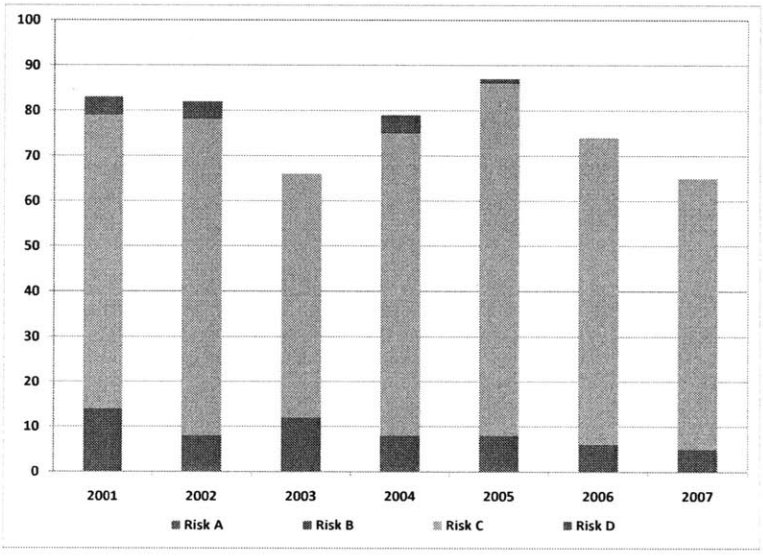

Figure 5-3: Number of Airprox involving commercial aircraft and investigated by the UKAB per year (*Data Source*: [119])

[a]No data is available on risk categories.

Final Report

The final report is compiled by adding the statement of causal factors and safety recommendations if applicable, to the initial investigation report. The majority of the safety recommendations by the UKAB are addressed either to the CAA, the MOD or jointly to both. It is a well-established practice that the CAA and the MOD respond to the safety recommendations [69].

In addition, the pilots and the air traffic controllers involved in the occurrence each receive their own full copy of the final report. In order to encourage an open and honest reporting environment, names of companies and individuals are not published in the reports [113].

Twice yearly, the UKAB produces the AIRPROX Report Book, which collates the Airprox occurrence reports and records the CAA's responses to the recommendations. It also contains the statistical and trend analysis of the Airprox [116].

5.2.4 Confidential Human Factors Incident Reporting Programme (CHIRP)

The Confidential Human Factors Incident Reporting Programme (CHIRP) is a voluntary, confidential, and non-punitive incident reporting system, maintained by the CHIRP Charitable Trust.

CHIRP currently receives confidential incident reports from professionally licensed pilots, air traffic controllers, licensed engineers, cabin crew members, and employees of approved maintenance organizations and design and production organizations within the air transport industry in the U.K. The General Aviation programme is also available to all General Aviation communities [23].

History

CHIRP was established in 1982 to identify and resolve a wide range of safety-related issues in the U.K. air transport industry and to supplement the CAA's MOR Scheme.

In 1996, the programme was restructured and the CHIRP Charitable Trust, a charitable company limited by guarantee, was established to maintain the programme. This corporate structure was selected in order to assure the independence from all regulatory, managerial

and employee-related interests [23], [98].

Program Management

The CAA is funding CHIRP, and a Board of Trustees holds management and fiscal responsibilities for the charity. Currently, the Board of Trustees is comprised of 14 members, including the Chief Inspector of the AAIB and the Group Director of the CAA [98]. The Board of Trustees together with 18 nominees from the principal air transport interests including the CAA comprise the Air Transport Advisory Board. Separate General Aviation Board and Cabin Crew Advisory Board have also been formed to assist with General Aviation reports and cabin crew reports respectively. The composition of the Advisory Boards is reviewed every three years to ensure that the membership is appropriate to the scope of the programme. Advisory Board members act as individual expert advisors and not as representatives of their sponsoring organizations.

The main roles of the Advisory Boards are to review the de-identified reports and to suggest the most appropriate way to resolve specific issues. The Advisory Boards also advise the Trustees on the performance of the programme.

In order to keep the programme effective, the annual performance reports are submitted to the programme sponsors and circulated widely to operational management. Additionally, the programme is subject to an independent review every five years. The review is conducted by members of the Advisory Boards and other industry specialists including the staff of the CAA. The terms of reference for the review should be agreed with the CAA [98].

Reports

The number of reports submitted to CHIRP by year is shown in Figure 5-4.

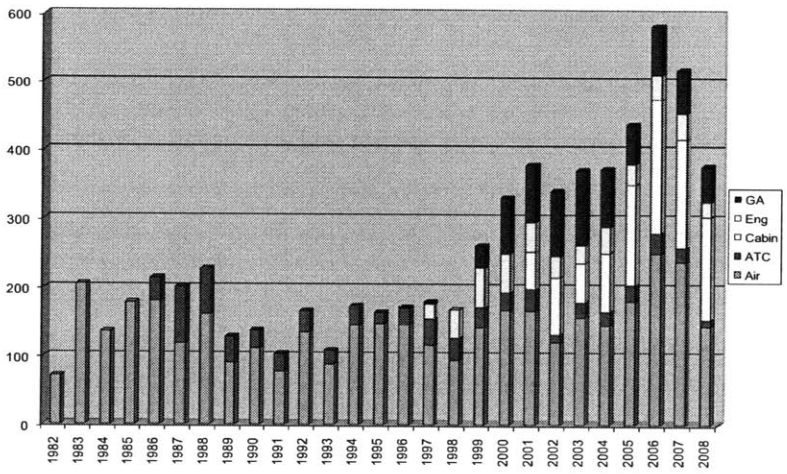

Figure 5-4: Number of reports submitted to CHIRP [98]

Confidentiality

On receiving reports, CHIRP validates them as far as possible. Anonymous reports are not normally acted upon as they cannot be validated. No personal details are retained from reports received. After ensuring that the report contains all relevant information, all personal details are returned to the reporter with an acknowledgment letter. Each report is allocated a unique reference identification so that the reporter can contact the CHIRP office for additional information using this reference identification. After the return of personal details, CHIRP is no longer able to contact the reporter.

By this means, the confidentiality of the reporter is assured. Only after all means of identifying the individual reporter are removed from reports, is information provided to the Advisory Boards. When appropriate, report information is also discussed with relevant agencies with the aim of finding a resolution. Again, only de-identified data are used in discussions with the third party organizations [23].

The de-identified data are recorded in a secure database for analysis of key topics and trends. They are made available to other safety systems and professional bodies [23]. Since the CHIRP Charitable Trust is not a government agency, it is not covered by the Freedom of Information Act in the U.K. [72].

Immunity

The CHIRP reports are handled on a strictly confidential basis, but it is possible that an incident reported to CHIRP may also be reported independently to the CAA by a third party.

In preparing for such a case, Aeronautical Information Circular P17/2009 [114] assures that the CAA will not "institute proceedings in respect of unpremeditated or inadvertent breaches of the law that are the subject of a CHIRP report and which come to its attention from such a third party report, except in cases involving dereliction of duty amounting to gross negligence."

Publication of Safety Bulletins

CHIRP publishes and distributes a quarterly newsletter Air Transport FEEDBACK to all commercially licensed pilots, air traffic controllers, and engineering personnel. The FEEDBACK covers the summary statistics and selected topics from de-identified reports, and suggestions for avoiding recurrences.

To cabin crew members, a separate quarterly Cabin Crew FEEDBACK is available. In addition, a quarterly General Aviation FEEDBACK containing reports of particular interest to light aircraft operations or leisure flying is distributed to the General Aviation communities. Before publishing each FEEDBACK, the relevant Advisory Board reviews the final draft [23].

Access to the Database

Unlike the ASRS of the U.S., the CHIRP database is confidential and is not made available to the public for secondary analysis [18].

5.2.5 Confidential/Voluntary Reporting Systems of the CAA

The CAA has its own confidential reporting system and voluntary reporting system. However, both systems are managed as a part of the MOR Scheme, and differ in characteristics from other voluntary reporting systems, including CHIRP, as discussed below. These reporting systems are little used at present [98], therefore, this thesis does not treat them as targets of comparative analysis.

Confidential Reporting System of the CAA

Under the MOR Scheme, if the scheme requires the submission of a report, but a reporter considers that it is essential that his/her identity not be revealed, the reporter can submit a report with clear annotation "CONFIDENTIAL" directly to the Safety Investigation and Data Department(SIDD), the Safety Regulation Group (SRG) of the CAA.

The request will be respected and the reporter will be contacted personally, either by the Head of SIDD or his deputy. A database entry will be made based on the de-identified report and will only be accessible by restricted users. The original report will eventually be destroyed.

However, the CAA cannot guarantee confidentiality when an occurrence is reported separately by another party or where Article 142 (17) of Air Navigation Order 2005 applies in respect to gross negligence. Reporters must also accept that effective investigation may be inhibited [116].

Voluntary Reporting System of the CAA

The voluntary reporting system of the CAA encourages reporting by persons or organizations across the whole spectrum of U.K. civil aviation operations, who are not required to report in accordance with the requirements of Air Navigation Order 2005.

The reporting criteria is the same as that of the MOR Scheme. Therefore, the CAA's organization and procedures for processing and recording reports do not substantially differentiate between voluntary and mandatory reports.

The voluntary reports, if published, will be published in a limited format which removes information and data which is likely to identify the reporter, as stipulated by Air Navigation Order 2005 [116].

5.2.6 Exchange of Information between EU Member States

The number of safety-related occurrences in individual states may not be sufficient to give an early indication of potentially serious hazards or to identify meaningful trends. Therefore, the EU Member States, including the U.K., have been exchanging the safety information with each other since 2005.

Directive 2003/42/EC of the European Parliament and of the Council stipulates that a

competent authority in Member States shall store information on safety-related occurrences including accidents and serious incidents in their database. The Directive also stipulates that the Member States shall participate in the exchange of the information by making available all information stored in their databases to the competent authorities of the other Member States and the Commission, and the Commission shall adopt measures for the dissemination of information to interested parties.

In accordance with Directive 2003/42/EC, Commission Regulation No.1321/2007 lays down implementing rules for the exchange of information. This regulation obliges the Commission to set up and manage a central repository to store all information received from the Member States. In addition, Commission Regulation 1330/2007 lays down implementing rules for the dissemination of the information to interested parties. In the U.K., Article 142 of Air Navigation Order 2005 stipulates the requirements above.

To assist the authorities in the EU in implementing the legislation, the European Co-ordination Centre for Accident and Incident Reporting Systems (ECCAIRS), a co-operative network of European Transport Authorities and Accident Investigation Bodies, was set up. ECCAIRS is being managed by the Joint Research Centre (JRC) of the European Commission.

What hinders the exchange of safety information between states the most is the incompatibility of the data storage formats. To overcome this obstacle, the JRC developed a software framework called ECCAIRS Reporting System. Since 1998, it has been distributed to authorities in the EU and other interested parties and has been used as a standard and flexible tool to collect, exchange, and analyze aviation safety information.

The ECCAIRS Reporting System is now becoming a de-facto standard beyond the EU. In 2004, ICAO adopted it to implement the new ADREP System. In addition, it was also adopted in many countries such as Brazil and South Korea. In 2007, a bi-directional data link between the EU and China was developed in co-operation with the Chinese Civil Aviation Administration [34].

5.3 Rulemaking Process

As described in Section 5.1, the rulemaking responsibility for aspects regarding aviation safety in the U.K. has been transferred from the CAA to EASA since 2003, and a broad

scope of rules will be covered by EASA's regulatory system in the future. Therefore, this thesis will discuss the rulemaking process in EASA rather than discussing that in the CAA of the U.K.

5.3.1 Legal Structures

Regulation (EC) No.216/2008 of the European Parliament and of the Council of the European Union

Regulation (EC) No.216/2008 of the European Parliament and of the Council of the European Union sets common rules in the field of civil aviation. The Regulation defines the scope of powers transferred from the Member States to the European Union, and is referred to as Basic Regulation.

Historically, Regulation (EC) No.1592/2002 of the European Parliament and of the Council of the European Union, which was adopted in July 2002, established EASA and gave the Agency responsibility for the airworthiness and environmental certification of all aeronautical products, parts and appliances designed, manufactured, maintained, or used by persons under the regulatory oversight of EU Member States. This includes all post-certification activities, such as the approval of changes to, and repairs of, aeronautical products and their components, as well as the issuing of airworthiness directives. Furthermore, EASA was charged with the oversight of EU organizations involved in the design of aeronautical products, parts and appliances as well as of non-EU organizations involved in the manufacture or maintenance of such products. In these domains, EASA has taken over the certification tasks that had been under the responsibility of Member States.

Regulation No.216/2008, which was adopted in February 2008, repealed Regulation (EC) No.1592/2002 and extended the scope of Community competence to air operations, flight crew licenses and aircraft used by third country operators into, within or out of the Community and gave the Agency additional operational responsibilities.

EASA is currently developing the related implementing rules on these additional competences, and EASA will exercise these competences once they become applicable.

Regulation (EC) No.2042/2003 of the Commission of the European Communities

Regulation (EC) No.2042/2003 of the Commission of the European Communities defines Implementing Rules for the Basic Regulation. It is on the continuing airworthiness of aircraft and related products, parts and appliances, and on the approval of organizations and personnel involved in these tasks. Details are stipulated in its Annexes, as shown in Table 5.2.

Table 5.2: Annexes of the Regulation (EC) No.2042/2003

Annex	Part	Contents
Annex I	Part-M	Continuing Airworthiness Requirements
Annex II	Part-145	Maintenance Organisations Approvals
Annex III	Part-66	Certifying Staff
Annex IV	Part-147	Training Organisations Requirements

Regulation (EC) No.1702/2003 of the Commission of the European Communities

Regulation (EC) No.1702/2003 of the Commission of the European Communities also defines Implementing Rules for the Basic Regulation. It is for the airworthiness and environmental certification of aircraft, and related products, parts and appliances, as well as for the certification of design and production organizations. Details are stipulated in Part 21 of its Annex.

The Basic Regulation and its Implementing Rules are legally binding and called "Hard Law." EASA does not have a legal authority to amend the Basic Regulation and its Implementing Rules. Instead, EASA prepares a draft of legislation and submits it as an opinion to the European Commission. It is further processed either by the European Parliament, the Council of the European Union, or the European Commission before the legislation is enacted.

Certification Specifications (CS)

EASA develops the Certification Specifications (CS) for the application of the Basic Regulation and its Implementing Rules. They are used in the certification process, and include the Airworthiness Codes and the Acceptable Means of Compliance (AMC).

Airworthiness Codes are issued as standard means to show compliance of products, parts and appliances with the essential requirements for airworthiness of aircraft laid down in Annex I to the Basic Regulation. Such codes are sufficiently detailed and specific to indicate to applicants the conditions under which certificates will be issued.

The CS does not constitute mandatory requirements and is simply the technical interpretation of the regulations.

Acceptable Means of Compliance (AMC)

The Acceptable Means of Compliance (AMC) illustrates means by which a requirement contained in the Basic Regulation, its Implementing Rules, and Airworthiness Codes, can be met by applicants.

The AMCs are not the only means for applicants to demonstrate compliance, and are not legally binding. The applicant can always choose to demonstrate compliance by other means. However, an applicant correctly implementing an AMC issued by EASA is assured of acceptance of compliance.

In addition to EASA, the National Aviation Authorities (NAAs) may also issue their own national AMCs, based or not on those issued by EASA. In such cases, EASA monitors that the NAAs manage the issuance process in a correct manner, and checks that these national AMCs actually provide for compliance with the applicable requirements.

Guidance Material (GM)

The Guidance Material (GM) is a non-binding material issued by EASA that illustrates the meaning of the Implementing Rules or Certification Specifications. The GM does not provide presumption of compliance when used in the certification process. While the regulations are referred to as "Hard Law," the CS, AMC, and GM, all of which are not legally binding, are referred to as "Soft Law" [30], [31].

5.3.2 Main Participants in Rulemaking Process

Executive Director

The Executive Director sets overall policy and direction for regulatory development activities. He/she approves the Rulemaking Programme and all final rules, including an opinion to the European Commission concerning regulations, the CS, AMC, and GM [32].

Rulemaking Directorate

The Rulemaking Directorate manages overall rulemaking activities. Publication of Notice of Proposed Amendment (NPA) and Comment Response Document (CRD) and the composition of Rulemaking Group and Review Group need approval by the Rulemaking Director [32].

Operational Directorates

Operational Directorates evaluate a proposal for rulemaking and determine whether they are accepted into the Rulemaking Programme. They are consulted on a draft of NPA, CRD, and final rule before publication. They nominate candidates for a Rulemaking Group [32].

Safety Standards Consultative Committee (SSCC)

The Safety Standards Consultative Committee (SSCC) is comprised of representatives from organizations and trade associations representing industries, professions and end user groups concerned. The tasks of the SSCC include providing EASA with advice on the content, priorities and execution of the Rulemaking Programme. The SSCC nominates candidates for a Rulemaking Group [32].

Advisory Group of National Authorities (AGNA)

The Advisory Group of National Authorities (AGNA) is comprised of one person per Member State, who represents those National Aviation Authorities. In addition to the tasks assigned to the SSCC, the AGNA fulfills a task of providing EASA with opinions when EASA receives major objections from the NAAs in Member States in the Notice of Proposed Amendment (NPA). The AGNA also nominates candidates for a Rulemaking Group [32].

Rulemaking Group

EASA may make use of outside resources for rulemaking except for the development of the GM, which EASA develops solely with its own staff. The Rulemaking Director invites the SSCC and the AGNA to nominate candidates. In addition to the Operational Directorates, foreign regulatory authorities such as the FAA are also consulted to nominate candidates if a task has common interest. The group size should not exceed six persons in normal cases, and members of Rulemaking Group are appointed by the Rulemaking Director [32].

Review Group

EASA Management Board Decision 08-2007 [29] requires that comments received in the Notice of Proposed Amendment (NPA) are also reviewed by appropriately qualified experts not directly involved in the drafting of the proposed rule. Its purposes are to improve the quality of agency measures and to ensure fair and appropriate treatment of all comments received.

A Review Group is composed of the Rulemaking Group and two additional members. One must be a person involved in standardization inspections in the domain affected by the proposed rule. The other person must be chosen to ensure that opposing views are duly represented in the review of comments and the drafting of the final rule.

The Agency invites the SSCC and AGNA to provide their opinion on the Review Group composition. The Review Group composition is then approved by the Rulemaking Director [32].

5.3.3 Public Consultation Requirements

EASA Management Board Decision 08-2007 [29] prescribes that public consultation is required for the development of rules, which cover the opinions concerning the scope and content of the Basic Regulation and its Implementing Rules, the CS, AMC, and GM.

Notice of Proposed Amendment (NPA)

EASA must publish a Notice of Proposed Amendment (NPA) for each rulemaking. In addition to the proposed rule, it must include a full RIA and details of significant or contentious issues identified during the drafting process. As regards the GM, it is sufficient that the

NPA contains a justification and the proposed new or amended material.

Prior to drafting an NPA, Terms of Reference (ToR) is developed by the Rulemaking Officer in accordance with the Rulemaking Programme. The ToR is approved by the Rulemaking Director through consultation with the AGNA and the SSCC.

The NPA is drafted in accordance with the corresponding ToR, and a full RIA is also developed in parallel. In those cases where the NPA contains provisions to be applied by Member States, its copies must be transmitted to national authorities.

After approval by the Rulemaking Director, the NPA is published for consultation. Generally, the consultation period is three months.

The review of comments is done by a Review Group. As regards the GM, a review of comments is done by the EASA staff or a rulemaking group, without the need for review by experts not involved in drafting. The received comments and the agency's responses and dispositions are consolidated into a CRD.

If the comments received from the NAAs in Member States indicate major objections to the proposed rule, EASA must consult the AGNA to discuss the rule further. In those cases when the disagreement still remains after the consultation with the AGNA, the results of this consultation and the impact and consequences of the agency's decision must be included in a CRD.

After approval by the Rulemaking Director, EASA publishes the CRD. In general, EASA publishes the CRD within three months of the expiry of the consultation period. When a text revised based on the results of NPA differs significantly from the original one, a further consultation round must be considered [32].

Advanced Notice of Proposed Amendment (A-NPA)

EASA may issue an Advanced Notice of Proposed Amendment (A-NPA) when it needs a broader discussion of new concepts or further information or data prior to the drafting of an NPA. In addition to an explanatory note, the A-NPA must contain either an outline of a proposed rule or various options to address an issue with explanation for each.

EASA determines the length of the consultation period for each case. The publication of the A-NPA does not necessarily mean EASA will proceed to an NPA after that [29].

Final Rule

The adoption and the publication of the final rule needs approval by the Executive Director. In order to allow sufficient time for consultees to respond its contents, Decision 08-2007 prescribes that EASA shall issue its decision in respect to all the rules except the GM, no earlier than two months following the date of publication of the CRD.

5.3.4 Regulatory Impact Analysis Requirements

Decision 08-2007, in its Article 3 and 5, prescribes that the Regulatory Impact Assessment (RIA) is required for the opinions concerning the scope and content of the Basic Regulation and its Implementing Rules and the Certification Specifications.

In EASA, the RIA is conducted in pace with the public consultation, and the required level of the RIA is different for the Annual Rulemaking Programme and the NPA. First, the Decision 08-2007 prescribes that the Annual Rulemaking Programme shall be supported by a preliminary RIA of each of the rules envisaged. A preliminary RIA evaluates the pros and cons of undertaking a rulemaking action. Such evaluation must be sufficient to demonstrate that serious consideration has been given to a range of possible options. In addition to the "do nothing" option, all other options must be considered, in particular non-regulatory options such as developing economic or procedural incentives to encourage industries to take particular approaches.

Second, Decision 08-2007 prescribes that each NPA shall include a "full" RIA. It requires quantifying, as much as is feasible, impacts on all categories of affected persons for each options identified in a preliminary RIA. Generally, a full RIA includes the following [32]:

Purpose and intended effect

The item describes an issue to be addressed and a perceived importance of the issue, and includes a brief statement of the objectives of the NPA.

Options

The item describes all options to deal with the issue and identifies a preferred option among them.

Sectors concerned

The item identifies the sectors of the civil aviation community including authorities

within the regulated domain, which will be affected. If appropriate, the number of organizations, persons, and aircraft, which will be affected should also be evaluated. Only those sectors that are directly affected need to be considered.

Impacts

The item evaluates all the possible impacts resulting from the considered option on all concerned sectors. The methodology used and any underlying assumptions must be explained. The impacts must be evaluated for each category listed below.

Safety

All safety impacts of the considered option must be identified and, wherever possible, quantified. The evaluation must include an identification of hazards and a classification of risks taking into account the probability of occurrences and the severity of effects.

Economic

All economic impacts of the considered option must be identified and, wherever possible, quantified. If it is impossible to quantify the economic impacts, the evaluation must describe how the concerned sectors are affected by the different options.

Environmental

Any significant environmental impact must be identified.

Social

Any positive or negative social impacts must be identified, such as on employment, working hours, working conditions, movement of personnel and health.

Other aviation requirements outside EASA scope

When the proposal may have an impact on other aviation requirements outside the scope of EASA, such as security, Air Traffic Management, and airports, the relevant regulatory bodies must be consulted.

Foreign comparable regulatory requirements

When the proposal may have an impact on the competitiveness of European industry or create conflict with foreign regulatory requirements, a comparison with such foreign requirements must be made and the quantitative consequences of differences must be assessed.

In addition to the impacts described above, the equity and fairness issues must also be identified. That is, an option may be undesirable which is likely to have the largest positive impacts but impose negative impacts on specific concerned sectors. The distribution of positive and negative impacts among the various concerned sectors must therefore be analyzed in detail.

Summary and final assessment

In summary, for each option being evaluated, the positive and negative impacts must be compared, and which sectors and persons are affected by these impacts and analysis of fairness and equity issues must be stated. Lastly, a final assessment must be made and a preferred option must be recommended.

5.3.5 Annual Rulemaking Programme

Decision 08-2007 requires that EASA shall establish an Annual Rulemaking Programme in consultation with the SSCC and AGNA. As stated, the programme must be supported by a preliminary RIA of each of the rules envisaged, and the priorities must be set for each task, taking account of the preliminary RIA and the agency's resources. All rulemaking activities must be initiated in accordance with these priorities. The SSCC and AGNA advise EASA on the priority of items, the scope and content of the items, timing, and working methods.

During the development process, EASA also consults with the Civil Aviation Authorities in third countries such as the FAA and Transport Canada, with which EASA has signed an arrangement for cooperation in rulemaking. The authorities exchange their views on respective rulemaking intentions, priorities and possible contentious issues. They identify tasks of common interest that need to be co-ordinated and determine how they will be executed.

The Annual Rulemaking Programme is verified by the Rulemaking Director and approved by the Executive Director. Once approved, the programme is made available to the public [32].

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Chapter 6

Australia

6.1 Organizations

6.1.1 Civil Aviation Authority: Civil Aviation Safety Authority (CASA)

The Civil Aviation Safety Authority (CASA) was established in 1995 as an independent statutory authority, which conducts the safety regulations of civil aviation in Australia. [17].

The objectives, strategies and policies to be followed by CASA are decided by the Board, whose members are appointed by the Minister for Infrastructure, Transport, Regional Development and Local Government. The Chief Executive Officer, who manages CASA, is responsible to the Minister [14].

6.1.2 Investigation Authority: Australian Transport Safety Bureau (ATSB)

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government Statutory Agency, and conducts the investigations of aviation, marine, and rail road accidents and incidents. It also administers aviation voluntary reporting systems.

The ATSB was established by the Transport Safety Investigation Act 2003 (TSI Act), and entirely separate from transport policy makers, industry operators, and from transport regulators such as CASA. The ATSB is managed by a Commission, which is constituted by a full-time Commissioner and two part-time Commissioners. The Minster for Infrastructure, Transport, Regional Development and Local Government appoints them. The Minister may appoint additional part-time Commissioners where their expertise is required for a

significant investigation. The ATSB has approximately 110 staff members, including about 60 aviation, marine and rail safety investigators [12].

6.2 Reporting and Investigation Systems

In Australia, other than an accident and incident reporting and investigation system by the ATSB, CASA has the Service Difficulty Reporting System. As regards the voluntary reporting systems, the ATSB has two systems: REPCON and the Aviation Self Reporting Scheme (ASRS).

6.2.1 Accident and Incident Reporting and Investigation System

The Transport Safety Investigation Act 2003 (TSI Act) defines an accident including aviation, marine, and railroad accidents as follows (Section 3).
"Accident means an investigable matter involving a transport vehicle where:

(a) a person dies or suffers serious injury as a result of an occurrence associated with the operation of the vehicle; or

(b) the vehicle is destroyed or seriously damaged as a result of an occurrence associated with the operation of the vehicle; or

(c) any property is destroyed or seriously damaged as a result of an occurrence associated with the operation of the vehicle."

The TSI Act does not define incidents and serious incidents. Instead, the Act defines the "Transport Safety Matters" which include occurrences from fatal accidents to minor incidents. (Refer to Appendix B, Section B.3, Subsection B.3.1.)

The Transport Safety Matters are classified into "Immediately Reportable Matters" and "Routine Reportable Matters," and reporting requirements are different for each of them. If a responsible person has knowledge of an Immediately Reportable Matter, the person must report it to the ATSB as soon as is reasonably practicable, and give a written report within 72 hours (except otherwise specified by the ATSB) (TSI Act, Section 18 and 19).

On the other hand, a responsible person is not required to report a Routine Reportable Matter immediately; instead, the person must give a written report within 72 hours (except otherwise specified by the ATSB) to the ATSB (TSI Act, Section 19).

The lists of Immediately Reportable Matters and Routine Reportable Matters are prescribed in the Transport Safety Investigation Regulations 2003, and are different for air transport operations and other operations (Regulation 2.3 and 2.4) (Refer to Appendix B, Section B.3, Subsection B.3.2).

Airprox is defined as "an occurrence in which 2 or more aircraft come into such close proximity that a threat to the safety of the aircraft exist or may exist, in airspace where the aircraft are not subject to an air traffic separation standard or where separation is a pilot responsibility" (Regulation 2.2). It should be noted that Airprox are immediately reportable matters for air transport operations and routine reportable matters for other operations.

The ATSB may investigate any transport safety matters, yet it investigates them selectively. Accidents and serious incidents, as defined by Annex 13, have priority for investigation, yet not all of them are investigated. The aim is to concentrate the limited resources on those investigations considered most likely to enhance aviation safety [8].

Categories of Investigation Level

On receiving an initial notification, the ATSB will decide what actions to take. The initiation of formal investigation can only be made at or above Team Leader level after discussion and agreement with the Deputy Director and Executive Director. Each investigation will be categorized on a Level 1 to 5 in order of priority. For example, accidents involving aircraft without fatalities and serious incidents, where the potential safety lessons do not justify the commitment of investigative resources after an initial review, are classified as Level 5 and only basic data will be filed for statistical purposes [13].

Following the initial assessment of occurrence and the allocation of investigation level, a decision will be made whether or not to conduct on-site investigation. Other actions taken by the ATSB may be a request for more information from an owner, employer or other party or an entry of accident or incident details into the ATSB's Safety Investigation Information Management System (SIIMS). The data entered into the database is used for future safety research and analysis [7], [8], [13].

Subsequently, the investigation may be upgraded or downgraded. The decision to upgrade and commit extra resources or to downgrade must be made at Deputy Director level after discussion with the Executive Director. Any decision to discontinue must be endorsed by the Executive Director [13].

A guidance on the categorization of transport safety matters is provided by the ATSB. (Refer to Appendix C.) It is intended to serve as a suggested starting point based on initial notification [13].

Level 5 Investigations

Recently, the ATSB has decided to gather additional factual information on all aviation accidents and serious incidents which were categorized in the initial decision as Level 5, with exception of high risk personal recreation or sports aviation or experimental aircraft operations. The aim is to address the risk posed by having to make decisions on whether to conduct an investigation within a short time frame based on preliminary information only. The additional information gathered enables a more informed decision. In addition, it is expected that further publicly available information on accidents and serious incidents would increase safety awareness in the industry and enable improved research activities and analysis of safety trends [11].

The ATSB established a small team to manage and process these factual investigations, the Level 5 Investigation Team. The primary objective of the teams is to undertake limited-scope fact-gathering investigations. The team compiles a short summary report, which contains the information on the circumstances surrounding the occurrence and what safety action may have been taken or identified as a result of the occurrence. The summary report will be collated and released to the public on a periodic basis. The implementation of the Level 5 Investigations just commenced in December 2009, and it will take some time for it to be fully adopted [11].

CASA will be provided with copies of all ATSB occurrence reports available. Database records are available for all occurrences regardless of categorization and will be provided on request [4].

Final Report and Safety Recommendations

After the investigation, the ATSB publishes a report and may issue safety recommendations to the relevant organizations. The organization that received the recommendations must give a written response to the ATSB within 90 days (TSI Act, Section 25 and 25A).

Such a response must contain

- whether it accepts the recommendation (in whole or in part); and

- if it accepts the recommendation (in whole or in part), details of any action that it proposes to take to give effect to the recommendation; and

- if it does not accept the recommendation (in whole or in part), the reasons why it does not accept the recommendation (in whole or in part).

Investigative Priority

If an aircraft accident investigation involves other police inquiries, the investigators of the ATSB will assist where possible, within the constraints of the legislation, provided this does not compromise their own investigation. If early evidence suggests the accident was the result of unlawful interference, the police normally directs the investigation and the ATSB does not investigate the accident [6].

6.2.2 Service Difficulty Reporting System

The Civil Aviation Regulations 1988 stipulates that those who own, operate, or maintain the aircraft or aircraft components shall report major defects discovered to CASA, and when those who detected the defects do not own aircraft or aircraft components, they shall report to the owner. Civil Aviation Advisory Publication (CAAP) 51-1(1) [15] lists the examples of the major defects to be reported to CASA. (Refer to Appendix B, Section B.3, Subsection B.3.5.)

Additionally, the Civil Aviation Safety Regulations 1998 stipulates that the holder of a Type Certificate, a Supplemental Type Certificate, an Australian Parts Manufacturer Approval, or an Australian Technical Standard Order authorisation, or the licensee of a type certificate or supplemental type certificate must report to CASA any failure, malfunction, or defect of aircraft, aircraft components or parts or manufacturing process that has resulted, or that has left its quality control and that could resulted in the occurrences listed in the regulation (For the list of the occurrences, refer to Appendix B, Section B.3, Subsection B.3.4). The Airworthiness Standards Branch has the primary responsibility for the system.

CAAP 51-1(1) describes the aim of the Service Difficulty Reporting (SDR) System as follows.

(a) permit timely airworthiness control action in the Australian aircraft fleet;

(b) assist in long term improvement in design, manufacturing and maintenance standards; and

(c) permit the assessment of risk levels in the Australian aircraft fleet.

CASA will

- Assess each report for airworthiness safety implications, both in itself and in relation to previous similar reports.
- Forward reports regarding Australian type certificated products to the relevant certificated holder and monitor these reports and the associated actions.
- When the defect or deficiency is found in the product of other countries, advise the overseas civil aviation authorities and the organizations who have a responsibility for the airworthiness of the product such as the holder of Type Certificate and the Australian Parts Manufacturing Approval.
- When appropriate, takes action such as the introduction or amendment of regulations or issue mandatory maintenance instructions such as Airworthiness Directives.

CASA also uses the information obtained through the SDR system as a basis for safety information such as the Airworthiness Bulletins, CAAPs, Advisory Circulars, and Flight Safety Australia articles [16].

The data obtained through the SDR system is entered into a computer database system. From this database, information may be obtained to provide reliability statistics and trend monitoring of aircraft, engines, propellers, systems, and components. CASA shares this information with the FAA and Transport Canada [15].

CASA publishes monthly and yearly summaries on the Internet. Archived records are also available from the Maintenance Standards Branch SDR Unit [15].

6.2.3 REPCON

REPCON is a voluntary confidential reporting system established in 1988, which mainly aims at reports not indicating contraventions of safety regulations. REPCON is managed by the ATSB.

The establishment of REPCON is based on Section 20A of the TSI Act, and the Air Navigation (Confidential Reporting) Regulations 2006 stipulates the scheme in detail.

The regulations prescribe the primary purpose of the scheme as follows:

(a) to provide a confidential reporting scheme for reportable safety concerns: and

(b) to use the reports made under the scheme to identify unsafe procedures, practices or conditions; and

(c) to provide information to the aviation industry about an identified unsafe procedure, practice or condition to facilitate safety awareness and safety action and improvements by other persons and organisations.

As the secondary purpose of the scheme, providing information, arising from reports, about aviation security concerns to an appropriate person or organisation to facilitate security awareness is stated in the regulations.

Reportable Matters

REPCON is not limited to persons in aviation community, but it allows any persons who observe or become aware of an aviation safety concern to report it to the ATSB. In addition to incidents and circumstances that affect the safety of air navigation and non-compliance with the safety regulations, the Air Navigation (Confidential Reporting) Regulations 2006 list the examples of the reportable unsafe practices, procedures, or conditions which may be reported as follows:

(i) poor training, behaviour or attitude displayed by an aircraft operator, airport operator or air traffic control service provider; or

(ii) insufficient qualifications or experience of employees of the aircraft operator, airport operator or air traffic control service provider; or

(iii) scheduling or rostering that contributes to the fatigue of employees of the aircraft operator, airport operator or air traffic control service provider; or

(iv) an aircraft operator, airport operator or air traffic control service provider bypassing safety procedures because of operational or commercial pressures; or

(v) inadequate airport facilities for safe operations; or

(vi) unsafe passenger, baggage or cargo management; or

(vii) inadequate traffic or weather information;

Following matters are not reportable under REPCON:

(a) acts of unlawful interference with an aircraft

(b) reports of conduct that represents a serious and imminent threat to a person's health or life

(c) industrial relations

(d) conduct that may constitute an offense against the law punishable by a maximum penalty of life or more than two years imprisonment

If a report relates to an act of unlawful interference, the ATSB informs the Office of Transport Security in the Department of Infrastructure, Transport, Regional Development and Local Government of the report and may send the report or the information from the report to the Office (the Air Navigation (Confidential Reporting) Regulations 2006, Regulation 16).

Confidentiality

In order to secure the confidentiality of reporters, the regulations stipulates that the ATSB may not disclose information from a report unless all personal information has been removed with some exceptions such as when the report relates to an act of unlawful interference.

In practice, when received reports, REPCON staff assess them for clarity, completeness and significance for aviation safety. As a general rule, REPCON does not accept anonymous reports because REPCON staff cannot contact a reporter to verify the report or to seek additional information. In addition, the staff must be convinced that the reporter's motivation for reporting is aviation safety promotion, and that the reporter is not attempting to damage a rival or pursue an industrial agenda [9] .

Once satisfied that the report is as complete as possible, the staff enter the de-identified contents of the report into the REPCON database, which allocates the report a unique

identification number. The report is returned to the the reporter or destroyed (the Air Navigation (Confidential Reporting) Regulations 2006, Regulation 11(4)).

Immunity

Under REPCON, non-compliance with the Civil Aviation Act 1988, the Civil Aviation Orders, the Civil Aviation Regulations 1988 (CAR) or the Civil Aviation Safety Regulations 1998 (CASR) is also reportable. However, REPCON does not provide immunity from enforcement actions. Instead, another voluntary reporting system named Aviation Self Reporting Scheme (ASRS), which will be discussed in the next section, provides immunity. A reporter seeking protection from administrative enforcement action by CASA should consider reporting to the ASRS and whether they meet its criteria. REPCON is a broader scheme designed to capture a wide range of aviation safety concerns from a larger pool of potential reporters than ASRS [9].

Publication of Information Bulletin and Provision of De-identified Data to CASA

REPCON may use the de-identified version of the report to issue an information brief or alert bulletin to a person or responsible organization to take actions in response to the safety concern. Additionally, the de-identified report may be passed on to CASA to make the organization aware of unsafe practices, procedures, or conditions [9].

6.2.4 Aviation Self Reporting Scheme (ASRS)

The Aviation Self Reporting Scheme (ASRS) is a system for voluntary and confidential reporting of contraventions of the regulations and commenced in 2004. As with REPCON, the ASRS is managed by the ATSB.

The Civil Aviation Act 1988 as amended by the Civil Aviation Amendment Act 2003 and the CASR as amended by the Civil Aviation Safety Amendment Regulations stipulate the ASRS. The CASR prescribes the purposes of the scheme as follows:

(a) to enable holders of civil aviation authorisations to voluntarily report reportable contraventions without administrative action being taken against them; and

(b) to strengthen the foundation of aviation human factors safety research; and

(c) to identify deficiencies and problems in the Australian aviation safety system; and

(d) to provide data for planning and improvements to the Australian aviation safety system.

Reportable Matters

The holders of civil aviation authorisation such as pilots, mechanics and flight radio telephone operators who have committed a contravention of the CAR or the CASR can report to the ATSB.

The following are not reportable under ASRS (CASR, Regulation 13.325):

1. a contravention that is deliberate;
2. a contravention that is fraudulent;
3. a contravention that causes or contributes to an accident or to a serious incident (whether before or after the cause contravention is reported.)
4. a contravention of a regulation that is prescribed [under the CASR].

The CASR also lists the contraventions of the CAR which are not reportable such as the offenses relating to licenses, certificates and authorities and the detention of aircraft. If a report relates to an act of unlawful interference, the ATSB must send the report to the Office of Transport Security in the Department of Infrastructure, Transport, Regional Development and Local Government (CASR, Regulation 13.355).

Immunity

The ASRS assures protection from administrative action for the contravention of regulations reported. However, to claim such protection, an authorisation holder must make a written report of the reportable contravention not rater than 10 days after the reportable contravention.

If the ATSB accepts a report, the ATSB gives a receipt to the authorisation holder. The authorisation holder must keep the receipt to claim protection from the administrative action. The ASRS is not intended to be a whistle-blowing scheme and the protection will only apply to the person who reports the contravention. Further, it is not the intention of the ASRS to protect an authorisation holder from prosecution action [109].

The authorisation holder can claim the protection from CASA exercising a power to vary, suspend or cancel their civil aviation authorisation if the authorisation holder produces the receipt provided to them by the ATSB to CASA to show that the authorisation holder reported the contravention to the ATSB within 10 days after the contravention and before the holder was given the show cause notice for the proposed decision. To claim the protection, the authorisation holder must produce the receipt to CASA before CASA varies, suspends or cancels the authorisation.

Similarly, when an infringement notice is issued, the authorisation holder is not required to pay the penalty specified in the infringement notice and the notice is withdrawn if the authorisation holder produces the receipt provided to them by the ATSB to CASA to show that the holder reported the contravention to the ATSB within 10 days after the contravention and before the holder was given the infringement notice. To claim the protection, the authorisation holder must produce the receipt to CASA before the due date for payment of the penalty specified in the infringement notice.

The holders of a civil aviation authorisation may make a report as often as they wish, but they will be able to claim protection from administrative action only once every five years (Civil Aviation Act 1988).

The report, receipt or any other evidence of the fact that a report of a reportable contravention was made by the authorisation holder are not admissible as evidence in criminal proceedings against the reporter (Civil Aviation Act 1988).

Confidentiality

The regulations stipulate that the ATSB must not keep a copy of a report made under the ASRS but return the report to the reporter with a receipt number.

Before returning a report, the ATSB stores the information in the files or databases primary kept for the ASRS. The regulations also stipulate that when storing the information, the ATSB must ensure that the information that identifies the authorisation holder who made the report or any person referred to in the report is not included to the extent practicable.

The ATSB may disclose the de-identified information without the consent of the reporter but only if the information is to be used for the ASRS purposes mentioned above (CASR).

Publication of Information Bulletin and Provision of De-identified Data to CASA

As with REPCON, the ATSB issues information briefs or alert bulletins. The ATSB publishes details of reviews of the information contained in reports including the identification of potential hazards, with other trend data.

In addition, de-identified data based on the ASRS reports will from time to time be provided to CASA for the purposes of aviation safety [10].

6.3 Rulemaking Process

6.3.1 Legal Structures

Civil Aviation Act 1988

The Civil Aviation Act 1988 establishes CASA with functions relating to civil aviation, in particular the safety of civil aviation and for related purposes. Section 98 of the Act gives the Governor-General of the Commonwealth of Australia the power to make regulations generally in relation to the safety of air navigation. Generally, the Act does not contain detailed rules governing aviation safety. These matters are mainly left to regulations that are made under the Act.

The Act falls under the responsibility of the Minister for Infrastructure, Transport, Regional Development and Local Government. Amendments to the Act require the approval of the Cabinet or the Prime Minister, the Department of Infrastructure, Transport, Regional Development and Local Government, and CASA. They must be passed by both Houses of Parliament and assented to by the Governor-General [17].

Airspace Act 2007

The Airspace Act 2007 gives CASA the power to administer and manage Australian-administered airspace. The Act also requires the Minister for Infrastructure, Transport, Regional Development and Local Government to make an "Australian Airspace Policy Statement" outlining the administration and management of Australian-administered airspace [17].

Civil Aviation Regulations 1988 (CAR) and Civil Aviation Safety Regulations 1998 (CASR)

The Civil Aviation Regulations 1988 (CAR) and the Civil Aviation Safety Regulations 1998 (CASR) are regulations made under the Civil Aviation Act 1988.

These regulations provide the general regulatory controls over air navigation safety. The regulations set out in some detail the safety standards that are required in relation to airworthiness of aircraft, licenses and ratings of operating crew and maintenance personnel, air traffic control, rules of air, dangerous goods and many other safety issues.

The CAR and the CASR are referred to as delegated legislation. Delegated legislation is a generic title given to instruments signed by the Governor-General, a Minister, or an official empowered by an Act, and issued under that Act. The Parliament does not debate delegated legislation and does not vote to accept or reject it, before it is made effective.

The CAR and the CASR are drafted by the Office of Legislative Drafting and Publishing (OLDP) in the Attorney-General's Department (AGD), with legal drafting instructions by CASA. The policy content of the CAR and the CASR must be cleared with the Department of Infrastructure, Transport, Regional Development and Local Government and legal clearance must be obtained from the OLDP. The regulations are formally made by the Governor-General in Executive Council (EXCO) on advice from the Minister for Infrastructure, Transport, Regional Development and Local Government.

The CAR and the CASR are disallowable instruments for the purposes of the Legislative Instrument Act (LIA) 2003, and these regulations, once made, must be tabled in Parliament, and are subject to disallowance [17].

Civil Aviation Orders (CAOs)

The Civil Aviation Orders (CAOs) set out CASA's directions and instructions in matters of complex detail. They typically contain technical details and requirements that complement the requirements set out in the regulations.

The CAOs also come within the definition of delegated legislation. However, they are generally made under the authority of the regulations rather than the Civil Aviation Act itself. They can only be made provided that the regulations authorize CASA to issue the CAO on that particular matter. The CAOs are signed and issued by the Director of Aviation

Safety of CASA.

The CAOs are also disallowable legislative instruments for the purposes of the LIA 2003, and must be tabled in Parliament and are subject to disallowance [17].

Manual of Standards (MOS)

A Manual of Standards (MOS) is comprised of detailed technical material prescribed by CASA, and of uniform specifications and standard application, determined to be necessary for the safety of air navigation.

The CASR authorizes CASA to issue standards/technical specifications in a MOS in relation to detailed technical matters as referenced in the associated regulation. The relevant CASA Group General Manager (GGM) is responsible for the technical policy content of a MOS. As with the CAOs, a MOS is signed and issued by the Director of Aviation Safety of CASA.

A MOS is also a disallowable legislative instrument for the purposes of the LIA 2003, and must be tabled in Parliament and is subject to disallowance [17].

Acceptable Means of Compliance (AMC)

The Acceptable Means of Compliance (AMC) is an advisory material issued by CASA, which serves as means by which the requirements contained in the CASR and associated with a certificate, license, permission, approval or other authorization can be met by the applicant.

The AMC sets out one or more acceptable methods of demonstrating compliance with a specific regulation, and is not legally binding. Applicants are free to put forward alternative methods of compliance. However, if an applicant follows the relevant AMC, the applicant is assured of satisfying the associated regulatory requirements.

The publication of an AMC or amendment to it must be approved by the relevant CASA GGM responsible for the technical policy and activity the AMC relates to. The AMCs are not disallowable legislative instruments for the purposes of the LIA 2003 [17].

Other Advisory Publications

In addition to the AMCs, CASA issues other advisory publications to explain the intent of the legislation and provide additional information on the reasons for the legislation and how

to apply it. The advisory publications are issued under various names, including, Civil Aviation Advisory Publications (CAAPs), Advisory Circulars (ACs), and Guidance Materials (GMs).

The publication of new CAAPs, ACs and GMs, or amendments to them, is approved by the relevant CASA GGM after consultation with the aviation industry or community. These various publications are not disallowable legislative instruments [17].

Regulatory Reform

CASA is currently undertaking a programme of regulatory reform to validate, update and consolidate its regulatory requirements for aviation safety. Regulatory requirements currently contained in the CAR and the CAOs are progressively being published in the new CASR.

The MOSs, the AMCs, the GMs, and the ACs are new legislations, which are currently being phased in and being maintained whereas the CAOs and the CAAPs are old legislations, which are currently being phased out [17].

6.3.2 Main Participants in Rulemaking Process

Chief Executive Officer (CEO)

The Chief Executive Officer (CEO) sets overall policy and direction for regulatory development activities. He/she approves a proposed CAR and CASR and forwards them to the Minister for Infrastructure, Transport, Regional Development and Local Government, and Executive Council for approval and making. He/she also approves the CAOs and the MOSs [17].

Planning and Governance Office (PAGO)

The Planning and Governance Office (PAGO) oversees CASA's regulatory development program, and coordinates and facilitates major regulatory projects. The Regulatory Development Management Branch (RDMB) coordinates and manages CASA's regulatory development activities. The roles of the RDMB include publishing consultation documents and preparing Regulatory Impact Statements (RISs) [17].

Legal Services Group (LSG)

The Legal Service Group (LSG) provides legal support for all legal issues in CASA. The LSG also drafts all new or amended CAOs, MOSs and other legislative instruments issued by CASA [17].

Operational Groups

Operational groups initiate a rulemaking process that falls within their jurisdiction. They provide a team leader and staff for a Project Team. Examples of operational groups include the Air Transport Operations Group (ATOG) and Airspace and Aerodrome Regulation Group (AAR). Group General Managers (GGMs) usually serve as Project Sponsors and approve regulatory and other documentation for public consultation and final publication [17].

Project Team

The Project Team usually consists of CASA staff designated by a Project Sponsor and industry subject matter experts nominated by the Standards Consultative Committee (SCC) and approved by a Project Sponsor. Generally, the number of team members does not exceed six [17].

Office of Best Practice Regulation (OBPR)

The Office of Best Practice Regulation (OBPR) is a division within the Department of Finance and Deregulation. The OBPR has been assigned a central role in improving the quality of regulation by administering Australian Government's best practice regulation requirements.

For example, the OBPR examines the adequacy of Regulatory Impact Statements (RISs) prepared by agencies. It also promotes the government-wide consultation principles and provide guidance on consultation in the policy development process [17].

Office of Legal Drafting and Publishing (OLDP)

The Office of Legal Drafting and Publishing (OLDP) is an office within the Attorney-General's Department. It is responsible for drafting regulations and for giving advice about

drafting and interpreting legislative instruments across Government. The OLDP drafts all of the new or amended CAR and CASR [17].

Standards Consultative Committee (SCC)

The Standards Consultative Committee (SCC) serves as the principal consultative body used by CASA to provide advice and recommendations to CASA on regulatory issues and proposals and associated documentation.

The SCC is composed of approximately 40 Australian industry bodies and operates through six subcommittees that broadly represent the various functional sectors of the aviation industry.

The principal roles of the SCC are:

- To provide advice to CASA on regulatory proposals and issues identified in DPs, NPRMs, NPCs and in draft CAAPs, ACs, AMCs and GMs.
- To assist CASA in identifying regulatory implementation issues and coordinating implementation activities.
- To provide advice to CASA on other aviation safety issues that have regulatory implications.
- To nominate industry subject matter experts to participate in regulatory development project teams.
- To Assist CASA in assigning priorities amongst regulatory development projects.
- To assist CASA to determine the impact, costs and benefits of regulatory proposals.

Project Team consults with the SCC regarding all regulatory and non-regulatory proposals before they are published for industry and public comment [17].

Regulatory Advisory Panel (RAP)

The Regulatory Advisory Panel (RAP) conducts an independent review and provides advice to the CEO on a proposed CASR Part and, where applicable, the associated MOS, prior to submission of the regulations to the CEO and publication of the Notice of Final Rule Making (NFRM) in relation to that Part.

The RAP is not intended to review the content of the particular CASR Part. Rather, it reviews whether proper procedures were followed during a development process of the new CASR Part, and whether industry views were fully considered [17].

6.3.3 Public Consultation Requirements

In 2006, the Australian Government adopted a government-wide policy on consultation, which sets out "best practice" principles to be followed by all agencies when developing regulations. This policy contains seven principles for best practice consultation: Continuity, Targeting, Appropriate Timeliness, Accessibility, Transparency, Consistency and Flexibility, and Evaluation and Review[a] [5].

CASA is responsible under Section 9 and 16 of the Civil Aviation Act 1988 for "promoting full and effective consultation and communication with all interested parties on aviation safety issues," and must, in performing its functions and exercising its powers, where appropriate, "consult with government, commercial, industrial, consumer and other relevant bodies and organisations." CASA conducts public consultations for the development or amendment of the CAR, the CASR, the CAOs, the MOSs, and the associated advisory publications [17].

Discussion Paper (DP)

CASA may issue a Discussion Paper (DP), which sets out issues and possible solutions, to seek a preliminary public comment as to whether CASA should proceed with new legislation or should initiate a change to existing legislation. In particular, CASA is required to issue a DP for matters of major significance.

The concept for initial consultation by way of a DP needs an approval from the Project Sponsor. The DP is pre-released to the SCC and relevant subcommittees for comments, before it is published for broader industry and public comments.

The Project Leader is responsible for reviewing comments. An evaluation of the DP comments may determine whether or not CASA will proceed with the proposal.

Where CASA intends to proceed with the proposal, the consolidation of the comments, CASA's responses, and the disposition actions are folded into the subsequent NPRM as an Annex [17].

[a]For details, refer to Appendix D.

Notice of Proposed Rule Making (NPRM)

A Notice of Proposed Rule Making (NPRM) is necessary for a proposal for new and amended regulatory policies affecting the CAR, the CASR, and the CAOs. The development of an NPRM for formal consultation purposes must be authorized by the Project Sponsor.

In most cases, the NPRM describes the proposed policy intent and outcomes rather than detailing the specific regulations. If possible, it should include other options considered, together with identification of the broad constraints that might make options unviable and a cost-benefit analysis of each option.

Normally, drafts of related advisory material are developed simultaneously with the new or amended regulations. They are incorporated into an Annex to the NPRM.

In addition, in cases when the CASR Part is newly developed and the technical specifications and standards identified as applicable to the CASR Part are to be mandated by way of a MOS, the MOS is also developed simultaneously. In such a case, a proposed draft MOS will be incorporated into an Annex to the NPRM.

An NPRM is pre-released to the SCC and relevant subcommittees for comments, before it is published for broader industry and public comments. The Project Sponsor gives a final approval for publishing the NPRM.

Currently, regulatory development policy allows eight weeks for the comment period of the NPRM. After the comment period closes, the Project Team consolidates all comments and prepares a Summary of Responses (SOR) that describes the comments received and how they were disposed of. This will be published in a Notice of Final Rule Making (NFRM).

After the final policy has been established with the authorization by the Project Sponsor, final drafting instructions will be sent to the OLDP. The drafted regulations will then also be made available to the aviation industry and public for further comments prior to finalization of the regulations.

In cases when an existing MOS is amended, all proposed amendments must be made available to the public. The public consultation on proposed amendments to the MOS takes the form of a Notice of Proposed Change (NPC) and follows a process similar to that for NPRMs. As for advisory materials, they are published in draft form for comments before they are finalized [17].

Notice of Final Rule Making (NFRM)

At the conclusion of the consultation process, the Notice of Final Rule Making (NFRM) is published. The NFRM closes the consultation on the particular proposal.

The NFRM includes the final regulation and an SOR. It may be accompanied by a final relevant MOS and all advisory materials, if any. If necessary, an RIS is finalized after the draft NFRM is prepared.

As with an NPRM, an NFRM is pre-released to the SCC and relevant subcommittees for comments, before it is published for broader industry and public comment. In addition, when a new CASR Part is being developed, a RAP is convened to conduct an independent review of the final regulations. The RAP is not intended to conduct a general review of technical or policy content relating to the particular CASR Part. Rather, the RAP reviews whether Government and CASA policies for regulatory development were followed in the development process. The Project Sponsor gives the final approval for publishing the NFRM.

In cases when an existing MOS is amended, the final MOS is published in the form of a Notice of Final Change (NFC), and its publication follows a process similar to that for NFRMs [17].

6.3.4 Regulatory Impact Analysis Requirements

The Australian Government has adopted a three-tiered system for assessing all regulatory and quasi-regulatory proposals[b] [5].

As for the legislations related to CASA, proposals to amend the Civil Aviation Act 1998, the CAR, and the CASR and regulatory changes passed through as Civil Aviation Orders are subject to this requirement [17].

To determine which level of analysis is appropriate, a preliminary assessment must be undertaken for all proposals.

- For proposals that will have no or low impacts on business and individuals or the economy (including no or low compliance costs), no additional regulatory analysis or documentation is required.

[b]The Best Practice Regulation Handbook of the Australian Government [5] explains "Quasi-regulations" as follows: "Quasi-regulation includes a wide range of rules or arrangements where governments influence businesses and individuals to comply, but which do not form part of explicit government regulation. Broadly, whenever the Government takes action that puts pressure on businesses to act in a particular way, the Government action may be quasi-regulatory."

- For proposals that are likely to involve medium business compliance costs, a full (quantitative) assessment of the compliance cost implications must be carried out using the Business Cost Calculator (BCC) or an approved equivalent.

- For proposals that are likely to have a significant impact on business and individuals or the economy (whether in the form of compliance costs or other impacts), a more detailed analysis must be undertaken and documented in a Regulation Impact Statement (RIS). If the impacts include medium or significant business compliance costs, the RIS should include a full (quantitative) assessment of these costs using the BCC or an approved equivalent.

Figure 6-1 shows the three-tiered system.

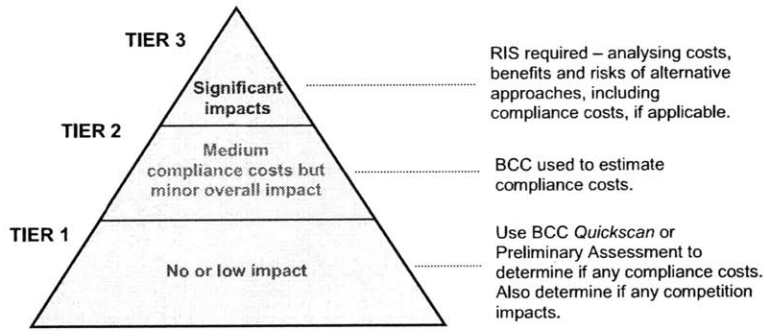

Figure 6-1: Three-tiered system of Regulatory Impact Analysis in the Australian Government [17]

Below are descriptions of the assessments conducted in a preliminary assessment [5], [17].

Business Compliance Costs Assessment

As the first step of the preliminary assessment, Business Compliance Costs Assessment identifies whether the proposal will impose compliance costs on business. Compliance costs are defined as the direct costs to businesses of performing the various tasks associated with complying with government regulations.

In the assessment, whether the proposal involves any of nine categories of compliance tasks are examined. These nine categories are: (1) Notification, (2) Education, (3) Permission, (4) Purchase Cost, (5) Record Keeping, (6) Enforcement, (7) Publication and

Documentation, (8) Procedural, and (9) Other. If the proposal involves any of the nine categories, then, whether the impact on business is low, medium, or significant is assessed.

In general, compliance costs to business would be low when only a few businesses are affected and the costs are negligible or trivial. Proposals that have a broad impact (that is, affect a large number of businesses), or involve a cost per business that is not negligible (in relation to the size of businesses involved), would not be considered to generate low compliance cost impacts.

Assessment of Other Impacts on Business and Individuals or the Economy

As the second step of the preliminary assessment, the assessment of whether the proposal will have any other potential impacts on business and individuals or the economy is conducted.

"Other impacts" capture the range of impacts a proposal may have that may not be classified as a compliance cost. They include financial and non-financial impacts, direct and indirect impacts, and market and non-market impacts, and they may be positive or negative. For example, questions that need to be answered in the assessment include the following: (1) Whether the proposal will potentially affect the number and range of businesses in an industry. (2) Whether the proposal will potentially change the ability of businesses to compete. and (3) Whether the proposal will potentially alter the incentives for business to compete.

Below are descriptions of the BCC Report and the RIS [5], [17].

BCC Report

The BCC Report contains a full assessment of the compliance cost of policy options. The BCC is an IT-based tool designed to assist policy officers in estimating business compliance costs of various policy options.

Based on the information on the policy options entered by policy officers, the BCC provides a range of reports about compliance costs, including compliance costs by task, compliance costs by cost categories, a summary report of total compliance costs, and a summary of supporting evidence. The BCC Report is an executive summary of these reports.

While there is no formal requirement to publicly release the BCC Reports, the government agencies and departments are strongly encouraged to do so. Where there are likely to be significant compliance costs, the quantification of these costs will form part of the RIS.

Regulation Impact Statement (RIS)

An RIS is a document which formalizes and provides evidence of the key steps taken in accordance with the Government's best practice regulation principles. It includes an assessment of the costs and benefits of each option, followed by a recommendation supporting the most effective and efficient option. An RIS should be prepared following consultation with affected parties, and it ensures that all relevant information is documented, and that the decision-making processes are made explicit and transparent.

An RIS has seven elements which set out:

(1) The problem or issues that give rise to the need for action;

(2) The desired objectives;

(3) The regulatory and/or non-regulatory options that may constitute viable means for achieving the desired objectives;

(4) An assessment of impact (costs, benefits and, where relevant, levels of risk) on consumers, business, government, and the community of each option;

(5) A consultation statement;

(6) A recommended option; and

(7) A strategy to implement and review the preferred option.

There are a number of additional elements that may be required in an RIS, depending on the nature of the proposal. While there is no formal requirement to publicly release the RIS, government agencies and departments are strongly encouraged to do so.

The Office of Best Practice Regulation (OBPR) has outlined the following key steps to be followed for an RIA to meet the government requirements [5], [17]. Figure 6-2 shows the key steps.

Step 1: Analyze the problem

The first step is to examine the problem to be addressed, identify the Government's

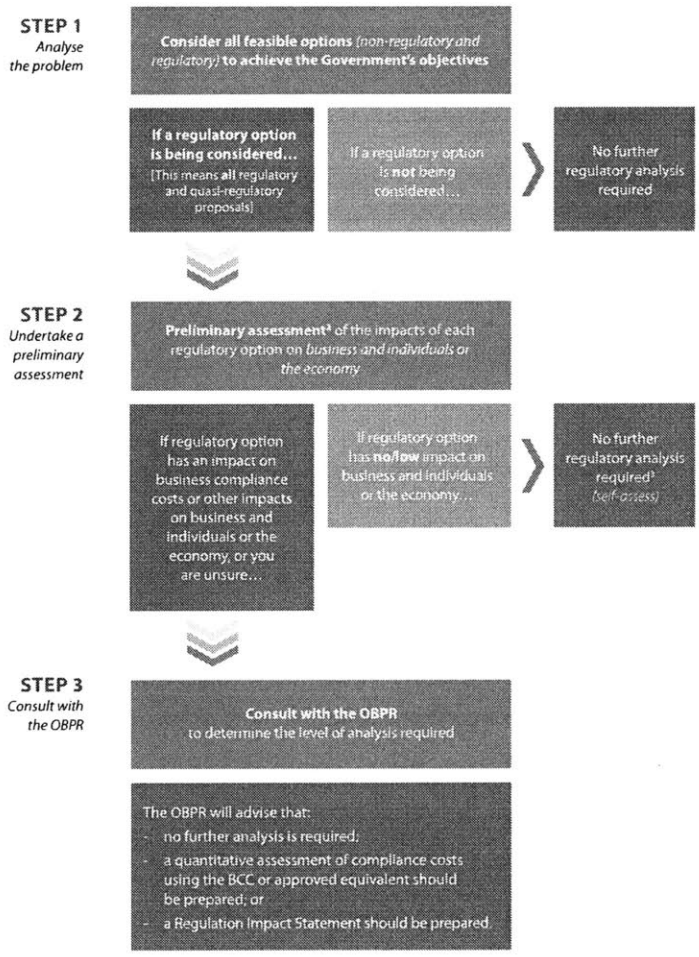

Figure 6-2: Steps for Regulation Impact Analysis in the Australian Government [17]

objectives, and consider all feasible options (non-regulatory and regulatory) to achieve the objectives. If only non-regulatory options are considered, no further regulatory analysis is required.

Step 2: Undertake an assessment

The second step is a preliminary assessment to identify whether the proposal will have any business compliance costs and whether it will have any impacts on business and individuals or the economy. If the preliminary assessment indicates the proposal will have no or low compliance costs and no or low other impacts on business and individuals or the economy, no further regulatory analysis is required.

Preliminary assessment should be informed by consultation with stakeholders.

Step 3: Consult with the OBPR

Once the preliminary assessment indicates that there may be medium or significant compliance costs or medium or significant other impacts on business and individuals, or the economy, the OBPR should be consulted through the Regulatory Impact Analyst. The OBPR determines whether a BCC Report and/or an RIS is required as follows:

- The proposal is likely to have no/low impacts and no further analysis is required;
- The proposal is likely to have medium compliance costs and a quantitative assessment of compliance costs should be prepared using the BCC or an approved equivalent; or
- The proposal is likely to have significant impacts on business and individuals, or the economy, and an RIS should be prepared, which may be required to include a quantitative assessment of business compliance costs.

The Australian Government has decided that, in the absence of exceptional circumstances as agreed by the Prime Minister, a regulatory proposal which falls within the last two cases listed above cannot proceed to the Cabinet or other decision makers unless it has complied with the regulatory impact analysis requirements [5], [17].

6.3.5 Annual Regulatory Plan

The Australian Government requires all agencies, including CASA, to prepare and publish an Annual Regulatory Plan to provide stakeholders with an early indication of potential regulatory changes. Proposals requiring further analysis such as a BCC Report or RIS and reviews of regulations should be included in the plan. The plan contains information about recent changes to existing legislation and planned regulatory activities, including a description of the issue, information about consultation opportunities, and an expected timetable [5], [17].

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Chapter 7

Japan

7.1 Organizations

7.1.1 Civil Aviation Authority: Civil Aviation Bureau of Japan (JCAB)

The Civil Aviation Bureau of Japan (JCAB) is one of the 13 bureaus of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), which oversights the civil aviation activities in Japan. The authority of the MLIT on civil aviation derives mainly from the Act for Establishment of the Ministry of Land, Infrastructure, Transport and Tourism and the Civil Aeronautics Act.

The bureau conducts various functions related to civil aviation, such as negotiation for air agreements with foreign countries, formulation of airport policies, and promulgation of the safety regulations. The bureau consists of four departments, and the Engineering Department is mainly responsible for the safety regulations of aircraft and its operations.

7.1.2 Investigation Authority: Japan Transport Safety Board (JTSB)

The Japan Transport Safety Board (JTSB) is one of the external organ of the MLIT, and conducts investigations of aircraft, marine and railway accidents and serious incidents. The authority of the Board derives from the Act for the Establishment of the Japan Transport Safety Board. The Board consists of the chairperson and 12 members, who shall be appointed by the Minister of Land, Infrastructure, Transport and Tourism with the consent of both Houses of the Diet. The Minister may appoint part-time Expert Advisors.

Historically, the aircraft accident investigation had been conducted by Aircraft Accident

Investigation Division within the Ministry of Transport in Japan. For serious accidents for which the division lacked enough resources to conduct the investigation, an ad-hoc investigation team comprised of the staff from the Civil Aviation Bureau, the staff from airlines and academic experts was formed for each accident. In 1974, Aircraft Accident Investigation Division was abolished, and the Aircraft Accidents Investigation Commission (AAIC) was established as a permanent council within the Ministry. In 2000, railway accident investigation was also mandated by the Diet to the AAIC, and the name of the commission was changed to the Aircraft and Railway Accidents Investigation Commission (ARAIC).

In 2008, the Japan Transport Safety Board (JTSB) was newly established as an external organ of the MLIT by the integration of the ARAIC and the Japan Marine Accident Inquiry Agency (JMAIA)At the same time, the power of the JTSB was enhanced compared with the power the ARAIC had. For example, the ARAIC was only able to make recommendations to the Minister of Land, Infrastructure, Transport and Tourism, whereas the JTSB is also able to make recommendations to other organizations involved and is able to request reports from them [83]. In the year 2008, the JTSB had 181 staff members [59].

7.2 Reporting and Investigation Systems

In Japan, other than an accident and serious incident reporting and investigation system by the JTSB, the JCAB has a mandatory incident reporting system as well as a mandatory Service Difficulty Reporting System. As regards the voluntary reporting systems, there is the Aviation Safety Information Network (ASI-NET), which is managed by a third party organization.

7.2.1 Accident and Serious Incident Reporting and Investigation System

Article 76 of Civil Aeronautics Act stipulates that the pilot in command or the operator of the Aircraft shall report to the Minister of Land, Infrastructure, Transport and Tourism in the event of any of the following accidents.

(i) Crash, collision, or fire of aircraft

(ii) Injury or death of any person, or destruction of any object caused by aircraft

(iii) Death (except those specified in Ordinances of the Ministry of Land, Infrastructure, Transport and Tourism) or disappearance of any person on board the aircraft

(iv) Contact with other aircraft

(v) Other accidents relating to aircraft specified in Ordinances of the Ministry of Land, Infrastructure, Transport and Tourism

The Ordinance for Enforcement of Civil Aeronautics Act specifies the exception of death in item (iii) as follows:

(i) Death from natural causes

(ii) Death from self-infliction or infliction by other persons

(iii) Death of those hiding outside the areas normally available to the passengers and crew

The Ordinance specifies the other accidents relating to aircraft in item (v) as the events where aircraft during flight sustains damage which would require major repair, except when the damage is limited to the engine, its cowlings or accessories, propellers, wing tips, antennas, tires, brakes, or fairings (Article 165-3).

Article 76-2 of the Act stipulates that the pilot in command or the operators of the aircraft shall report the serious incidents to the Minister, and the Ordinance lists the types of serious incidents to be reported. (Refer to Appendix B, Section B.4, Subsection B.4.1.) The Near Midair Collision (NMAC), which is defined as "an event when the pilot in command has recognized during flight that there was a danger of collision or contact with any other aircraft" is included in Article 76-2.

The Act for Establishment of the Japan Transport Safety Board, which stipulates the mandate of the JTSB and the procedures to be followed in the investigations, stipulates that the Minister shall report to the JTSB when the Minister receives a report of an accident or a serious incident.

In accordance with the Act for Establishment of the Japan Transport Safety Board, the Board investigates all the accidents and serious incidents reported by the Minister. The JTSB does not have such a party system as the NTSB has, and the JCAB does not participate in the investigation process unless the JTSB requests the assistance from the Minister.

Investigative Priority

The Act does not stipulate the priority of the JTSB in the accident investigation over other government agencies such as the police. The police can enter the scene of accident and conduct an independent investigation. Therefore, a conflict between the JTSB and the police can arise during an investigation.

In order to avoid such a conflict, the Ministry of Transport and the National Police Agency (NPA) signed a memorandum in 1972, and the AAIC and the NPA set the related detailed rules in 1975. According to the memorandum, when the AAIC enters the scene of the accident, the office of the aircraft operator, or any other places deemed necessary, examines the aircraft wreckage or related materials, or interrogates the person involved, unless such an action does not interfere with the investigation by the police, the AAIC must consult the police beforehand and must perform such an action to the extent that it does not interfere with the investigation by the police [62].

In addition, according to the detailed rules, it is the police that preserves the scene of the accident in principle. When both the AAIC and the police need to take custody of the aircraft wreckage or related materials, the policy takes custody of it based on the Code of Criminal Procedure. As for electric devices such as an FDR or a Cockpit Voice Recorder for which prompt analysis is needed, the police will entrust the analysis to the ARAIC as soon as the police takes custody of it [62].

In 2008, after the establishment of the JTSB, the MLIT and the NPA confirmed the validity of the memorandum of 1972 and signed a new memorandum, which states that neither agency has priority over the other. In the same year, the JTSB and the NPA set the new detailed rules on investigation, which are substantially the same as the rules set in 1975 [91].

Final Report and Safety Recommendations

After the investigation, the JTSB submits a report to the Minister and publishes it (Article 25). The JTSB may issue safety recommendations to the Minister and other relevant organizations. The Minister shall report the corrective actions which have been taken to the Board, and the organizations shall also do so if requested (Article 26 and 27).

7.2.2 Incident Reporting and Investigation System

Article 111-4 of the Civil Aeronautics Act stipulates that domestic air carriers shall, when an occurrence which affects normal flight operations of aircraft takes place, report the occurrence to the Minister. Article 221-2 of the Ordinance lists the types of the incidents to be reported. (Refer to Appendix B, Section B.4, Subsection B.4.1.) This article was added to the Act in October 2006, intended to supplement the accident and serious incident reporting to the JTSB.

Advisory Circular No.6-001 [75] and No.6-002 [76] impose additional reporting requirements. In accordance with the requirements of Annex 8 to the Chicago Convention, Advisory Circular 6-001 imposes on the operators of aeroplanes over 5,700 kg and helicopters over 3,175 kg maximum certificated takeoff mass the reporting requirements of the occurrences listed in the circular to the JCAB and to the organizations responsible for aircraft or aircraft components design. (For the list of the occurrences, refer to Appendix B, Section B.4, Subsection B.4.2.)

On the other hand, Advisory Circular No.6-002 requires the operators of aircraft, the organizations or those engaged in the repair or maintenance of the aircraft, aircraft components, equipment, parts, and emergency equipments to report the occurrences listed in the circular. (For the list of the occurrences, refer to Appendix B, Section B.4, Subsection B.4.3.) Some occurrences listed in Article 221-2 of the Ordinance and the Advisory Circulars are duplicative, yet a dual reporting is not necessary [76].

The operators can submit reports required by the Ordinance and Advisory Circular No.6-001 through the Internet to the Aviation Safety Information Management and Service (ASIMS) system installed in the JCAB. The descriptions that can be used to identify the individuals are removed from the reports. The reporters can access the de-identified reports including the one submitted in accordance with Advisory Circular 6-002 and other safety information posted in the ASIMS system [78].

For reference, the number of reports submitted in compliance with Article 111-4 of the Civil Aeronautics Act was 740 in the fiscal year 2007 and 856 in the fiscal year 2008 [79],[80].

Analysis

The JCAB conducts a statistical analysis on reports, particularly the ones submitted by the requirements of the Ordinance, and a detailed analysis of reports on the occurrence which it judges can significantly affect the safety of operations of aircraft. The JCAB also monitors the corrective actions for these reports taken by the operators.

Further, the JCAB established the Aviation Safety Information Analysis Committee, which is comprised of academic experts, experts from a broad range of aviation community and representatives from the JCAB. The committee analyzes the selected reports in detail, up to the root causes of occurrences including the organizational backgrounds that are deemed to have contributed the occurrences, and considers the measures to prevent the recurrence. The measures are later reflected in policies of the JCAB [80].

7.2.3 Aviation Safety Information Network (ASI-NET)

Aviation Safety Information Network (ASI-NET) is a confidential voluntary reporting system. The ASI-NET was established in order to collect the incident information in an integrated fashion, which had been done separately by some airlines, and to share the information among the airlines [2].

The ASI-NET has two separate networks: one for large aircraft for scheduled operation and one for Small Aircraft. The ASI-NET for Large Aircraft started to operate in 1999, and the ASI-NET for Small Aircraft started in 2004 [2]. At present, 19 airlines are participating in the ASI-NET for Large Aircraft, and 50 organizations other than the airlines are participating in the ASI-NET for Small Aircraft [3].

Management

The management organization of the ASI-NET comprises of the Management Office, the Steering Committee, and the Working Groups. The Management Office was established at the Association of Air Transport Engineering and Research (ATEC). The ATEC is a non-profit foundation established in 1989 with financial contributions from major airlines and is under the supervision of the MLIT. The role of the ATEC is to contribute to development of safe and efficient air transportation through research and educational activities [1].

Two corporate aggregates, the Japan Aircraft Pilot Association (JAPA) and the All

Japan Air Transport and Service Association, and a government research organization, the Japan Aerospace Exploration Agency (JAXA), collaborate with the Management Office [2].

The Steering Committee determines the overall policy on the management of the ASI-NET and deliberates and approves the recommendations or requests to relevant organizations drafted by the Working Groups. The Steering Committee has about 10 members and is comprised of aviation experts, human factor experts, legal experts, representatives from the pilot associations, and persons in charge of safety from the airlines. Neutrality and independence from the JCAB are assured for the Steering Committee.

The Working Groups analyze reports, draft the recommendation or request to relevant organizations. There are two separate working groups for the ASI-NET. The Working Group for the ASI-NET for the Large Aircraft has about 10 members and is comprised of pilots and ground personnel in charge of safety in participating airlines. The Working Group for the ASI-NET for Small Aircraft has about seven members and is comprised of pilots from the All Japan Air Transport and Service Association and the JAPA as well as researchers from the JAXA [2].

Reports

In the ASI-NET, individuals cannot report to the network directly. In the ASI-NET for Large Aircraft, pilots and flight engineers of participating airlines can report to the network through the internal reporting system of their company. In the ASI-NET for Small Aircraft, employees or constituent members of the participating organizations can report to the network through their organizations. Those who do not belong to the participating organizations of the network can report to the network through the JAPA [2].

The number of reports submitted to the ASI-NET by year is shown in Table 7.1.

Table 7.1: Number of reports submitted to the ASI-NET (*Data Source*: [2])

System (Network)	2004	2005	2006	2007	2008	Average
ASI-NET for Large Aircraft	55	65	87	71	94	74.4
ASI-NET for Small Aircraft	18	9	7	12	32	15.6

In addition to the incident information not required to be reported by statute, the ASI-NET for Large Aircraft also collects the information required to be reported by statute if it is related to human error or believed to be worth sharing. However, reports of violation of regulations that are deliberate or reports that accuse other people are not accepted under both ASI-NET networks [2].

Analysis

The Working Groups analyze the reports, identify the causes, and discuss the measures to be taken. The reports are de-identified before the Working Groups analyzes them.

Based on the analysis, the Working Groups draft the recommendations or requests to the JCAB, airlines, the JAPA, and other organizations responsible for aviation safety. The Steering Committee deliberates the proposal from the Working Groups and gives final approval for publication. From 2001 to 2008, the ASI-NET proposed 10 recommendations or requests [2].

Confidentiality and Data Protection

For the ASI-NET for Large Aircraft, each airline validates reports, selects the data to enter the database, de-identifies reports, and enters the selected data into the database. For the ASI-NET for Small Aircraft, on receiving reports, the Management Office of the ASI-NET validates its content. The office contacts the reporters or the organizations they belong to, if applicable. After the validation of the content, the office removes the information that could lead to the identification of the reporters, and enters the data into the database with the approval of its Working Group [2].

Since the ATEC is not a government agency, the Freedom of Information Act in Japan does not apply to it. Further, the JCAB has expressed in writing its policy regarding the ASI-NET as follows:

- The JCAB will not directly access the information which has been provided to the ASI-NET nor demand the information from the administrator of the ASI-NET.

- Even if the JCAB happens to know the information which has been provided to the ASI-NET in some way, the JCAB will not take administrative actions[a] based solely on

the information nor demand that information from the administrator of the ASI-NET with an aim of taking administrative actions [2].

The second item listed above can be interpreted to mean that immunity from the administrative actions is not guaranteed to the reporter in case there is sufficient evidence indicating the violations of the regulations. In addition, criminal acts are outside the scope of its protection [2].

Database Utilization

Participating organizations in the ASI-NET can access the database and the utilization of data is left at their discretion. Some companies disseminate the information to the employees via each company's media. The database is not available to the general public [2].

Publication of Safety Bulletin

The ASI-NET for Large Aircraft does not publish the safety bulletin. Only the ASI-NET for Small Aircraft publishes the safety bulletin called FEEDBACK with an approval from its Working Group [2].

7.3 Rulemaking Process

7.3.1 Legal Structures

Civil Aeronautics Act

The Civil Aeronautics Act, enacted in 1952, stipulates most of activities related to civil aviation such as aircraft registration, certification of the aircraft, certification of airmen, air traffic rules, and airport design. The Act also includes the commercial regulations, such as the provisions on the conditions of carriage established by the air carrier. Detailed rules are mainly left to the Ordinance for Enforcement of Civil Aeronautics Act.

The Act falls under the responsibility of the Minister of Land, Infrastructure, Transport and Tourism. The bills to amend the Act are normally drafted by the JCAB and are submitted to the Diet by the Prime Minister on behalf of the Cabinet. Before being brought

[a] "Administrative actions" used here include the suspension and revocation of the certification

to the Cabinet Meetings for decisions, the bills must clear the legal examination by the Cabinet Legislation Bureau. The bills must be passed by both Houses of Diet, and the new law are promulgated by the Emperor [74].

Cabinet Order for Enforcement of Civil Aeronautics Act

The Cabinet Order for Enforcement of Civil Aeronautics Act sets the rules to enforce the Act or designates the coverage of the Act. The Cabinet Order is enacted by the Cabinet on the basis of authorization by the Act.

Drafts to amend the Order must clear the legal examination by the Cabinet Legislation Bureau before being brought to Cabinet Meetings for decisions. After enacted by the Cabinet, the Cabinet Orders are promulgated by the Emperor [74].

Ordinance for Enforcement of Civil Aeronautics Act

The Ordinance for Enforcement of Civil Aeronautics Act is issued by the Minister on the basis of authorization by the Act and for the purpose of implementing the Act. The Ordinance also sets the rules to enforce the Act or designates the coverage of the Act.

Public Notices

The Public Notices are issued by the Minister to notify the public of various decisions, such as the coverage of the Act or the Ordinance. As with the Act, Cabinet Order, and the Ordinance, the Public Notices are published in the Official Gazette.

Advisory Circulars (ACs)

The Advisory Circulars (ACs) are non-binding materials issued by the JCAB that illustrate the meaning of the Act and the Ordinance and demonstrate acceptable methods of compliance with these legislations. The AC is developed by the JCAB office having primary responsibility for the subject of the AC.

7.3.2 Main Participants in Rulemaking Process

Minister of Land, Infrastructure, Transport and Tourism

The Minister of Land, Infrastructure, Transport and Tourism sets the overall policy and direction for regulatory development activities and approves bills and drafts of Cabinet Orders to be brought to Cabinet Meetings. He/she also issues Ordinances and Public Notices. Minister's Secretariat manages regulatory activities across the Ministry and provides legal support.

General Affairs Division of the JCAB

The General Affairs Division of the JCAB manages regulatory activities across the bureau and provides legal support. It serves as a liaison between the bureau and the Minister's Secretariat.

Operational Divisions

Operational divisions initiate a rulemaking process that falls within their jurisdiction. They provide a team leader and staff for a Project Team.

Project Team

The Project Team consists of staff provided by the relevant Operating Divisions. When deemed necessary, industry experts are invited to participate in the Project Team.

Cabinet Legislation Bureau

The Cabinet Legislation Bureau provides legal support for the Cabinet. It examines the bills drafted by the Ministries, drafts of Cabinet Orders, and drafts of treaties. It also gives opinions on legal issues to the Cabinet. The bills to amend the Civil Aeronautics Act and the drafts to amend the Cabinet Order for Enforcement of Civil Aeronautics Act are examined before being brought to the Cabinet Meetings for decisions [74].

7.3.3 Public Consultation Requirements

The Administrative Procedure Act (APA) sets out common rules concerning procedures for dispositions, administrative guidance and notifications, and procedures for rulemaking, which the Administrative Agencies must follow.

Among the rules related to the JCAB, the following are subject to public consultation requirements of the APA: the Cabinet Order for Enforcement of Civil Aeronautics Act and the Ordinance for Enforcement of Civil Aeronautics Act as well as the Public Notices which set out the requirements for administrative dispositions and the Advisory Circulars which set out review standards for applications seeking permissions or approvals, administrative disposition standards, and Administrative Guidance guidelines.

Notice of Proposed Rule Making (NPRM)

The APA stipulates that when the Cabinet or Administrative Organs establishes orders, regulations, review standards, disposition standards, and public Guidance guidelines, it shall publish the proposal together with its related materials.

The consultation period must be 30 days or more except when there are some compelling grounds. In such a case, the grounds must be shown at the same time as the publication of the NPRM. After the consultation period closes, the JCAB consolidates received comments, determines how they are disposed of, and prepares a summary of responses.

Final Rule

After the preparation of a summary of responses, the JCAB publishes the final rule. In particular, the JCAB publishes the amendment to the Cabinet Order and the Ordinance and the new or amendment to Public Notices in the Official Gazette. The APA stipulates that the Cabinet or Administrative Organs shall publish a summary of responses at the same time as the publication of the final rule.

Direct Final Rule

The APA stipulates that the NPRM procedure can be dispensed with in such cases as when there is an urgent need to establish rules for public interest and when merely a minor technical amendment is involved. In such cases, the Administrative Organs shall publish the grounds for it at the same time as the publication of the final rule.

Notice of Withdrawal

The APA stipulates that the Cabinet or Administrative Organs must publish a notice promptly when it determines to withdraw a proposal even though an NPRM was issued.

7.3.4 Regulatory Impact Analysis Requirements

The Government Policy Evaluation Act stipulates that the Administrative Organs shall carry out the ex-ante evaluation when they set policies that meet the following criteria.

(1) It is expected that administrative act pursuant to the policy has considerable impact on the lives of people and/or society and the economy, or a large amount of expense is incurred before the aims of the policy are achieved.

(2) It is established knowledge that the methods for acquiring information on the Effects of Policy and other methodologies required for the conduct of Ex-ante Evaluation have been developed.

The Cabinet Order for Enforcement of the Government Policy Evaluation Act sets the scope of the policies that are subject to the evaluation. Specifically, the policies that intend to newly develop, abolish, or modify the regulation by the establishment, revision or abolition of Acts or Cabinet Orders are included in the scope. With respect to policies that are not covered by the Government Policy Evaluation Act, the Administrative Organs are also encouraged to conduct an evaluation.

After a policy evaluation, the Administrative Organs shall prepare, publish, and forward a report to the Minister of Internal Affairs and Communications. The report should include:

Purpose, contents and necessity of the regulation

Other options

Whenever possible, other options including non-regulatory one should be presented.

Analysis of cost and benefit of the regulation

The cost and benefit of the regulation should be quantified whenever possible. Particularly, the analysis of the cost of the proposal should include the estimated compliance cost of businesses and administrative cost, together with the bearer of the cost. The impacts on competition conditions for businesses or the impacts on the environment should also be taken into account. If applicable, the analysis of the cost and benefit of other options should also be included.

Result of the evaluation

Result of the deliberations of advisory councils or opinions of knowledgeable persons

When there is a result of the deliberations of advisory councils or opinions of knowledgeable persons regarding the result of the analysis, they should also be included. Related information on such things as the references or the data used in the evaluation should also be included.

Time and conditions of policy review

The time and conditions when a review will be conducted to determine whether the established policy is appropriate in light of socioeconomic circumstances should be included [81].

In cases in which the development, revision or abolition of regulations is based on an act, the Administrative Organs should publish a report before the bill to amend the act is brought to the Cabinet Meetings for decisions. In cases when it is based on an Cabinet order or other subordinate legislations, they should include a report in the NPRM of the proposed regulation [81].

Chapter 8

Comparisons

This chapter conducts a comparative analysis of the feedback systems of the four states. In previous chapters, the reporting and investigation systems in each state were described. In addition, as one sort of corrective actions which are taken responding to the safety risk identified, the rulemaking processes in each Civil Aviation Authority were also described. Accordingly, this chapter is divided into two sections; in the first section, a comparative analysis of the reporting and investigation systems is presented. In the second section, a comparative analysis of the rulemaking process is presented.

8.1 Reporting and Investigation Systems

This section presents a comparison of the reporting and investigation systems in each state. First of all, this section describes that there are no substantial differences of the structure of the reporting and investigation system and the definition of the accident which must be reported to the Investigation Authority in each state.

Next, this section discusses a number of differences identified in the reporting and investigation systems. The thesis identified that there are differences in the threshold of incidents and other safety-related occurrences which must be reported to the Investigation Authority and Civil Aviation Authority. This thesis also identified that there are differences in the air proximity hazard reporting and investigation system in each state. The differences identified include a scope of air proximity hazard occurrences to be reported and investigated, whether reporting is mandatory or voluntary, and to whom the occurrences are reported.

In addition, this section discusses differences in voluntary reporting systems in each

state. Several differences were identified regarding the voluntary reporting systems, and each difference is presented in order. Furthermore, this section discusses the exchange of safety information between states.

Lastly, this thesis also identified a difference of how establishment of flight data analysis programs by airlines has been implemented in each state. This section concludes with a discussion of the policy implications which the difference has.

8.1.1 Structures of Reporting and Investigation Systems

As regards the structures of reporting and investigation systems in each state, it was found that there are no substantial differences among the four states. That is, in accordance with Annex 8 and Annex 13 of the Chicago Convention, all of the four states have the accident and serious incident reporting and investigation system of the Investigation Authority as well as the incident reporting and investigation systems of Civil Aviation Authority.

In addition, although Annex 13 of the Chicago Convention leaves the establishment of voluntary reporting systems at contracting states' discretion, the four states have at least one voluntary reporting systems as shown in Table 8.1.

Table 8.1: Voluntary reporting systems in each state

State	Voluntary Reporting System
U.S.	Aviation Safety Reporting System (ASRS)
	Aviation Safety Action Program (ASAP)
	Voluntary Disclosure Reporting Program (VDRP)
U.K.	Confidential Human Factors Incident Reporting Programme (CHIRP)
Australia	REPCON
	Aviation Self Reporting Scheme (ASRS)
Japan	Aviation Safety Information Network (ASI-NET)

8.1.2 Definitions of Accidents which must be Reported to the Investigation Authority

A comparison of the definitions of the accidents which must be reported to the Investigation Authority in each state was conducted. The regulations which define the accidents in each state are summarized in Table 8.2.

Table 8.2: Regulations which define the accidents

State	Regulations
U.S.	49 CFR Part 830 (Section 830.2)
U.K.	EU Council Directive 94/56/EC (Article 3) Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1997 (Regulation 2-1)
Australia	Transport Safety Investigation Act 2003 (Section 3 and Section 23) Transport Safety Investigation Regulations 2003 (Regulation 2.3 and 2.4)
Japan	Civil Aeronautics Act (Article 76) Ordinance for Enforcement of Civil Aeronautics Act (Article 165-3)

Through a comparison of the regulations in Table 8.2, it was observed that there are no substantial differences among the definitions of the accidents in each state, all of which basically follow the definition by ICAO (Refer to Subsection 3.2.1). That is, the accident is defined as an occurrence associated with the operation of an aircraft, in which a person is fatally or serious injured, the aircraft receives substantial damage, or the aircraft is missing or completely inaccessible.

8.1.3 Threshold of Incidents which must be Reported to the Investigation Authority

A comparison of the threshold of incidents which must be reported to the Investigation Authority in each state was conducted. The regulations which define the incidents or list the examples of the incidents which must be reported to the Investigation Authority in each state are summarized in Table 8.3.

Table 8.3: Regulations which define the incidents or list the examples of the incidents which must be reported to the Investigation Authority

State	Regulations
U.S.	49 CFR Part 830 (Section 830.5)
U.K.	EU Council Directive 94/56/EC (Article 3 and Annex) Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1997 (Regulation 2-1)
Australia	Transport Safety Investigation Regulations 2003 (Regulation 2.3 and 2.4)
Japan	Civil Aeronautics Act (Article 76-2) Ordinance for Enforcement of Civil Aeronautics Act (Article 166-4)

Through a comparison of the regulations in Table 8.3, two unique characteristics of Australia were observed.

1. The incidents which are required to be reported to the Investigation Authority are divided into two categories: the incidents which are required to be reported immediately ("Immediately Reportable Matters"), and the incidents which are not required to be reported immediately but are required to be reported within 72 hours ("Routine Reportable Matters").

2. Routine Reportable Matters for air transport operation include the incidents which are not considered serious incidents defined by ICAO, that is, "an incident involving circumstances indicating that an accident nearly occurred."

On the other hand, in the other three states, all reportable incidents must be reported immediately and are considered serious incidents defined by ICAO.

A rough comparison of the Immediately Reportable Matters and Routine Reportable Matters with the accidents defined by ICAO and the list of examples of serious incidents provided by ICAO is shown in Table 8.4.

Table 8.4: A rough comparison of the Immediately Reportable Matters and Routine Reportable Matters in Australia with the accidents defined by ICAO and the list of examples of serious incidents provided by ICAO

	Air Transport Operations	**Other Operations**
Immediately Reportable Matters	Accidents and Serious Incidents	Accidents
Routine Reportable Matters	Other Incidents	Serious Incidents

The incidents of air transport operations which are required to be reported to the Investigation Authority as "Routine Reportable Matters" in Australia but are not required to be reported to the Investigation Authorities in the other states include:

- Misinterpretation by a flight crew member of information or instructions;
- Breakdown of coordination, being an occurrence in which traffic related information flow within the air traffic service system is late, incorrect, incomplete, or absent;
- Failure or inadequacy of an air traffic control service or navigation facility; and
- An occurrence arising from incorrect loading of passengers, baggage or cargo.

These incidents are covered by mandatory reporting systems of the Civil Aviation Authorities or voluntary reporting systems in the other states.

An accident of air transport aircraft can become a major accident involving a large number of fatalities. The case of Australia suggests that the incidents reportable to the Investigation Authority can be flexibly set taking account of two things: (1) the likelihood that safety lessons to prevent major accidents can be expected from the investigation and (2) the amount of available resources of the Investigation Authority and the Civil Aviation Authority.

8.1.4 Threshold of Incidents and Other Safety-related Occurrences which must be Reported to the Civil Aviation Authority

A comparison of the the incidents and other safety-related occurrences which must be reported to the Civil Aviation Authority in each state was conducted. The regulations

which define the incidents and other safety-related occurrences which must be reported to the Civil Aviation Authority or which list the examples of those in each state are summarized in Table 8.5.

Table 8.5: Regulations which define the incidents and other safety-related occurrences which must be reported to the Civil Aviation Authority or which list the examples of those

State	Regulations
U.S.	14 CFR Part 21(Sec 21.3)
	14 CFR Part 121(Sec 121.703)
	14 CFR Part 125 (Sec 125.409)
	14 CFR Part 135 (Sec 135.415)
	14 CFR Part 145 (Sec 145.221)
U.K.	CAP 382 "MOR Scheme" (Annex)
Australia	Civil Aviation Safety Regulations 1998 (Regulation 21.003)
	Civil Aviation Regulations 1988 (Regulation 51A)
	Civil Aviation Advisory Publication 51-1 (1) (Section 1 and Appendix A)
Japan	Civil Aeronautics Act (Article 111-4)
	Ordinance for Enforcement of Civil Aeronautics Act (Article 221-2)
	Advisory Circular No. 6-001 (Section 3-1)
	Advisory Circular No. 6-002 (Section 3)

Based on the comparison of these regulations, it was observed that the MOR Scheme in the U.K. requires that incidents and other safety-related occurrences in a relatively broader scope be reported than mandatory reporting systems of the Civil Aviation Authorities in the other states.

In all of the four states, reportable occurrences include incidents such as fire, smoke, leakage of fuel, and engine shutdown during flight, cracks or corrosion, or other failures, malfunctions, or defects in an aircraft, which has endangered or may endanger the safe operation of the aircraft.

Reportable occurrences under the MOR Scheme in the U.K. which are not covered by the mandatory reporting systems of the Civil Aviation Authorities but are covered by the voluntary reporting systems in the other states include occurrences related to human

errors during operation or deficiencies of procedures which could affect the safety of aircraft operations. For example:

- Breakdown in communication between flight crew.
- Incorrect programming of, or erroneous entries into, equipment used for navigation or performance calculations, or use of incorrect data.
- Loss of position awareness relative to actual position or to other aircraft.
- Inadequacy of any procedures designed to be used in an emergency, including when being used for maintenance, training or test purposes.
- Misleading, incorrect or insufficient maintenance data or procedures that could lead to maintenance errors.

The data of the number of reports submitted suggests that the MOR Scheme in the U.K. covers a broader scope of incidents and other safety-related occurrences than mandatory reporting systems of the Civil Aviation Authorities in the other states. Table 8.6 shows a comparison of the number of reports submitted under the MOR Scheme of the U.K. and the number of reports submitted in accordance with Article 111-4 of Civil Aeronautics Act of Japan per year. In order to take into account a difference in the size of aviation activities, numbers normalized by the flight hours of public transport are also shown.

Table 8.6: Comparison of the number of reports submitted[b] (*Data Source*: [79], [80], [82], [119])

State	System	Number of Reports per Year (a)	Flight Hours of Public Transport per Year (b)	$(a)/(b) \cdot 10^5$
U.K.	MOR Scheme	12,000	2,700,000	444.4
Japan	Article 111-4 of Civil Aeronautics Act	800	1,500,000	53.3

Since there are other mandatory reporting systems of the JCAB, which are prescribed by Advisory Circular No. 6-001 and No. 6-002, making a simple comparison is misleading.

[b]Number of reports per year and flight hours of per year are rough numbers.

However, the difference in the number of reports submitted under the MOR Scheme of the U.K. and in accordance with Article 111-4 of Civil Aeronautics Act of Japan is still big.

Setting a threshold of severity of reportable occurrences under the mandatory reporting systems needs careful consideration. Unlike in the voluntary reporting systems, it can be assumed that all reportable occurrences are actually reported in mandatory reporting systems. This ensures that the acquired data can be used for trend analysis. However, compared to the voluntary reporting systems, the mandatory reporting systems are less likely to identify unknown hazards because the reportable occurrences are more precisely defined. In fact, Tamuz [99] reported a case in which the precise definitions of reportable occurrences actually hindered reporting of the occurrence which indicated the safety risk.

As described above, mandatory reporting systems and voluntary reporting systems have advantages and disadvantages, and they supplement each other. Therefore, the threshold of severity of reportable occurrences under the mandatory reporting systems should be set taking account of the advantages and disadvantages of both systems as well as the available resources of the Civil Aviation Authorities to analyze the reports.

8.1.5 Comparison of Air Proximity Hazard Reporting and Investigation Systems

The thesis found that, unlike other incidents, there are notable differences in the air proximity hazard reporting and investigation in the four states. The differences are a scope of air proximity hazard occurrences to be reported and investigated, whether reporting is mandatory or voluntary, and to whom the occurrences are reported.

As regards the scope of air proximity hazard occurrences to be reported and investigated, from the definitions of the air proximity hazard occurrences (Airprox or Near Midair Collisions (NMACs)) which are to be reported in each state, it can be expected that the U.K. and Australia collect a broader scope of these occurrences than the U.S. and Japan. In addition, since only NMACs considered to be serious incidents must be reported in Japan, it can also be expected that the U.S. collects a broader scope of NMACs than Japan. Furthermore, it should be noted that the U.K. investigates a broader scope of the reported Airprox than Australia.

Particularly, the most important finding in this subsection is that some Airprox actually investigated and judged to have compromised the safety of the aircraft in the U.K. would

not have been reported and investigated if they had happened in the U.S. or Japan.

Table 8.7 shows a summary of the air proximity hazard reporting and investigation systems in the four states.

Table 8.7: Air Proximity Hazard Reporting and Investigation System

State	Occurrence to be Reported	Reporting	Investigative Organization	
U.S.	NMAC	Voluntary	FAA	Civil Aviation Authority
U.K.	Airprox	Mandatory	CAA	Civil Aviation Authority
		Voluntary	UKAB	Independent organization specialized in Airprox investigation
Australia	Airprox	Mandatory	ATSB	Investigation Authority
Japan	NMAC (only Serious Incident)	Mandatory	JTSB	Investigation Authority

In the U.S., the NMAC reporting to the FAA is voluntary and all NMACs reported to the FAA are thoroughly investigated by the FAA. In the U.K., the Airprox must be reported to the CAA as one kind of incidents under the MOR Scheme. However, they can also be voluntarily reported to the UKAB, a specialized organization for Airprox investigation, and all Airprox reported to the UKAB are thoroughly investigated by the UKAB.

On the other hand, in Australia, all Airprox must be reported to the ATSB as immediately reportable matters for air transport operations and routine reportable matters for other operations. However, as with other transport safety matters, Airprox which are considered to be serious incidents, as defined by Annex 13, have priority for investigation. Lastly, in Japan, only NMACs where accidents nearly occurred must be reported to the JTSB as a serious incident and all reported NMACs are investigated by the JTSB.

Table 8.8 summarizes the definitions of the Airprox/Near Midair Collision (NMAC) of each state. The Airprox and NMAC are not exactly the same. An NMAC is also an Airprox whereas an Airprox is not necessarily an NMAC [111].

Table 8.8: Definitions of Airprox/Near Midair Collision (NMAC)

State	Occurrence	Definition
U.S.	NMAC	An incident associated with the operation of an aircraft in which a possibility of collision occurs as a result of proximity of less than 500 feet to another aircraft, or a report is received from a pilot or a flight crew member that a collision hazard existed between two or more aircraft [40].
U.K.	Airprox	A situation in which, in the opinion of a pilot or an air traffic controller, the distance between aircraft as well as their relative positions and speed, had been such that the safety of the aircraft involved was or may have been compromised [69].
Australia	Airprox	An occurrence in which 2 or more aircraft come into such close proximity that a threat to the safety of the aircraft exist or may exist, in airspace where the aircraft are not subject to an air traffic separation standard or where separation is a pilot responsibility (Transport Safety Investigation Regulations 2003).
Japan	NMAC	[An event] when [the pilot in command] has recognized during flight that there was a danger of collision or contact with any other aircraft (Civil Aeronautics Act).

Table 8.9 shows a comparison of the numbers of Airprox/NMACs involving commercial air transport and investigated by the FAA, the UKAB, and the JTSB. It supports the argument that the U.K. and Australia collect a broader scope of the midair collision hazard occurrences than the U.S. and Japan, and the U.S. collects a broader scope of these occurrences than Japan.

Table 8.9: Comparison of the numbers of Airprox/NMACs involving commercial air transport[d] (*Data Source*: [22], [82], [86], [94], [119])

	Risk Category	Year							Average (a)	Average Number of Departures per year (b)	$(a)/(b) \cdot 10^5$
		2001	2002	2003	2004	2005	2006	2007			
FAA	-	**48**	**53**	**55**	**44**	**42**	**24**	**24**	**41.4**	10,811,094	**0.38**
UKAB	A	0	1	0	1	1	0	0	0.4	1,151,143	0.04
	B	14	7	12	7	7	6	5	8.3		0.72
	C	65	70	54	67	78	68	60	66.0		5.73
	D	4	4	0	4	1	0	0	1.9		0.16
	Total	**83**	**82**	**66**	**79**	**87**	**74**	**65**	**76.6**		**6.65**
JTSB	-	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0.9**	798,212	**0.11**

If it is assumed that there is little difference in the rates of air proximity hazard occurrences in these three states (this assumption is considered reasonable because there is little difference in accident rates in these three states[e]), Table 8.9 indicates that the UKAB actually collects the broadest scope of occurrences, followed by the FAA. It should also be noted that Table 8.9 indicates that some Airprox investigated and assigned a risk "B" (Safety not assured) by the UKAB would not have been reported and investigated if they had happened in the U.S. or Japan.

According to Boeing, the midair collision/NMAC ranks fifth as an accident category in terms of total number of fatalities, as shown in Figure 8-1[f].

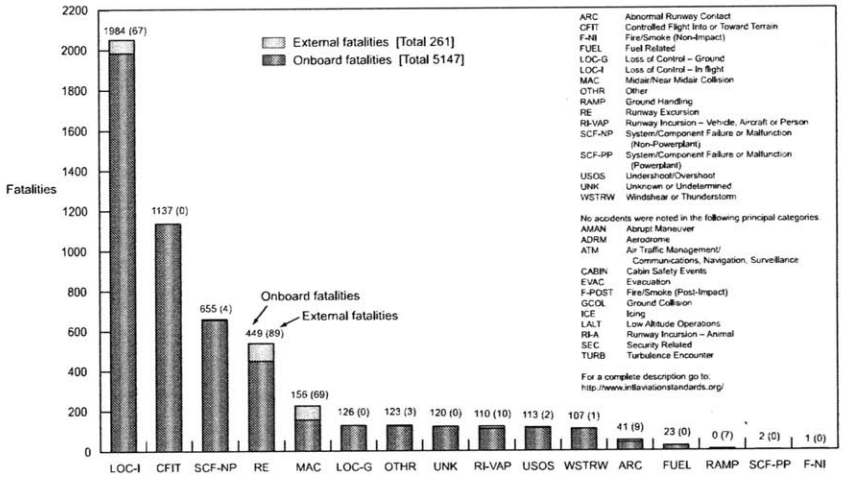

Figure 8-1: Fatalities by a cause of fatal accidents - worldwide commercial jet fleet 1998-2007 [19]

Since subjectivity is inherent in the risk of midair collision perceived by pilots and air traffic controllers [46], a system like the one in the U.K., where a broader scope of occurrences are reported and thoroughly investigated, may identify unknown hazards that could lead to more serious events.

[d]The FAA data includes only the data of Part 121 Operators. No data was available in each risk category assigned by the FAA. The JTSB data excludes the NMACs investigated as accidents. For the definition of the risk category assigned by the UKAB, refer to Table 5.1 in Subsection 5.2.3.

[e]For the accident rates of the four states, refer to Appendix A.

[f]Based on the Commercial Aviation Safety Team (CAST)/ICAO Common Taxonomy Team (CICTT) Aviation Occurrence Categories.

8.1.6 Comparison of Voluntary Reporting Systems

Through a comparison of the voluntary reporting systems in the four states, several differences were observed. First, this thesis identified that only the VDRP of the U.S is aimed at organizations, whereas the other voluntary reporting systems are aimed at individuals. Next, this thesis identified that the voluntary reporting systems whose targets are individuals can be classified into three types. This thesis also identified that the management organizations of the voluntary reporting systems can be classified into three categories. In addition, this thesis identified that there is a difference in terms of whether or not limited immunity from enforcement actions by the CAA is provided. Data will be presented which indicates that limited immunity does indeed encourage voluntary reporting. This thesis also identified that there is a difference in terms of persons covered by the systems, the processing of security reports, and the degree of database utilization.

Target of Reporting Systems (Organizations or Individuals)

Among the voluntary reporting systems studied, only the VDRP of the U.S. is aimed at organizations (companies' management), not individuals. The possibility was pointed out that a company's management can suppress the release of information by company's employees to the CAA for fear of enforcement actions against the company's management by the CAA [62]. The VDRP of the U.S provides limited immunity from enforcement actions against organizations, and it expects that organizations are encouraged to report safety-related occurrences which involve the violations of regulations, and the organizations, in turn, further encourage their employees to report these occurrences. In fact, as discussed in Subsection 4.2.6, when an ASAP program is also available to employees, an ASAP report triggers a VDRP report and a VDRP report triggers an ASAP report. As with the case of the VDRP and the ASAP, the combinations of a system which aims at organizations and a company-specific system which aims at employees may work synergistically in encouraging reporting.

System Types

It was identified that the voluntary reporting systems whose targets are individuals can be classified into three types. The three types are: (1) Non-company-specific Type, (2)

Company-specific Type, and (3) Inter-company Information Sharing and Analysis Type.

Table 8.10 shows a type of each voluntary reporting system whose targets are individuals.

Table 8.10: System types

State	Reporting System	Type
U.S.	ASRS	Non-company-specific
	ASAP	Company-specific
U.K.	CHIRP	Non-company-specific
Australia	REPCON	Non-company-specific
	ASRS	Non-company-specific
Japan	ASI-NET	Inter-company Information Sharing and Analysis

The characteristics of the system of each type are as follows:

Non-company-specific Type

This type of systems collect and analyze reports at a national level. This type of systems allow persons to report directly to the system without passing through internal reporting systems of the companies to which persons belong. As stated in Section 2.5, a concern that information may be used for companies' management for punitive purposes can impede reporting. Therefore, more honest reporting can be expected in this type of systems when reported events involve errors of reporter because reporters do not have to fear of disciplinary actions for their errors from companies' management.

Another advantage of this type of systems is that they normally allow anyone in aviation community to submit reports. In the other types of systems, the persons who can report is limited. For example, in the ASAP of the U.S., the persons who can report to the program is usually limited to the employees whose union signed the MOU of the program. In the ASI-NET for Large Aircraft of Japan, the persons who can report to the system is limited to the pilot and flight engineers of participating airlines. Other professional groups of participating airlines or those who belong to other airlines cannot submit reports to the system.

Therefore, by collecting reports from a broad scope of aviation community, this type

of systems enable the identification of hazards related to persons to whom the systems of the other types are unavailable. One example of the persons to whom the other types of systems are currently unavailable but who play an important role in assuring safety of aircraft operations are ground service personnel.

In addition, Tamuz [100] pointed out another advantage of this type of systems that they are able to identify patterns in rare events by aggregating data at a national level.

Furthermore, if collected information is shared as is done in the ASRS of the U.S., companies can even make use of the information for safety purposes by themselves. In fact, for nine years from 1998 to 2006, 120 Search Requests were made from airlines and 37 were made from aircraft manufacturers to the ASRS of the U.S. [103].

However, there is one disadvantage in this type of systems. In this type of systems, not only information that helps in identifying a reporter, but also information that helps in identifying a company to which the reporter belongs is usually de-identified. Therefore, it is difficult to identify hazards which are specific to a company and take corrective actions with the company [100]. Examples of such hazards which are specific to a company include improper procedures of operations or maintenance of aircraft, confusing directions in manuals, unbalanced workload allocations, insufficient training, and lack of communication between management and front-line personnel.

Company-specific Type

In this type of systems, a specific voluntary reporting program is established for each company based on the agreement between the management organization of the systems and the company. Since reports are collected and analyzed at each program level, this type of systems are able to identify hazards specific to a company, which is difficult in the Non-company-specific type of systems. In addition, in this type of systems, the management organization of the systems can take corrective actions in collaboration with the company. For example, in the ASAP, representatives from pilot unions in the ERC can urge pilots to take remedial training, representatives from a company management can initiate changes of company procedures, and representatives from the FAA can influence regulatory changes [100].

In fact, as stated in Chapter 1, many airlines have their own internal reporting systems [68]. However, the company-specific type of systems have an advantage over airlines' own

internal reporting systems. That is, in the company-specific type of systems, by providing limited immunity from enforcement actions by the Civil Aviation Authority (CAA), the CAA and the companies' management can collect reports involving possible violations of regulations which might otherwise not be submitted. To obtain this advantage to full extent, limited immunity from disciplinary action by the companies' management should also be provided.

The benefits of this types of systems can be augmented if the data obtained by each program established for a company are compiled and analyzed at the national level, and results of the analysis are shared with the participating companies. Such a central compilation and analysis of the data enables the identification of patterns in rare events, as the Non-company specific type of systems do.

As stated in Subsection 4.2.5, the FAA currently lacks a centralized system that analyzes the ASAP data to identify unknown hazards at a national level. In order to address the problem, the FAA is currently working to expand functionalities of the Aviation Safety Information Analysis and Sharing (ASIAS), a centralized system developed to store, analyze and share the safety related information, to include the information acquired through ASAP. The work will be completed by the end of calendar year 2010 [45].

Inter-company Information Sharing and Analysis Type

This type of systems share the safety information with participating companies, and the management organizations of the systems analyze reports collected through the participating companies on behalf of them. In this type of systems, persons cannot report to the systems directly; instead, they report to the systems through the companies they belong to.

This type of systems can identify hazards which occur rarely if a sufficiently large number of companies participate in the systems. Furthermore, this type of systems can also identify hazards specific to a company if the information that helps in identifying the company to which the reporter belongs is not removed at the analysis stage.

In this type of the systems, the participating companies can directly access the centralized database and use the data for their own purpose. In fact, as will be mentioned in Subsection 8.1.7, without participating in such a system, some companies are exchanging information among them by using compatible software designed to collect and analyze

safety data such as BASIS. However, this type of systems are different from such a simple information exchange in that the management organizations of the systems analyze reports on behalf of the participating companies. Therefore, the systems are beneficial from the companies' standpoint in that they can make use of outside expertise.

One concern on this type of systems is that since reports are submitted only through a company's internal reporting system, not all reports may be shared with the systems. In the ASI-NET for Large Aircraft, reports are screened and filtered by an airline before they are shared with the system. This practice saves a need of validation of reports by a management organization of the system, but involves a concern that reports which are worthwhile to be shared from a safety perspective are also filtered out by a company for some other reasons. Limited immunity from disciplinary action by the companies' management should be provided to encourage reporting.

One observation in the above discussion of the three types of systems is that they are not exclusive. That is, the states can establish different types of systems at the same time, as the U.S. has both a Non-company-specific Type of system (ASRS) and a Company-specific Type of system (ASAP). In addition, as discussed in the above, each type of system has advantages and disadvantages. Therefore, by establishing different types of systems, the state can expect that they supplement each other.

Management of Systems

It was identified that the management organizations of the voluntary reporting systems studied can be classified into three categories: (1) Civil Aviation Authority, (2) Investigation Authority or other government agencies, and (3) Third-party organization. As will be discussed below, each category of the management organization has suitable types of systems described above. Table 8.11 shows a management organization of each voluntary reporting system studied.

Table 8.11: Management of voluntary reporting systems

State	Reporting System	Management Organization	
U.S.	ASRS	NASA	Research Agency
	ASAP	FAA	Civil Aviation Authority
	VDRP	FAA	Civil Aviation Authority
U.K.	CHIRP	CHIRP Charitable Trust	Charitable Trust
Australia	REPCON	ATSB	Investigation Authority
	ASRS	ATSB	Investigation Authority
Japan	ASI-NET	ATEC	Non-profit Foundation

Civil Aviation Authority (CAA)

The ASAP and the VDRP of the U.S. are managed by the CAA. The CAA has authority to enforce safety regulations and can determine whether corrective actions which are taken by a company responding to reports involving violations of regulations are sufficient or not. Therefore, the CAA is more suitable for Company-specific Type of systems than the other two types of systems. In the Company-specific Type of systems, the CAA can take corrective actions and conduct follow-up monitoring, together with a company.

The CAA has the authority to take enforcement actions against the violations of the regulations, and hence, it is most likely to impede reporting. Therefore, limited immunity from enforcement actions against the violations of regulations should be provided. Since the Freedom of Information Act[g] applies to the CAA, the data it acquires should be protected from public disclosure.

Investigation Authority or other government agencies

REPCON and the ASRS of Australia are managed by the Investigation Authority, and the ASRS of the U.S. is administered by a research agency. The Investigation Authority or other government agencies are more suitable for Non-company-specific Type of systems and Inter-company Information Sharing and Analysis Type of systems than Company-specific

[g]All four contracting states studied have the Freedom of Information Act.

Type of systems because they don't have authority to determine whether corrective actions taken are sufficient or not. Since they have no authority to take enforcement actions against the violations of the regulations, they are less likely to impede reporting than the CAA.

At the same time, as government agencies, they are well positioned to issue safety alerts to relevant organizations, including the CAA. They may also issue safety recommendations which have some legal authority as the Investigation Authorities can issue safety recommendations after accident or serious investigations.

In addition, as with the ATSB in the cases of REPCON and the ASRS of Australia, these agencies may be delegated a power to provide the de-identified data to the CAA for safety purposes. It is also an advantage that of these agencies that they can utilize expertise on investigation of safety-related occurrences, data analysis, or human factors. Since the Freedom of Information Act applies to these agencies, the data they acquire should be protected from public disclosure.

Third-party organization

CHIRP of the U.K. and the ASI-NET of Japan are managed by the third-party organizations. Third-party organizations are suitable for Non-company-specific Type of systems and Inter-company Information Sharing and Analysis Type of systems because they don't have authority to determine whether corrective actions taken are sufficient or not. Since third-party organizations are not government agencies, they are the least likely to impede reporting.

However, by comparison with government agencies, third-party organizations are less well positioned to issue safety alerts to relevant organizations. In addition, it is difficult for the CAA to learn unsafe practices, procedures, or conditions, or to utilize the information for policy-making unless they provide the CAA with the information acquired in the system. Since they are not government agencies, the Freedom of Information Act does not apply to them, and hence, the protection of data from the public is not needed.

Limited Immunity from Enforcement Actions by the CAA

It was identified that there is a difference in terms of whether or not limited immunity from enforcement actions by the CAA against reported violations of regulations is provided in each system. This is shown in Table 8.12.

Table 8.12: Limited immunity provided in each voluntary reporting system

State	Reporting System	Limited Immunity Provided?
U.S	ASRS	Yes
	ASAP	Yes
	VDRP	Yes
U.K.	CHIRP	Yes
Australia	REPCON	No
	ASRS	Yes
Japan	ASI-NET	No

A summary of limited immunity from enforcement actions by the CAA provided in voluntary reporting systems in each state is as follows. In voluntary systems of the U.S. and the U.K., if a person files a report and the report meets the criteria, immunity from enforcement actions against the violations of regulations is provided. In voluntary reporting systems of Australia, although the limited immunity is not provided in REPCON, it is provided in the ASRS, another voluntary reporting system managed by the same organization (i.e. the ATSB). Persons seeking protection from enforcement actions by CASA can submit reports to the ASRS instead of REPCON. Therefore, if the two systems are considered together, it can be said that limited immunity is provided in voluntary reporting systems in Australia.

On the other hand, under the ASI-NET of Japan, it is assured only that the JCAB will not seek information provided to the system nor take enforcement actions based solely on that information. That is, immunity from enforcement actions is not guaranteed to the reporter in case there is sufficient evidence indicating the violations of the regulations.

As stated in Section 2.5, it is considered that a concern among people that reported information may be used for enforcement actions deters reporting. Data indicates that the possibility that whether limited immunity from enforcement actions is provided or not does indeed influence the number of reports submitted. Table 8.13 shows a comparison of the number of reports submitted to the ASRS of the U.S. and to the ASI-NET of Japan per year. In order to take account of a difference in the size of aviation activities, numbers

normalized by the flight hours of public transport are also shown in the table.

Table 8.13: Comparison of the number of reports submitted[i] (*Data Source*: [2], [82], [94], [103])

State	Reporting System (Report Source)	Number of Reports per Year (a)	Flight Hours of Public Transport per Year (b)	$(a)/(b) \cdot 10^5$
U.S.	ASRS reports from flight crew of airlines	26,500	22,200,000	118.7
	ASRS reports from General Aviation	7,500		33.9
Japan	ASI-NET for Large Aircraft	75	1,500,000	5.0
	ASI-NET for Small Aircraft	15		1.0

From the table, it can be seen that there is a notable difference in the number of reports submitted. The difference may be influenced by whether limited immunity is provided or not.

It can also be seen that a difference between the number of ASRS reports from General Aviation and the number of reports submitted to the ASI-NET for Small Aircraft is bigger than the difference between the number of ASRS reports from airlines and the number of reports submitted to the ASI-NET for Large Aircraft. This may be because in the ASI-NET for Large Aircraft, employees are encouraged to report to the airlines' internal reporting system anyway.

Other conceivable contributing factors to the difference between the number of reports submitted to the ASRS of the U.S. and to the ASI-NET of Japan other than limited immunity include:

Awareness of systems

The ASRS, established in 1976, has more than 30 years of history, whereas the ASI-NET for Large Aircraft was established in 1999 and the ASI-NET for Small Aircraft was established in 2004. In addition, people in the U.S. might be more educated to report through the company's training program. For example, the Air Line Pilots Association (ALPA) encourages its members to file ASRS reports. Instructions in the

[i]Number of reports per year and flight hours per year are rough numbers. Flight hours of the U.S. is calculated as the sum of the flight hours of Part 121 Operators plus those of Part 135 Operators.

use of ASRS reporting forms is routinely included in the training of General Aviation pilots [100]. For a variety of reasons, people are more aware of the ASRS than they are of the ASI-NET.

Screening and filtering by a company

In the ASI-NET for Large Aircraft, reports submitted to a airlines' internal reporting system are screened and filtered by the airline before they are shared with the system. This practice may have reduced the number of reports shared with the system.

Cultural Difference

It has been pointed out that national culture, together with professional culture and organizational culture, influences how information is shared [71].

In the above argument, the possibility that limited immunity from enforcement actions is actually encouraging reporting is pointed out. However, it should also be remembered that a proper balance should be sought between affording limited immunity and exercising enforcement power in order to enhance overall safety.

If limited immunity is not provided and enforcement actions are strictly applied to every violation of regulation, events involving possible violations of regulations may be not reported and unsafe practices, procedures, or conditions can be left as they are. However, exercising enforcement power also promotes compliance with regulations.

For example, the limited immunity may create a moral hazard and the compliance with regulations may be undermined. In fact, an independent review team of the ASAP convened by the Secretary of Transportation pointed out a concern that the FAA's acceptance of repetitive reports of the same problem would undermine incentives for compliance with regulations [45]. Therefore, a limit on frequency of providing limited immunity from enforcement actions against the violations of regulations committed by the same person should be set, as the ASRS of the U.S. and REPCON of Australia set the limit at once in five years.

Persons Covered by Reporting Systems

The ASRS of the U.S., CHIRP of the U.K., and REPCON of Australia cover most or all professional groups (e.g. pilots, flight engineers, air traffic controllers, cabin crew, and mechanics). However, the ASI-NET for Large Aircraft of Japan covers only pilots and flight engineers of participating airlines.

The extension of coverage of the ASI-NET for Large Aircraft of Japan may enable identification of hazards in other areas of aviation activity. For example, as can be seen in Figure 5-4 in Subsection 5.2.4, CHIRP collects as many reports from cabin crew as from flight crew, about 150 reports annually.

Cabin crew also play an important role to assure safety of aircraft operation. For example, for every flight, cabin crew are required to set the doors in a mode that ensures that emergency slides are automatically unfolded when the doors are opened. There was once an occurrence in Japan that cabin crew forgot to set the door in that mode due to a lack of communication and the aircraft departed in that state [73]. Therefore, it can be expected that these kinds of safety-related occurrences will be reported to the ASI-NET for Large Aircraft if the coverage is extended to include cabin crew.

Security Reports

Among the voluntary reporting systems studied, only REPCON of Australia clearly states, by regulation, that to provide information about aviation security concerns to appropriate person or organization is one of its purposes. Additionally, in practice, the ASRS of the U.S. has been receiving increasing numbers of reports describing security-related occurrences since the September 11 attacks in 2001 [24]. Other voluntary reporting systems may have been receiving reports regarding security as well.

Currently, in all voluntary reporting systems studied, reports regarding safety and the ones regarding security are being dealt with under a single system. However, a study of reports of the ASRS of the U.S. regarding security suggests that these reports have an extremely sensitive nature, and hence, may require different methods of analysis and evaluation [24]. Therefore, an establishment of a new system which deals with the security reports may be appropriate. Particularly when a current voluntary reporting system is managed by a third-party organization, as CHIRP of the U.K and the ASI-NET of Japan, an establishment of a new system managed by the government agencies may be appropriate.

There is another reason why an establishment of a new system deals with the security reports may be appropriate. The reason is that, in some voluntary reporting systems, groups of personnel involved directly with the security process are not covered. Even if they are covered, they are less educated about the voluntary reporting systems compared to pilots, air traffic controllers, mechanics and other groups of personnels who are the main target of

the voluntary reporting systems [24].

In fact, NASA is proposing a Security Incident Reporting System (SIRS) as a part of a new program called the Aviation Safety and Security Program (AvSSP). Although the proposed SIRS would be a replication of the ASRS model with all of the essential criteria of the original model, the SIRS will probably provide alternative processing features that include more extensive protections [24].

Although it is difficult to prove the benefits of voluntary reporting systems in accident prevention, in the ASRS of the U.S., several cases have been actually reported in which corrective actions were taken proactively by the organizations which had received alerts from the ASRS [103].

Therefore, establishing a voluntary reporting system of security information which is separate from the voluntary reporting system of safety information may help in preventing future criminal acts such as an unlawful seizure of an aircraft or destruction of aircraft.

Degree of Database Utilization

Among the reporting systems studied, the ASRS of the U.S. is noteworthy in terms of database utilization. It has a well-established system to respond to the database search requests from outside.

In particular, the utilization of the ASRS database by the government organizations such as the FAA and Congress for purposes such as rulemaking and airspace design shows that the data provided to the voluntary reporting system can also be useful for the identification of hazards which are likely to come into existence when some changes are introduced into the current aviation system.

Furthermore, it is only the ASRS of the U.S. that currently permits the public to access the database. Giving the public access to the database enables the outside researchers to use the data, and their research can lead to further understanding on themes such as human factors, which may eventually enhance aviation safety.

If a voluntary reporting system gives the public access to the database, information in the reports including company's name should be thoroughly de-identified as done in the ASRS to prevent inappropriate and misleading comparisons of companies, which could adversely and incorrectly affect public confidence in a particular company. In fact, before the FAA issued the regulation that assures the protection of the FOQA data collected from airlines

from public disclosure, the study conducted by the Flight Safety Foundation recognized that the data must be de-identified so that the data cannot be linked with a specific airline in order to prevent inappropriate and misleading comparisons of airlines [26].

8.1.7 Exchange of Safety Information between States

As discussed in Subsection 5.2.6, the EU Member States, including the U.K., are exchanging safety information with each other, a purpose of which is to collect sufficient data to identify hazards or meaningful trends. On the other hand, it appears that the U.S., Australia, and Japan are not exchanging the safety information with other states.

In order to exchange information between organizations in the EU Member States, the compatible software was necessary. To this end, the ECCAIRS Reporting System was developed.

In fact, without the agreements between the states, the aviation industry is also exchanging safety information across borders. A typical example of the safety information exchange between the organization in the aviation industry is the one between organizations using the common software tool named British Airways Safety Information System (BASIS).

BASIS is a software tool designed to help airlines assess and manage the risks associated with flight operations. BASIS was originally developed to gather and analyze pilot incident reports internally at British Airways. Yet, BASIS has been expanded and marketed to other organizations over time, and is currently being used by over 100 organizations, including airlines, pilot unions, and aircraft manufacturers to manage the risks associated with flight operations.

One of the strengths of BASIS is its compatibility for an industry-wide data exchange. A separate BASIS module allows participants to share dis-identified data with other BASIS users via a secure Internet database [18].

BASIS is also used by the International Air Transport Association (IATA) for its Safety Trend Evaluation, Analysis and Data Exchange System (STEADES). STEADES is currently collecting incident data from nearly 100 airlines worldwide. IATA issues regular reports, which review safety events, present analysis in the form of trend charts, and provide overviews of emerging safety concerns [65], [68].

In addition, the development of the Global Aviation Information Network (GAIN),

which aims at sharing safety information from airlines, manufacturers, and other aviation organizations worldwide, is currently in progress on the aviation industry's initiative with the support from government organizations.

As mentioned in Subsection 5.2.6, a bi-directional data link between the EU and China has been developed to exchange safety information. Considering this fact, geographic relationships are not considered to pose an impediment. The exchange of safety information between states is worth considering for the responsible authorities in other states which are currently not so doing.

8.1.8 Implementation of International Standards by Industry's Voluntary Initiative

The thesis identified that there is a difference how the Civil Aviation Authorities have implemented the ICAO Standard on the establishment of a flight data analysis program by airlines. In 2005, ICAO adopted a Standard which require the establishment of a flight data analysis program by airlines operating aeroplanes of a maximum certificated take-off mass in excess of 27,000 kg.

In accordance with the Standard, EASA has mandated the flight data analysis program (EASA OPS-1, OPS 1.037). The JCAB has also mandated it (Civil Aeronautics Act, Article 61 and Ordinance for Enforcement of Civil Aeronautics Act, Article 149) [77].

On the other hand, as discussed in Subsection 4.2.7, the FAA has not issued regulations to require U.S. airlines to establish such programs[j]. Instead, the FAA leaves it at the airlines' discretion, and by providing airlines and their employees with limited immunity from enforcement actions against the violations of regulations, the FAA acquires the flight data from the airlines in return.

The FAA policy on the FOQA program offers the Civil Aviation Authorities in other states valuable insights for implementing the Standards adopted by ICAO. Considering that the FAA has been able to achieve wide participation in the FOQA program by major U.S. airlines on a voluntary basis, this kind of policy, which practically implements the Standards adopted by ICAO by encouraging the industry's voluntary initiative, may be applied to other Standards which will be adopted in the future.

[j] As regards Australia, the author could not find out whether or not CASA mandated the establishment of a flight data analysis program by airlines.

8.2 Rulemaking Process

The public consultation requirements and the Regulatory Impact Analysis (RIA) requirements are two essential requirements which government agencies must fulfill when they make rules. The comparison of these two requirements which the Civil Aviation Authorities (the FAA of the U.S., EASA of the EU, CASA of Australia, and the JCAB of Japan) must fulfill in rulemaking was conducted.

8.2.1 Comparison of Public Consultation Requirements

Public consultation concerning proposed rules aims at ensuring transparency and fairness in rulemaking. It also aims at avoiding establishment of regulations that are inappropriate to the circumstances, poorly adhered to, or unnecessary [17].

It was observed that there are no substantial differences in the public consultation requirements for rulemaking among the four Civil Aviation Authorities. All of the Civil Aviation Authorities are required to publish proposed rules together with related materials for consultation. In addition, all of the Civil Aviation Authorities are required to publish the comments received in the consultation and the disposition of them.

One difference is that drafts to amend the Basic Regulation and its Implementing Rules are brought to public consultation in the form of opinions before being submitted to the legislative bodies in the EU, whereas bills to amend the Civil Aeronautics Act are not subject to public consultation requirements in Japan. However, considering that consultations with stakeholders are conducted in practice before the bills to amend the Civil Aeronautics Act are brought to the Cabinet for decisions, it is considered that this difference is of little significance.

Another difference is that only EASA of the EU, by the Management Board Decision 08-2007, assures that comments received in public consultation are also reviewed by those not directly involved in the drafting of the proposed rule. This practice is intended to ensure that all received comments are treated fairly.

Table 8.14 shows the appellation of public consultation documents prepared by each Civil Aviation Authority. In the table, some fields are left blank, yet it is merely because the documents are not officially prescribed by laws or regulations or not given specific appellations, and no laws or regulations prohibit the publication of the documents. In fact,

the JCAB of Japan publishes the documents to seek public opinions on specific topics on which the JCAB is considering rulemaking, which corresponds to ANPRM, A-NPA, and DP published by the other Civil Aviation Authorities.

Table 8.14: Appellation of the public consultation documents in each Civil Aviation Authority

FAA (the U.S.)	EASA (the EU)	CASA (Australia)	JCAB (Japan)
ANPRM	A-NPA	DP	
NPRM	NPA	NPRM/NPC	NPRM
SNPRM			
Final Rule	Final Rule	NFRM/NFC	Final Rule

8.2.2 Comparison of Regulatory Impact Analysis (RIA) Requirements

By systematically assessing the potential impacts of new regulations, the RIA aims at improving the objectivity of the regulatory development process and at avoiding making rules which are too costly to comply with [81].

As with the public consultation requirements, it was observed that there are no substantial differences in the RIA requirements among the four Civil Aviation Authorities. In all of the four Civil Aviation Authorities, the RIA includes the economic analysis of costs and benefits of the proposed rule as well as its impacts on areas such as business environment, society, and environment. Furthermore, in addition to the analysis of the proposed rule, the identification and the analysis of the possible alternative policies are also required.

Compared to the other Civil Aviation Authorities, the FAA of the U.S. is required to conduct a relatively large number of analyses such as the Regulatory Flexibility Analysis and the Unfunded Mandates Assessment, which reflects the social circumstances specific to the U.S.

As regards the publication of the results of the RIA, the FAA of the U.S. and EASA of the EU are required to publish the results for consultation. CASA of Australia and the JCAB of Japan, although not formally required, generally publish the results as well.

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Chapter 9

Conclusions

9.1 Summary of Results

This thesis examined the aviation safety information feedback systems in four contracting states of the Chicago Convention, namely, the United States, the United Kingdom, Australia and Japan. By conducting a comparative analysis of the feedback systems in each state, this thesis aimed at offering insights for responsible authorities in the contracting states to improve their own feedback systems.

As part of the feedback systems, this thesis examined reporting and investigation systems in each state. More specifically, this thesis examined mandatory reporting systems of the Investigation Authority and Civil Aviation Authority as well as voluntary reporting systems.

In addition, as one sort of corrective actions which are taken responding to the safety risk identified through investigation, this thesis examined the rulemaking process in four Civil Aviation Authorities. In examining the rulemaking process, this thesis focused on the two essential requirements in rulemaking: the public consultation requirements and Regulatory Impact Analysis (RIA) requirements.

This thesis identified similarities as well as differences in the feedback systems among the four states, which are described in detail in Chapter 8. Particularly, as regards the mandatory reporting systems and voluntary reporting systems, this thesis, as expected, identified a relatively larger number of differences in voluntary reporting systems, whose establishment ICAO leaves at states' discretion.

A summary of similarities is as follows.

Structures of Reporting and Investigation Systems

All of the four states have the accident and serious incident reporting and investigation system of the Investigation Authority as well as the incident reporting and investigation systems of Civil Aviation Authority. In addition, all of the four states have voluntary reporting systems.

Definitions of Accidents which must be Reported to the Investigation Authority

The definitions of the accidents which must be reported to the Investigation Authority in each state basically follow the definition by ICAO. That is, the accident is defined as an occurrence associated with the operation of an aircraft, in which a person is fatally or serious injured, the aircraft receives substantial damage, or the aircraft is missing or completely inaccessible.

Public Consultation Requirements and Regulatory Impact Analysis (RIA) Requirements in Rulemaking Process

As regards the public consultation requirements, all of the four Civil Aviation Authorities (the FAA of the U.S., EASA of the EU, CASA of Australia, and the JCAB of Japan) are required to publish proposed rules together with related materials for consultation. In addition, they are required to publish the comments received in the consultation and the disposition of them.

As regards the Regulatory Impact Analysis (RIA) requirements, in all of the four Civil Aviation Authorities, the RIA includes the economic analysis of costs and benefits of the proposed rule as well as its impacts on areas such as business environment, society, and environment. Furthermore, in addition to the analysis of the proposed rule, the identification and the analysis of the possible alternative policies are also required.

The FAA of the U.S. and EASA of the EU are required to publish the results for consultation. CASA of Australia and the JCAB of Japan, although not formally required, generally publish the results as well.

A summary of differences is as follows.

Threshold of Incidents which must be Reported to the Investigation Authority

Two unique characteristics of Australia were observed. First, the incidents which are required to be reported to the Investigation Authority are divided into two categories: the incidents which are required to be reported immediately ("Immediately Reportable Matters"), and the incidents which are not ("Routine Reportable Matters").

Second, Routine Reportable Matters for air transport operation include the incidents which are not considered serious incidents defined by ICAO, that is, "an incident involving circumstances indicating that an accident nearly occurred." On the other hand, in the other three states, all reportable incidents must be reported immediately and are considered serious incidents defined by ICAO.

The reportable incidents which are not covered by the mandatory reporting systems of Investigation Authority in Australia are covered by mandatory reporting systems of the Civil Aviation Authorities or voluntary reporting systems in the other states.

An accident of air transport aircraft can become a major accident involving a large number of fatalities. The case of Australia suggests that the incidents reportable to the Investigation Authority can be flexibly set taking account of two things: (1) the likelihood that safety lessons to prevent major accidents can be expected from the investigation and (2) the amount of available resources of the Investigation Authority and the Civil Aviation Authority.

Threshold of Incidents and Other Safety-related Occurrences which must be Reported to the Civil Aviation Authority

It was observed that the MOR Scheme in the U.K. requires that incidents and other safety-related occurrences in a relatively broader scope be reported than mandatory reporting systems of the Civil Aviation Authorities in the other states.

Reportable occurrences under the MOR Scheme in the U.K. which are not covered by the mandatory reporting systems of the Civil Aviation Authorities but are covered by the voluntary reporting systems in the other states include occurrences related to human errors during operation or deficiencies of procedures which could affect the safety of aircraft operations.

Mandatory reporting systems and voluntary reporting systems have advantages and disadvantages, and they supplement each other. Therefore, the threshold of severity of re-

portable occurrences under the mandatory reporting systems should be set taking account of the advantages and disadvantages of both systems as well as the available resources of the Civil Aviation Authorities to analyze the reports.

Differences in Air Proximity Hazard Reporting and Investigation Systems

Unlike other incidents, there are notable differences in the air proximity hazard occurrence reporting and investigation in the four states. The differences are a scope of air proximity hazard occurrences to be reported and investigated, whether reporting is mandatory or voluntary, and to whom the occurrences are reported.

In particular, the U.K. collects and investigates the broadest scope of the air proximity hazard occurrences among the four states. Data suggests that some midair collision hazard occurrences actually investigated and judged to have compromised safety of the aircraft in the U.K. would not have been reported and investigated if they had happened in the U.S. or Japan.

Since subjectivity is inherent in the risk of midair collision perceived by pilots and air traffic controllers, a system like the one in the U.K., where a broad scope of occurrences are reported and thoroughly investigated, may identify unknown hazards that could lead to more serious events.

Differences in Voluntary Reporting Systems

Several differences were observed in voluntary reporting systems.

Target of reporting systems (organizations or individuals)

Among the voluntary reporting systems studied, only the VDRP of the U.S. is aimed at organizations (companies management), not individuals. By providing voluntary reporting systems which are aimed at organizations, it can be expected that organizations are encouraged to report safety-related occurrences, and the organizations, in turn, further encourage their employees to report these occurrences.

System types

It was identified that the voluntary reporting systems whose target is individuals can be classified into three types. The three types are: (1) Non-company-specific Type, (2) Company-

specific Type, and (3) Inter-company Information Sharing and Analysis Type.

Non-company-specific Type of systems collect and analyze reports at a national level. In contrast, in Company-specific Type of systems, a specific voluntary reporting program is established for each company based on the agreement between the management organization of the systems and the company, and reports are collected and analyzed at each program level. Inter-company Information Sharing and Analysis Type of systems share the safety information with participating companies, and the management organizations of the systems analyze reports collected through the participating companies on behalf of them.

These three types of systems are not exclusive. That is, the states can establish different types of systems at the same time. In addition, each type of system has advantages and disadvantages. Therefore, by establishing different types of systems, the state can expect that they supplement each other.

Management of systems

It was identified the management organizations of voluntary reporting systems can be classified into three categories: (1) Civil Aviation Authority (CAA), (2) Investigation Authority or other government agencies, and (3) Third-party organization. Each of these categories has suitable types of systems. That is, the CAA is more suitable for Company-specific Type of systems than Non-company-specific Type of systems and Inter-company Information Sharing and Analysis Type of systems because the CAA can determine whether corrective actions which are taken by a company responding to reports involving violations of regulations are sufficient or not.

On the other hand, Investigation Authority or other government agencies and Third-party organization are more suitable for Non-company-specific Type of systems and Inter-company Information Sharing and Analysis Type of systems than Company-specific Type of systems because they do not have authority to determine whether corrective actions which are taken by a company responding to reports involving violations of regulations are sufficient or not.

Limited immunity from enforcement actions by the Civil Aviation Authority

There is a difference in terms of whether or not limited immunity from enforcement actions by the Civil Aviation Authority against reported violations of regulations is provided in the

system. The U.S., the U.K., and Australia have voluntary reporting systems which provide limited immunity. However, Japan does not have voluntary reporting systems which provide limited immunity. The fact that the number of reports submitted to the ASRS of the U.S. is larger than that to the ASI-NET of Japan after taking account of the difference in the size of aviation activities indicates that the limited immunity from enforcement actions does indeed encourage voluntary reporting.

Persons covered by reporting systems

There is a difference in terms of the scope of persons covered by systems. The U.S., the U.K., and Australia have voluntary reporting systems which cover most or all professional groups. However, the ASI-NET for Large Aircraft of Japan covers only pilots and flight engineers. The extension of coverage of the ASI-NET for Large Aircraft to other professional groups such as mechanics and cabin crew may enable the identification of hazards in other areas of aviation activity.

Security reports

Among the voluntary reporting systems studied, only REPCON of Australia clearly states, by regulation, that to provide information about aviation security concerns to appropriate person or organization is one of its purposes. Currently, in all voluntary reporting systems studied, reports regarding safety and the ones regarding security are being dealt with under a single system. Considering an extreme sensitive nature of the security reports, an establishment of a new system deals with the security reports may be appropriate.

Degree of database utilization

Compared to the other voluntary reporting systems, the ASRS of the U.S. has a well-established system to respond to the database search requests from outside. Furthermore, only the ASRS of the U.S gives the public access to the database. Effective database utilization may create new knowledge which leads to the enhancement of aviation safety.

Exchange of Safety Information between States

The EU Member States, including the U.K., are exchanging safety information with each other, a purpose of which is to collect sufficient data to identify hazards or meaningful

trends. On the other hand, it appears that the U.S., Australia, and Japan are not exchanging the safety information with other states. The exchange of safety information between states is worth considering for the responsible authorities in states which are currently not so doing.

Implementation of International Standards by Industry's Voluntary Initiative
In 2005, ICAO adopted a Standard which requires the establishment of a flight data analysis program by airlines. EASA of the EU and the JCAB of Japan have mandated it by regulations. However, the FAA of the U.S. has not mandated it. Instead, the FAA of the U.S. leaves it at the airlines' discretion, and by providing limited immunity from enforcement actions against the violations of regulations, the FAA acquires the FOQA data from the airlines in return.

Considering that the FAA has been able to achieve wide participation in the FOQA program by major U.S. airlines on a voluntary basis, the policy which practically implements the Standards adopted by ICAO by encouraging the industrys voluntary initiative may be applied to other Standards which will be adopted in the future.

9.2 Conclusions

The aviation safety information feedback systems were found to play an important role to assure the aviation safety, and the Investigation Authority and the Civil Aviation Authority in each state are responsible for ensuring that these feedback systems function properly. That is, the risk events, such as accidents, serious incidents, incidents, and other safety-related occurrences, are reported and investigated, and corrective actions are taken to mitigate the identified hazards without fail.

By conducting a comparative analysis of the feedback systems in the four contracting states of the Chicago Convention, this thesis identified that each state has the reporting and investigation systems with the similar structures. On the other hand, this thesis also identified that there are several differences in the practices in the reporting and investigation systems among the contracting states.

For the responsible authorities in the contracting states of the Chicago Convention, learning practices in the feedback systems in other contracting states can offer the oppor-

tunities to improve their own feedback systems. Based on the differences in the practices identified in this thesis, best practices which could improve the feedback systems were observed.

First, the U.K. collects and investigates the broadest scope of the air proximity hazard occurrences among the four states. Considering the data which indicates that some air proximity hazard occurrences actually investigated and judged to have compromised safety of the aircraft in the U.K. would not have been reported and investigated if they had happened in the U.S. or Japan, under the current systems, the U.S., Australia, and Japan may be missing chances to identify some unknown air proximity hazards. Therefore, establishing a system which collects and investigates a broader scope of air proximity hazard occurrences than the current systems may be a policy option worth considering for the responsible authorities in the U.S., Australia, and Japan.

Second, as regards the types of voluntary reporting systems, only the U.S. has has both a system which is aimed at organizations (VDRP) and systems which are aimed at individuals (ASRS and ASAP). On the other hand, the other three states have only systems which are aimed at individuals.

It can be expected that the systems which are aimed at organizations and the systems which are aimed at individuals work synergistically in encouraging reporting. Therefore, establishing both kinds of voluntary reporting systems may be a policy option worth considering for the responsible authorities in the U.K., Australia, and Japan.

Third, as regards the types of voluntary reporting systems which are aimed at individuals, only the U.S. has two types of systems: a Non-company-specific Type of system (ASRS) and a Company-specific Type of systems (ASAP). On the other hand, the other three states have only one type of system.

As discussed in detail in Chapter 8, it can be expected that the different types of systems supplement each other. Therefore, establishing different types of voluntary reporting systems may be a policy option worth considering for the responsible authorities in the U.K., Australia, and Japan.

Fourth, this thesis identified that Japan does not have voluntary reporting systems which provide limited immunity from enforcement actions against the violations of regulations, whereas the other three states have voluntary reporting systems which provide limited immunity. This thesis also presented data which indicates that the limited immunity does

indeed encourage voluntary reporting. Therefore, providing limited immunity in the voluntary reporting system to encourage reporting may be a policy option worth considering for the Civil Aviation Authority in Japan.

Fifth, this thesis identified that the U.S., the U.K., and Australia have voluntary reporting systems which cover most or all professional groups, whereas the ASI-NET for Large Aircraft of Japan covers only pilots and flight engineers. The extension of coverage may enable the identification of hazards in other areas of aviation activity. Therefore, the extension of coverage of the ASI-NET for Large Aircraft to other professional groups, such as mechanics or cabin crew, may be a policy option worth considering for the responsible authorities in Japan.

In considering policy options, it is also important for the responsible authorities in each state to consider the circumstances specific to the state. Due to the circumstances specific to the states, it may be difficult or undesirable for some states to adopt the practices in other states. This appears to be one of the reasons why ICAO does not specify the details of the reporting and investigation systems, adopts the details as Recommended Practices instead of Standards, or provides the contracting states of the Chicago Convention with the options not to comply with the Standards.

One example of the circumstances which can constrain responsible authorities to adopt the policy options is the available resources such as budget and human resources. For example, the investigation of serious incidents is prescribed as a Recommended Practice by Annex 13 of the Chicago Convention, and in accordance with the Recommended Practice, the Investigation Authority in Japan investigates all serious incidents (the Act for Establishment of the Japan Transport Safety Board). On the other hand, the Investigation Authority in Australia does not investigate all serious incidents due to resource constraints [8].

Another example of the circumstances which can constrain responsible authorities to adopt the policy options is the national culture. One of the reasons why limited immunity against the violations of regulations is not provided in the voluntary reporting system of Japan may be due to cultural consideration. It may be more acceptable in Japanese culture to take enforcement actions against the violations of regulations in order to promote the compliance with the regulations, rather than to provide immunity to encourage reporting.

Therefore, the responsible authorities in each state should adopt the best practices in other states while considering the circumstances specific to the state.

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Appendix A

Statistics of the Accident Rates

The statistics of the accident rates from 2001 to 2007 in the four states are presented to the extent the data is available. Figure A-1 shows that the majority of fatal accidents involving commercial jet aircraft occur at low altitudes or on runways during taxi, take-off, initial climb, final approach, and landing phases. Therefore, in comparing the accident rates, the accident rate per departure is preferable to the accident rate per flight hours.

The data sources are shown in Table A.1. Since the categorizations of the aircraft operations are slightly different depending on states, a strict comparison is not appropriate. However, it can be seen that the accident rates in Australia is a little higher than those in the other three states.

Table A.1: Data sources

State	Data Sources
U.S.	[94]
U.K.	[119]
Australia	[7]
Japan	[82], [85]

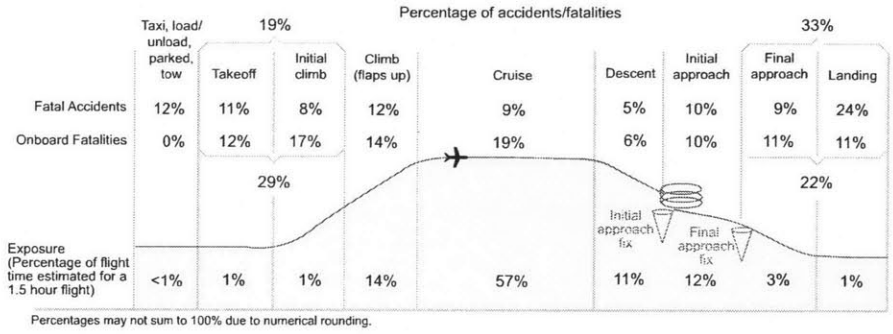

Figure A-1: Fatal accidents and onboard fatalities by phase of flight - worldwide commercial jet fleet 1998-2007 [19]

Scheduled Public Transport[a]

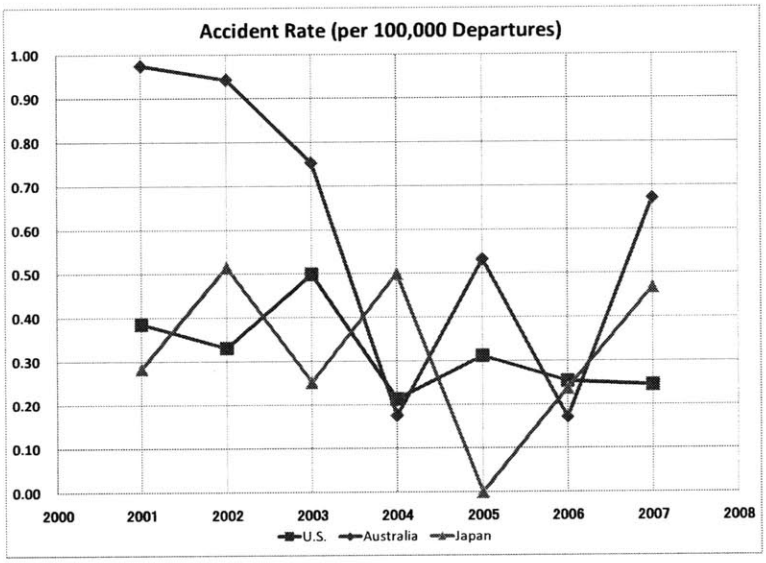

Figure A-2: Accident rates per 100,000 departures of scheduled public transport

Table A.2: Accident rates per 100,000 departures of scheduled public transport

State	Average	Standard Deviation (σ)
U.S.	0.32	0.09
Australia	0.60	0.31
Japan	0.32	0.17

[a]The data of the U.S is that of the scheduled flights conducted by the Part 121 Operators. The data of Australia only includes that of VH -registered aircraft. The data of Japan includes that of the non-scheduled international flights.

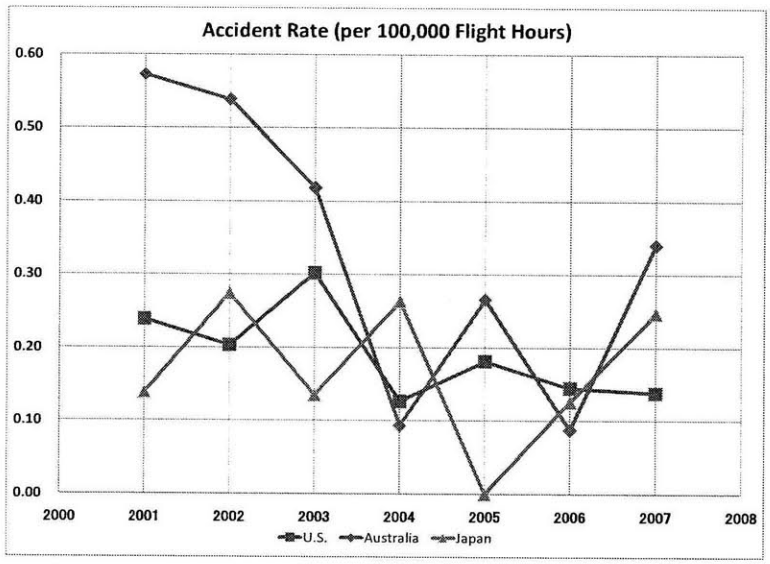

Figure A-3: Accident rates per 100,000 flight hours of scheduled public transport

Table A.3: Accident rates per 100,000 flight hours of scheduled public transport

State	Average	Standard Deviation (σ)
U.S.	0.19	0.06
Australia	0.33	0.18
Japan	0.17	0.09

Non-scheduled Public Transport[b]

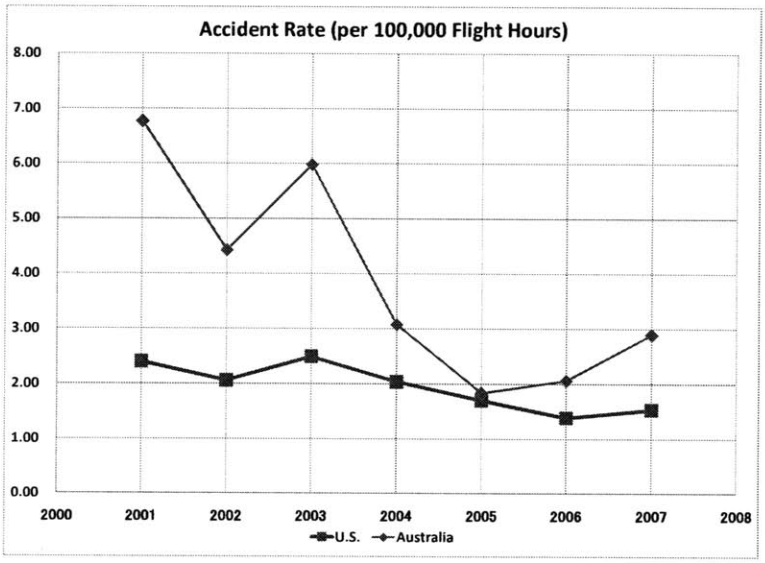

Figure A-4: Accident rates per 100,000 flight hours of non-scheduled public transport

Table A.4: Accident rates per 100,000 flight hours of non-scheduled public transport

State	Average	Standard Deviation (σ)
U.S.	1.95	0.39
Australia	3.87	1.78

[b]The data of the U.S is that of the non-scheduled flights conducted by the Part 135 Operators. The data of Australia only includes that of VH -registered aircraft.

Public Transport[c]

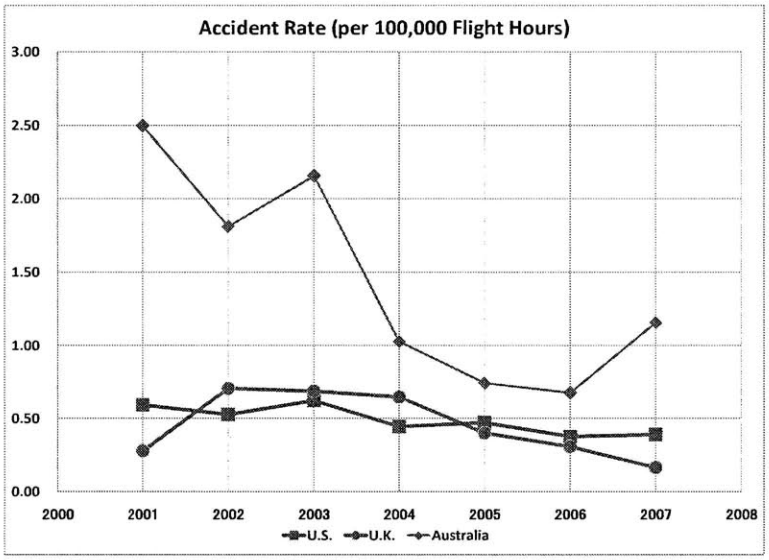

Figure A-5: Accident rates per 100,000 flight hours of public transport

Table A.5: Accident rates per 100,000 flight hours of public transport

State	Average	Standard Deviation (σ)
U.S.	0.49	0.09
U.K.	0.46	0.20
Australia	1.44	0.66

[c]The data of the U.S. is the sum of the data of the flights conducted by the Part 121 Operators plus the data of the flights conducted by the Part 135 Operators. The data of the U.K. only includes that of the aircraft whose authorized maximum take-off weight exceeds 5,700 kg. The data of Australia only includes that of the VH -registered aircraft.

General Aviation[d]

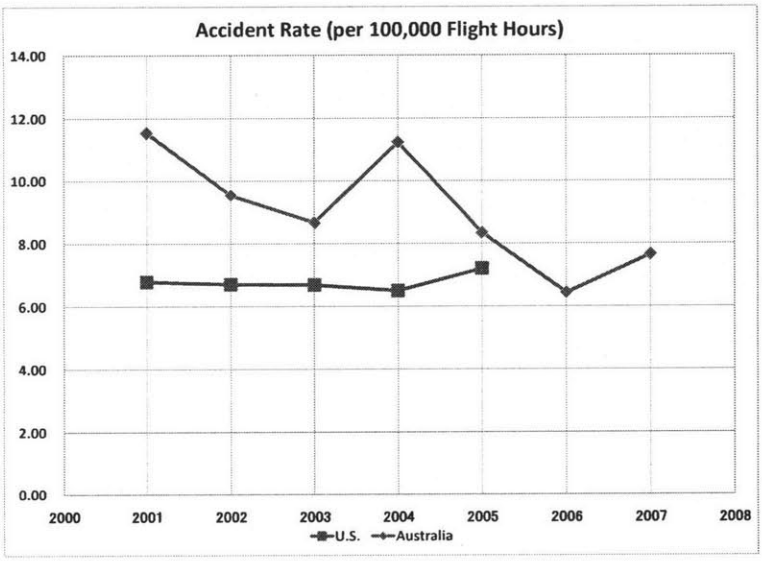

Figure A-6: Accident rates per 100,000 flight hours of General Aviation

Table A.6: Accident rates per 100,000 flight hours of General Aviation

State	Average	Standard Deviation (σ)
U.S.	6.78	0.10
Australia	9.06	1.72

[d]The data of Australia includes that of aerial work, flight training, the operation for the business use, and the operation for private use, but excludes the data of sports aviation. It only includes that of the VH -registered aircraft.

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Appendix B

Excerpts of Regulations regarding Reportable Accidents and Incidents

B.1 Regulations of the United States

B.1.1 Title 14 of the Code of Federal Regulations

Part 21 CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS
Subpart A–General

Sec. 21.3 Reporting of failures, malfunctions, and defects.

(a) Except as provided in paragraph (d) of this section, the holder of a Type Certificate (including a Supplemental Type Certificate), a Parts Manufacturer Approval (PMA), or a TSO authorization, or the licensee of a Type Certificate shall report any failure, malfunction, or defect in any product, part, process, or article manufactured by it that it determines has resulted in any of the occurrences listed in paragraph (c) of this section.

(b) The holder of a Type Certificate (including a Supplemental Type Certificate), a Parts Manufacturer Approval (PMA), or a TSO authorization, or the licensee of a Type Certificate shall report any defect in any product, part, or article manufactured by it

that has left its quality control system and that it determines could result in any of the occurrences listed in paragraph (c) of this section.

(c) The following occurrences must be reported as provided in paragraphs (a) and (b) of this section:

(1) Fires caused by a system or equipment failure, malfunction, or defect.

(2) An engine exhaust system failure, malfunction, or defect which causes damage to the engine, adjacent aircraft structure, equipment, or components.

(3) The accumulation or circulation of toxic or noxious gases in the crew compartment or passenger cabin.

(4) A malfunction, failure, or defect of a propeller control system.

(5) A propeller or rotorcraft hub or blade structural failure.

(6) Flammable fluid leakage in areas where an ignition source normally exists.

(7) A brake system failure caused by structural or material failure during operation.

(8) A significant aircraft primary structural defect or failure caused by any autogenous condition (fatigue, understrength, corrosion, etc.).

(9) Any abnormal vibration or buffeting caused by a structural or system malfunction, defect, or failure.

(10) An engine failure.

(11) Any structural or flight control system malfunction, defect, or failure which causes an interference with normal control of the aircraft or which derogates the flying qualities.

(12) A complete loss of more than one electrical power generating system or hydraulic power system during a given operation of the aircraft.

(13) A failure or malfunction of more than one attitude, airspeed, or altitude instrument during a given operation of the aircraft.

(d) The requirements of paragraph (a) of this section do not apply to -

(1) Failures, malfunctions or defects that the holder of a Type Certificate (including a Supplemental Type Certificate), Parts Manufacturer Approval (PMA), or TSO authorization, or the licensee of a Type Certificate -

(i) Determines were caused by improper maintenance, or improper usage;

(ii) Knows were reported to the FAA by another person under the Federal Aviation Regulations; or

(iii) Has already reported under the accident reporting provisions of Part 430 of the regulations of the National Transportation Safety Board.

(2) Failures, malfunctions or defects in products, parts, or articles manufactured by a foreign manufacturer under a U.S. Type Certificate issued under Sec. 21.29 or Sec. 21.617, or exported to the United States under Sec. 21.502.

(e) ...

(f) ...

Part 121 OPERATING REQUIREMENTS: DOMESTIC, FLAG, AND SUPPLEMENTAL OPERATIONS

Subpart V–Records and Reports

Sec. 121.703 Service difficulty reports.

(a) Each certificate holder shall report the occurrence or detection of each failure, malfunction, or defect concerning -

(1) Fires during flight and whether the related fire-warning system functioned properly;

(2) Fires during flight not protected by a related fire-warning system;

(3) False fire warning during flight;

(4) An engine exhaust system that causes damage during flight to the engine, adjacent structure, equipment, or components;

(5) An aircraft component that causes accumulation or circulation of smoke, vapor, or toxic or noxious fumes in the crew compartment or passenger cabin during flight;

(6) Engine shutdown during flight because of flameout;

(7) Engine shutdown during flight when external damage to the engine or airplane structure occurs;

(8) Engine shutdown during flight due to foreign object ingestion or icing;

(9) Engine shutdown during flight of more than one engine;

(10) A propeller feathering system or ability of the system to control overspeed during flight;

(11) A fuel or fuel-dumping system that affects fuel flow or causes hazardous leakage during flight;

(12) An unwanted landing gear extension or retraction, or an unwanted opening or closing of landing gear doors during flight;

(13) Brake system components that result in loss of brake actuating force when the airplane is in motion on the ground;

(14) Aircraft structure that requires major repair;

(15) Cracks, permanent deformation, or corrosion of aircraft structures, if more than the maximum acceptable to the manufacturer or the FAA;

(16) Aircraft components or systems that result in taking emergency actions during flight (except action to shut down an engine); and

(17) Emergency evacuation systems or components including all exit doors, passenger emergency evacuation lighting systems, or evacuation equipment that are found defective, or that fail to perform the intended functions during an actual emergency or during training, testing, maintenance, demonstrations, or inadvertent deployments.

(b) For the purpose of this section *during flight* means the period from the moment the aircraft leaves the surface of the earth on takeoff until it touches down on landing.

(c) In addition to the reports required by paragraph (a) of this section, each certificate holder shall report any other failure, malfunction, or defect in an aircraft that occurs or is detected at any time if, in its opinion, that failure, malfunction, or defect has endangered or may endanger the safe operation of an aircraft used by it.

(d) ...

(e) ...

(f) A certificate holder that is also the holder of a Type Certificate (including a Supplemental Type Certificate), a Parts Manufacturer Approval, or a Technical Standard Order Authorization, or that is the licensee of a type certificate holder, need not report a failure, malfunction, or defect under this section if the failure, malfunction, or defect has been reported by it under 21.3 of this chapter or under the accident reporting provisions of 14 CFR part 830.

(g) No person may withhold a report required by this section even though all information required in this section is not available.

(h) When certificate holder gets additional information, including information from the manufacturer or other agency, concerning a report required by this section, it shall

expeditiously submit it as a supplement to the first report and reference the date and place of submission of the first report.

Part 125 CERTIFICATION AND OPERATIONS: AIRPLANES HAVING A SEATING CAPACITY OF 20 OR MORE PASSENGERS OR A MAXIMUM PAYLOAD CAPACITY OF 6,000 POUNDS OR MORE

Subpart L–Records and Reports

Sec. 125.409 Service difficulty reports

(a) Each certificate holder shall report the occurrence or detection of each failure, malfunction, or defect, in a form and manner prescribed by the Administrator.

(b) ...

Sec. 125.410 Service difficulty reports (structural).

(a) Each certificate holder shall report the occurrence or detection of each failure or defect related to–

(1) Corrosion, cracks, or disbonding that requires replacement of the affected part;

(2) Corrosion, cracks, or disbonding that requires rework or blendout because the corrosion, cracks, or disbonding exceeds the manufacturer's established allowable damage limits;

(3) Cracks, fractures, or disbonding in a composite structure that the equipment manufacturer has designated as a primary structure or a principal structural element; or

(4) Repairs made in accordance with approved data not contained in the manufacturer's maintenance manual.

(b) In addition to the reports required by paragraph (a) of this section, each certificate holder shall report any other failure or defect in aircraft structure that occurs or is detected at any time if that failure or defect has endangered or may endanger the safe operation of an aircraft.

(c) ...

(d) ...

(e) A certificate holder that also is the holder of a Type Certificate (including a Supplemental Type Certificate), a Parts Manufacturer Approval, or a Technical Standard Order authorization, or that is a licensee of a Type Certificate holder, need not report a failure or defect under this section if the failure or defect has been reported by that certificate holder under 21.3 of this chapter or under the accident reporting provisions of 49 CFR part 830.

(f) A report required by this section may be submitted by a certificated repair station when the reporting task has been assigned to that repair station by the part 125 certificate holder. However, the part 125 certificate holder remains primarily responsible for ensuring compliance with the provisions of this section. The part 125 certificate holder shall receive a copy of each report submitted by the repair station.

(g) No person may withhold a report required by this section although all information required by this section is not available.

(h) When a certificate holder gets supplemental information to complete the report required by this section, the certificate holder shall expeditiously submit that information as a supplement to the original report and use the unique control number from the original report.

Part 135 OPERATING REQUIREMENTS: COMMUTER AND ON-DEMAND OPERATIONS AND RULES GOVERNING PERSONS ON BOARD SUCH AIRCRAFT

Subpart J–Maintenance, Preventive Maintenance, and Alterations

Sec. 135.415 Service difficulty reports

(a) Each certificate holder shall report the occurrence or detection of each failure, malfunction, or defect in an aircraft concerning -

(1) Fires during flight and whether the related fire-warning system functioned properly;

(2) Fires during flight not protected by related fire-warning system;

(3) False fire-warning during flight;

(4) An exhaust system that causes damage during flight to the engine, adjacent structure, equipment, or components;

(5) An aircraft component that causes accumulation or circulation of smoke, vapor, or toxic or noxious fumes in the crew compartment or passenger cabin during flight;

(6) Engine shutdown during flight because of flameout;

(7) Engine shutdown during flight when external damage to the engine or aircraft structure occurs;

(8) Engine shutdown during flight due to foreign object ingestion or icing;

(9) Shutdown of more than one engine during flight;

(10) A propeller feathering system or ability of the system to control overspeed during flight;

(11) A fuel or fuel-dumping system that affects fuel flow or causes hazardous leakage during flight;

(12) An unwanted landing gear extension or retraction or opening or closing of landing gear doors during flight;

(13) Brake system components that result in loss of brake actuating force when the aircraft is in motion on the ground;

(14) Aircraft structure that requires major repair;

(15) Cracks, permanent deformation, or corrosion of aircraft structures, if more than the maximum acceptable to the manufacturer or the FAA; and

(16) Aircraft components or systems that result in taking emergency actions during flight (except action to shut-down an engine).

(b) For the purpose of this section, *during flight* means the period from the moment the aircraft leaves the surface of the earth on takeoff until it touches down on landing.

(c) In addition to the reports required by paragraph (a) of this section, each certificate holder shall report any other failure, malfunction, or defect in an aircraft that occurs or is detected at any time if, in its opinion, the failure, malfunction, or defect has endangered or may endanger the safe operation of the aircraft.

(d) ...

(e) ...

(f) A certificate holder that is also the holder of a type certificate (including a supplemental type certificate), a Parts Manufacturer Approval, or a Technical Standard Order Authorization, or that is the licensee of a type certificate need not report a failure, malfunction, or defect under this section if the failure, malfunction, or defect has been reported by it under 21.3 or 37.17 of this chapter or under the accident reporting provisions of part 830 of the regulations of the National Transportation Safety Board.

(g) No person may withhold a report required by this section even though all information required by this section is not available.

(h) When the certificate holder gets additional information, including information from the manufacturer or other agency, concerning a report required by this section, it shall expeditiously submit it as a supplement to the first report and reference the date and place of submission of the first report.

Part 145 REPAIR STATIONS

Subpart E–Operating Rules

Sec. 145.221 Service difficulty reports

(a) A certificated repair station must report to the FAA within 96 hours after it discovers any serious failure, malfunction, or defect of an article. The report must be in a format acceptable to the FAA.

(b) ...

(c) The holder of a repair station certificate that is also the holder of a part 121, 125, or 135 certificate; type certificate (including a supplemental type certificate); parts manufacturer approval; or technical standard order authorization, or that is the licensee of a type certificate holder, does not need to report a failure, malfunction, or defect under this section if the failure, malfunction, or defect has been reported under parts 21, 121, 125, or 135 of this chapter.

(d) A certificated repair station may submit a service difficulty report for the following:

(1) A part 121 certificate holder, provided the report meets the requirements of part 121 of this chapter, as appropriate.

(2) A part 125 certificate holder, provided the report meets the requirements of part 125 of this chapter, as appropriate.

(3) A part 135 certificate holder, provided the report meets the requirements of part 135 of the chapter, as appropriate.

(e) A certificated repair station authorized to report a failure, malfunction, or defect under paragraph (d) of this section must not report the same failure, malfunction, or defect under paragraph (a) of this section. A copy of the report submitted under paragraph (d) of this section must be forwarded to the certificate holder.

B.2 Regulations of the United Kingdom

B.2.1 EU Council Directive 94/56/EC

LIST OF EXAMPLES OF SERIOUS INCIDENTS

The incidents listed below are typical examples of serious incidents. The list is not exhaustive and only serves as a guide to the definition of 'serious incident'.

- A near collision requiring an avoidance manoeuvre or when an avoiding manoeuvre would have been appropriate to avoid a collision or an unsafe situation.
- Controlled flight into terrain (CFIT) only marginally avoided.
- An aborted take-off on a closed or engaged runway, or a take-off from such runway with marginal separation from obstacle(s).
- A landing or attempted landing on a closed or engaged runway.
- Gross failure to achieve predicted performance during take-off or initial climb.
- All fires and smoke in the passenger compartment or in cargo compartments, or engine fires, even though such fires are extinguished with extinguishing agents.
- Any events which required the emergency use of oxygen by the flight crew.
- Aircraft structural failure or engine disintegration which is not classified as an accident.
- Multiple malfunctions of one or more aircraft systems that seriously affect the operation of the aircraft.
- Any case of flight crew incapacitation in flight.
- Any fuel state which would require the declaration of an emergency by the pilot.
- Take-off or landing incidents, such as undershooting, overrunning or running off the side of runways.
- System failures, weather phenomena, operation outside the approved flight envelope or other occurrences which could have caused difficulties controlling the aircraft.

- Failure of more than one system in a redundancy system which is mandatory for flight guidance and navigation.

B.2.2 Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996

2.-(1) In these Regulations, unless the context otherwise requires -

"accident" means 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 suffers a fatal or serious injury as a result of -

- being in or upon the aircraft,
- 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, tyres, brakes, fairings, small dents or puncture holes in the aircraft skin; or

(c) the aircraft is missing or is completely inaccessible;

...

"incident" means an occurrence, other than an accident, associated with the operation of an aircraft which affects or would affect the safety of operation;

...

"serious incident" means an incident involving circumstances indicating that an accident nearly occurred;

...

B.2.3 CAP 382 "The Mandatory Occurrence Reporting Scheme"

Part 1

List of Aircraft Operations, Maintenance, Repair and Manufacture - Related Occurrences to be Reported

1 Aircraft flight operations

1.1 Operation of the aircraft

a) Avoidance manoeuvres:

- risk of collision with another aircraft, terrain or other object or an unsafe situation when avoidance action would have been appropriate;
- an avoidance manoeuvre required to avoid a collision with another aircraft, terrain or other object;
- an avoidance manoeuvre to avoid other unsafe situations.

b) Take-off or landing incidents, including precautionary or forced landings. Incidents such as under-shooting, overrunning or running off the side of runways. Take-offs, rejected take-offs, landings or attempted landings on a closed, occupied or incorrect runway. Runway incursions.

c) Inability to achieve predicted performance during take-off or initial climb.

d) Critically low fuel quantity or inability to transfer fuel or use total quantity of usable fuel.

e) Loss of control (including partial or temporary) regardless of cause.

f) Occurrences close to or above V_1 resulting from or producing a hazardous or potentially hazardous situation (e.g. rejected take-off, tail strike, engine-power loss etc.).

g) Go around producing a hazardous or potentially hazardous situation.

h) Unintentional significant deviation from airspeed, intended track or altitude (more than 300 ft) regardless of cause.

i) Descent below decision height/altitude or minimum descent height/altitude without the required visual reference.

j) Loss of position awareness relative to actual position or to other aircraft.

k) Breakdown in communication between flight crew "CRM" (crew resource management) or between flight crew and other parties (cabin crew, ATC [air traffic control] engineering).

l) Heavy landing - a landing deemed to require a "heavy landing check".

m) Exceedance of fuel imbalance limits.

n) Incorrect setting of an "SSR" (secondary surveillance radar) code or of an altimeter subscale.

o) Incorrect programming of, or erroneous entries into, equipment used for navigation or performance calculations, or use of incorrect data.

p) Incorrect receipt or interpretation of radio-telephony messages.

q) Fuel system malfunctions or defects, which had an effect on fuel supply and/or distribution.

r) Aircraft unintentionally departing from a paved surface.

s) Collision between an aircraft and any other aircraft, vehicle or other ground object.

t) Inadvertent and/or incorrect operation of any controls.

u) Inability to achieve the intended aircraft configuration for any flight phase (e.g. landing gear and gear doors, flaps, stabilisers, slats etc.).

v) A hazard or potential hazard which arises as a consequence of any deliberate simulation of failure conditions for training, system checks or training purposes.

w) Abnormal vibration.

x) Operation of any primary warning system associated with manoeuvring the aircraft e.g. configuration warning, stall warning (stick shaker), over-speed warning etc. unless:

   i) the crew conclusively established that the indication was false and provided that the false warning did not result in difficulty or hazard arising from the crew response to the warning; or

   ii) operated for training or test purposes.

y) "GPWS" (ground proximity warning system)/"TAWS" (terrain awareness and warning system) "warning" when:

i) the aircraft comes into closer proximity to the ground than had been planned or anticipated; or

ii) the warning is experienced in instrument meteorological conditions or at night and is established as having been triggered by a high rate of descent (mode 1); or

iii) the warning results from failure to select landing gear or landing flaps by the appropriate point on the approach (mode 4); or

iv) any difficulty or hazard arises or might have arisen as a result of crew response to the "warning" e.g. possible reduced separation from other traffic. This could include warning of any mode or type i.e. genuine, nuisance or false.

z) GPWS/TAWS "alert" when any difficulty or hazard arises or might have arisen as a result of crew response to the "alert".

aa) "ACAS" (air collision advisory system)"RA"s (resolution advisories).

ab) Jet or prop blast incidents resulting in significant damage or serious injury.

ac) Landing at the wrong airfield.

1.2 Emergencies

a) Fire, explosion, smoke or toxic or noxious fumes, even though fires were extinguished.

b) The use of any non-standard procedure by the flight or cabin crew to deal with an emergency when:

i) the procedure exists but is not used;

ii) the procedure does not exist;

iii) the procedure exists but is incomplete or inappropriate;

iv) the procedure is incorrect;

v) the incorrect procedure is used.

c) Inadequacy of any procedures designed to be used in an emergency, including when being used for maintenance, training or test purposes.

d) An event leading to an emergency evacuation.

e) Depressurisation.

f) The use of any emergency equipment or prescribed emergency procedures in order to deal with a situation.

g) An event leading to the declaration of an emergency ("Mayday" or "PAN").

h) Failure of any emergency system or equipment, including all exit doors and lighting, to perform satisfactorily, including when being used for maintenance, training or test purposes.

i) Events requiring any use of emergency oxygen by any crew member.

1.3 Crew incapacitation

a) Incapacitation of any member of the flight crew, including that which occurs prior to departure if it is considered that it could have resulted in incapacitation after take-off.

b) Incapacitation of any member of the cabin crew which renders them unable to perform essential emergency duties.

1.4 Injury Occurrences which have or could have led to significant injury to passengers or crew but which are not considered reportable as an accident.

1.5 Meteorology

a) A lightning strike which resulted in damage to the aircraft or loss or malfunction of any essential service.

b) A hail strike which resulted in damage to the aircraft or loss or malfunction of any essential service.

c) Severe turbulence encounter, an encounter resulting in injury to occupants or deemed to require a "turbulence check" of the aircraft.

d) A windshear encounter.

e) Icing encounter resulting in handling difficulties, damage to the aircraft or loss or malfunction of any essential service.

1.6 Security

a) Unlawful interference with the aircraft including a bomb threat or hijack.

b) Difficulty in controlling intoxicated, violent or unruly passengers.

c) Discovery of a stowaway.

1.7 Other occurrences

a) Repetitive instances of a specific type of occurrence which in isolation would not be considered "reportable" but which due to the frequency with which they arise, form a potential hazard.

b) A bird strike which resulted in damage to the aircraft or loss or malfunction of any essential service.

c) Wake-turbulence encounters.

d) Any other occurrence of any type considered to have endangered or which might have endangered the aircraft or its occupants on board the aircraft or persons on the ground.

2 Aircraft technical

2.1 Structural

Not all structural failures need to be reported. Engineering judgment is required to decide whether a failure is serious enough to be reported. The following examples can be taken into consideration:

a) damage to a "PSE" (principal structural element) that has not been designated as damage-tolerant (life-limited element). PSEs are those which contribute significantly to carrying flight, ground, and pressurisation loads, and the failure of which could result in a catastrophic failure of the aircraft;

b) defect or damage exceeding admissible damages to a PSE that has been designated as damage-tolerant;

c) damage to or defect exceeding allowed tolerances of a structural element, the failure of which could reduce the structural stiffness to such an extent that the required flutter, divergence or control reversal margins are no longer achieved;

d) damage to or defect of a structural element, which could result in the liberation of items of mass that may injure occupants of the aircraft;

e) damage to or defect of a structural element, which could jeopardise proper operation of systems. See paragraph 2.2 below;

f) loss of any part of the aircraft structure in flight.

2.2 Systems

The following general criteria applicable to all systems are proposed:

a) loss, significant malfunction or defect of any system, subsystem or set of equipment when standard operating procedures, drills etc. could not be satisfactorily accomplished;

b) inability of the crew to control the system, for example:

i) uncommanded actions,

ii) incorrect and/or incomplete response, including limitation of movement or stiffness,

iii) runaway,

iv) mechanical disconnection or failure;

c) failure or malfunction of the exclusive function(s) of the system (one system could integrate several functions);

d) interference within or between systems;

e) failure or malfunction of the protection device or emergency system associated with the system;

f) loss of redundancy of the system;

g) any occurrence resulting from unforeseen behaviour of a system.

h) for aircraft types with single main systems, subsystems or sets of equipment: loss, significant malfunction or defect in any main system, subsystem or set of equipment.

i) for aircraft types with multiple independent main systems, subsystems or sets of equipment: the loss, significant malfunction or defect of more than one main system, subsystem or set of equipment.

j) operation of any primary warning system associated with aircraft systems or equipment unless the crew conclusively established that the indication was false,

provided that the false warning did not result in difficulty or hazard arising from the crew response to the warning;

k) leakage of hydraulic fluids, fuel, oil or other fluids which resulted in a fire hazard or possible hazardous contamination of aircraft structure, systems or equipment, or risk to occupants;

l) malfunction or defect of any indication system when this results in the possibility of misleading indications to the crew;

m) any failure, malfunction or defect if it occurs at a critical phase of the flight and is relevant to the system operation;

n) significant shortfall of the actual performances compared to the approved performance which resulted in a hazardous situation (taking into account the accuracy of the performance-calculation method) including braking action, fuel consumption etc.;

o) asymmetry of flight controls; e.g. flaps, slats, spoilers etc.

The Appendix to this Schedule gives a list of examples of reportable occurrences resulting from the application of these general criteria to specific systems.

2.3 Propulsion (including engines, propellers and rotor systems) and "APUs" (auxiliary power units).

a) Flameout, shutdown or malfunction of any engine.

b) Overspeed or inability to control the speed of any high-speed rotating component(for example: APU, air starter, air cycle machine, air turbine motor, propeller or rotor).

c) Failure or malfunction of any part of an engine or powerplant resulting in any one or more of the following:

i) non-containment of components/debris;

ii) uncontrolled internal or external fire, or hot gas breakout;

iii) thrust in a direction different from that demanded by the pilot;

iv) thrust-reversing system failing to operate or operating inadvertently;

v) inability to control power, thrust or revolutions per minute;

vi) failure of the engine mount structure;

vii) partial or complete loss of a major part of the powerplant;

viii) dense visible fumes or concentrations of toxic products sufficient to incapacitate crew or passengers;

ix) inability, by use of normal procedures, to shutdown an engine;

x) inability to restart a serviceable engine.

d) An uncommanded thrust/power loss, change or oscillation which is classified as a "LOTC" (loss of thrust or power control):

i) for a single-engine aircraft; or

ii) where it is considered excessive for the application; or

iii) where this could affect more than one engine in a multi-engine aircraft, particularly in the case of a twin-engine aircraft; or

iv) for a multi-engine aircraft where the same, or similar, engine type is used in an application where the event would be considered hazardous or critical.

e) Any defect in a life-controlled part causing its withdrawal before completion of its full life.

f) Defects of common origin which could cause an in-flight shut-down rate so high that there is the possibility of more than one engine being shut down on the same flight.

g) An engine limiter or control device failing to operate when required or operating inadvertently.

h) Exceedance of engine parameters.

i) "FOD" (foreign objects damage).

Propellers and transmission

a) Failure or malfunction of any part of a propeller or powerplant resulting in any one or more of the following:

i) an overspeed of the propeller;

ii) the development of excessive drag;

iii) a thrust in the opposite direction to that commanded by the pilot;

iv) a release of the propeller or any major portion of the propeller;

v) a failure that results in excessive imbalance;

vi) the unintended movement of the propeller blades below the established minimum in-flight low-pitch position;

vii) an inability to feather the propeller;

viii) an inability to change propeller pitch;

ix) an uncommanded change in pitch;

x) an uncontrollable torque or speed fluctuation;

xi) the release of low-energy parts.

Rotors and transmission

b) Damage or defect of main rotor gearbox/attachment which could lead to in-flight separation of the rotor assembly and/or malfunctions of the rotor control.

c) Damage to tail rotor, transmission and equivalent systems.

APUs

d) Shut down or failure when the APU is required to be available by operational requirements, e.g. ETOPS, "MEL" (minimum equipment list).

e) Inability to shut down the APU.

f) Overspeed.

g) Inability to start the APU when needed for operational reasons.

2.4 Human factors

Any incident where any feature or inadequacy of the aircraft design could have led to an error of use that could contribute to a hazardous or catastrophic effect.

2.5 Other occurrences

a) Any incident where any feature or inadequacy of the aircraft design could have led to an error of use that could contribute to a hazardous or catastrophic effect.

b) An occurrence not normally considered as reportable (e.g., furnishing and cabin equipment, water systems), where the circumstances resulted in endangering the aircraft or its occupants.

c) A fire, explosion, smoke or toxic or noxious fumes.

d) Any other event which could endanger the aircraft, or affect the safety of the occupants of the aircraft, or people or property in the vicinity of the aircraft or on the ground.

e) Failure or defect of passenger address system resulting in loss of, or inaudible, passenger address system.

f) Loss of pilot seat control during flight.

3 Aircraft maintenance and repair

a) Incorrect assembly of parts or components of the aircraft found during an inspection or test procedure not intended for that specific purpose.

b) Hot bleed air leak resulting in structural damage.

c) Any defect in a life-controlled part causing retirement before completion of its full life.

d) Any damage or deterioration (e.g. fractures, cracks, corrosion, delamination, disbonding etc.) resulting from any cause (e.g. as flutter, loss of stiffness or structural failure) to:

i) a primary structure or a "PSE" (principal structure element) (as defined in the manufacturers' Repair Manual) where such damage or deterioration exceeds allowable limits specified in the Repair Manual and requires a repair or complete or partial replacement;

ii) a secondary structure which consequently has or may have endangered the aircraft;

iii) the engine, propeller or rotorcraft rotor system.

e) Any failure, malfunction or defect of any system or equipment, or damage or deterioration thereof found as a result of compliance with an airworthiness directive or other mandatory instruction issued by a regulatory authority, when:

i) it is detected for the first time by the reporting organisation implementing compliance;

ii) on any subsequent compliance, it exceeds the permissible limits quoted in the instruction and/or published repair/rectification procedures are not available.

f) Failure of any emergency system or equipment, including all exit doors and lighting, to perform satisfactorily, including when being used for maintenance or test purposes.

g) Non-compliance or significant errors in compliance with required maintenance procedures.

h) Products, parts, appliances and materials of unknown or suspect origin.

i) Misleading, incorrect or insufficient maintenance data or procedures that could lead to maintenance errors.

j) Any failure, malfunction or defect of ground equipment used for testing or checking of aircraft systems and equipment when the required routine inspection and test procedures did not clearly identify the problem, where this results in a hazardous situation.

4 Ground services and facilities

4.1 "ANS" (Air navigation services)

See Part 2, list of reportable ANS-related occurrences.

4.2 Aerodrome and aerodrome facilities

a) Significant spillage during fuelling operations.

b) Loading of incorrect fuel quantities likely to have a significant effect on aircraft endurance, performance, balance or structural strength.

c) Failure or significant deterioration of aerodrome aircraft operating surfaces.

4.3 Handling of passengers, baggage and cargo

a) Significant contamination of aircraft structure, systems and equipment arising from the carriage of baggage or cargo.

b) Incorrect loading of passengers, baggage or cargo, likely to have a significant effect on aircraft mass and/or balance.

c) Incorrect stowage of baggage or cargo (including hand baggage) likely in any way to endanger the aircraft, its equipment or occupants or to impede emergency evacuation.

d) Inadequate stowage of cargo containers or other substantial items of cargo.

e) Carriage or attempted carriage of dangerous goods in contravention of applicable regulations, including incorrect labelling and packaging of dangerous goods.

4.4 Aircraft ground handling and servicing

a) Failure, malfunction or defect of ground equipment used for the testing or checking of aircraft systems and equipment when the required routine inspection and test procedures did not clearly identify the problem, where this results in a hazardous situation.

b) Non-compliance or significant errors in compliance with required servicing procedures.

c) Loading of contaminated or incorrect type of fuel or other essential fluids (including oxygen and potable water).

Appendix to Part 1

The following subparagraphs give examples of reportable occurrences resulting from the application of the general criteria to specific systems listed in paragraph 2.2 of Part 1.

1 Air conditioning/ventilation

a) complete loss of avionics cooling;

b) depressurisation.

2 Autoflight system

a) failure of the autoflight system to achieve the intended operation while engaged;

b) significant reported crew difficulty to control the aircraft linked to autoflight system functioning;

c) failure of any autoflight system disconnect device;

d) uncommanded autoflight mode change.

3 Communications

a) failure or defect of passenger address system resulting in loss of or inaudible passenger address;

b) total loss of communication in flight.

4 Electrical system

a) loss of one electrical distribution system (AC/DC);

b) total loss or loss of more than one electrical generation system;

c) failure of the back up (emergency) electrical generation system.

5 Cockpit/Cabin/Cargo

a) pilot seat control loss during flight;

b) failure of any emergency system or equipment, including emergency evacuation signalling system, all exit doors, emergency lighting, etc.;

c) loss of retention capability of the cargo loading system.

6 Fire protection system

a) fire warnings, except those immediately confirmed as false;

b) undetected failure or defect of fire/smoke detection/protection system, which could lead to loss or reduced fire detection/protection;

c) absence of warning in case of actual fire or smoke.

7 Flight controls

a) asymmetry of flaps, slats, spoilers, etc.;

b) limitation of movement, stiffness or poor or delayed response in the operation of primary flight control systems or their associated tab and lock systems;

c) flight control surface runaway;

d) flight control surface vibration felt by the crew;

e) mechanical flight control disconnection or failure;

f) significant interference with normal control of the aircraft or degradation of flying qualities.

8 Fuel system

a) fuel quantity indicating system malfunction resulting in total loss or wrong indication of fuel quantity on board;

b) leakage of fuel which resulted in major loss, fire hazard, significant contamination;

c) malfunction or defects of the fuel jettisoning system which resulted in inadvertent loss of significant quantity, fire hazard, hazardous contamination of aircraft equipment or inability to jettison fuel;

d) fuel system malfunctions or defects which had a significant effect on fuel supply and/or distribution;

e) inability to transfer or use total quantity of usable fuel.

9 Hydraulics

a) loss of one hydraulic system (ETOPS only);

b) failure of the isolation system;

c) loss of more than one hydraulic circuit;

d) failure of the back-up hydraulic system;

e) inadvertent ram air turbine extension.

10 Ice detection/protection system

a) undetected loss or reduced performance of the anti-ice/de-ice system;

b) loss of more than one of the probe-heating systems;

c) inability to obtain symmetrical wing de-icing;

d) abnormal ice accumulation leading to significant effects on performance or handling qualities;

e) crew vision significantly affected.

11 Indicating/warning/recording systems

a) malfunction or defect of any indicating system when the possibility of significant misleading indications to the crew could result in an inappropriate crew action on an essential system;

b) loss of a red warning function on a system;

c) for glass cockpits: loss or malfunction of more than one display unit or computer involved in the display/warning function.]

12 Landing gear system/brakes/tyres

a) brake fire;

b) significant loss of braking action;

c) asymmetrical braking action leading to significant path deviation;

d) failure of the landing gear free fall extension system (including during scheduled tests);

e) unwanted landing gear or gear doors extension/retraction;

f) multiple tyre burst.

13 Navigation systems (including precision approach systems) and air data systems

a) total loss or multiple navigation equipment failures

b) total or multiple air data system equipment failures

c) significant misleading indications

d) significant navigation errors attributed to incorrect data or a database coding error

e) unexpected deviations in lateral or vertical path not caused by pilot input

f) problems with ground navigational facilities leading to significant navigation errors not associated with transitions from inertial navigation mode to radio navigation mode.

14 Oxygen for pressurised aircraft

a) loss of oxygen supply in the cockpit

b) loss of oxygen supply to a significant number of passengers (more than 10 %), including when found during maintenance or training or testing.

15 Bleed air system

a) hot bleed air leak resulting in fire warning or structural damage

b) loss of all bleed air systems

c) failure of bleed air leak detection system.

d) Unsatisfactory ground de-icing/anti-icing.

B.3 Regulations of Australia

B.3.1 Transport Safety Investigation Act 2003

23 Transport safety matters

(1) Each of the following occurrences involving a transport vehicle is a ***transport safety matter*** for the purposes of this Act:

(a) the transport vehicle is destroyed;

(b) the transport vehicle is damaged;

(c) the transport vehicle is abandoned, disabled, stranded or missing in operation;

(d) a person dies as a result of an occurrence associated with the operation of the transport vehicle;

(e) a person is injured or incapacitated as a result of an occurrence associated with the operation of the transport vehicle;

(f) any property is damaged as a result of an occurrence associated with the operation of the transport vehicle;

(g) the transport vehicle is involved in a near-accident;

(h) the transport vehicle is involved in an occurrence that affected, or could have affected, the safety of the operation of the vehicle

Other matters

(2) For the purposes of this Act, a transport safety matter also includes something that occurred that affected, is affecting, or might affect, transport safety.

B.3.2 Transport Safety Investigation Regulations 2003

2.3 Immediately reportable matters (Act s 3)

All aircraft operations

(1) For the purposes of the definition of immediately reportable matter in subsection 3 (1) of the Act, the following investigable matters, in relation to an aircraft operation (other than an aircraft operation mentioned in subregulation 2.1 (2)), are prescribed:

(a) subject to subregulation (2), the death of, or a serious injury to:

(i) a person on board the aircraft or in contact with the aircraft or anything attached to the aircraft or anything that has become detached from the aircraft; or

(ii) a person who has been directly exposed to jet blast;

(b) the aircraft being missing;

(c) the aircraft suffering serious damage, or the existence of reasonable grounds for believing that the aircraft has suffered serious damage;

(d) the aircraft being inaccessible and the existence of reasonable grounds for believing that the aircraft has been seriously damaged;

(e) breakdown of separation standards, being a failure to maintain a recognised separation standard (vertical, lateral or longitudinal) between aircraft that are being provided with an air traffic service separation service.

Note This may result from air traffic service, pilot or other actions, and may occur even if only 1 of the aircraft involved is under control of an air traffic service.

(2) For paragraph (1) (a), ***the death of, or a serious injury to, a person*** does not include:

(a) death or serious injury resulting from natural causes (except to a flight crew member); or

(b) death or serious injury that is intentionally self-inflicted; or

(c) death or serious injury that is intentionally caused by another person; or

(d) death or serious injury suffered by a stowaway in a part of the aircraft that is not usually accessible to crew members or passengers after take-off; or

(e) death occurring more than 30 days after the occurrence that caused the death, unless the death was caused by an injury that required admission to hospital within 30 days after the occurrence.

Air transport operations

(3) For the purposes of the definition of immediately reportable matter in subsection 3 (1) of the Act, the following investigable matters, in relation to an air transport operation (other than an aircraft operation mentioned in subregulation 2.1 (2)), are prescribed:

(a) airprox;

(b) violation of controlled airspace;

(c) a near-collision involving aircraft manoeuvring on the ground;

(d) an occurrence in which flight into terrain is narrowly avoided;

(e) the rejection of a take-off from a closed or occupied runway;

(f) a take-off from a closed or occupied runway with marginal separation from an obstacle or obstacles;

(g) a landing on a closed or occupied runway;

(h) a significant failure to achieve predicted performance during take-off or initial climb;

(i) a fire (even if subsequently extinguished), smoke, fumes or an explosion on or in any part of the aircraft;

(j) an uncontained engine failure;

(k) a mechanical failure resulting in the shutdown of an engine;

(l) the use of any procedure for overcoming an emergency;

(m) an event requiring the use of oxygen by a flight crew member;

(n) malfunction of an aircraft system that seriously affects the operation of the aircraft;

(o) a flight crew member becoming incapacitated during flight;

(p) fuel exhaustion;

(q) the aircraft's supply of useable fuel becoming so low (whether or not as a result of fuel starvation) that the pilot declares an emergency in flight;

(r) undershooting, over-running or running off the side of a runway during take-off or landing, or any other similar occurrence;

(s) any of the following occurrences, if the occurrence causes difficulty controlling the aircraft:

(i) a weather phenomenon;

(ii) operation outside the aircraft's approved envelope;

(t) the failure of 2 or more related redundant systems for flight guidance and navigation;

(u) serious damage to, or destruction of, any property outside the aircraft caused by contact with the aircraft or anything that has become detached from the aircraft.

2.4 Routine reportable matters (Act s 3)

Air Transport operations

(1) For the purposes of the definition of routine reportable matter in subsection 3 (1) of the Act, the following investigable matters, in relation to an air transport operation (other than an aircraft operation mentioned in subregulation 2.1 (2)), are prescribed:

(a) an injury, other than a serious injury, to:

(i) a person on board the aircraft or in contact with the aircraft or anything attached to the aircraft or anything that has become detached from the aircraft; or

(ii) a person who has been directly exposed to jet blast;

(b) the aircraft suffering damage that compromises or has the potential to compromise the safety of the flight but is not serious damage;

(c) flight below the minimum altitude, except in accordance with a normal arrival or departure procedure;

(d) a ground proximity warning system alert;

(e) a critical rejected take-off, except on a closed or occupied runway;

(f) a runway incursion;

(g) any of the following occurrences, if the occurrence compromises or has the potential to compromise the safety of the flight:

(i) a failure to achieve predicted performance during take-off or initial climb;

(ii) malfunction of an aircraft system, if the malfunction does not seriously affect the operation of the aircraft;

(iii) fuel starvation that does not require the declaration of an emergency; *Note* Aircraft systems include flight guidance and navigation systems.

(h) any of the following occurrences, if the occurrence compromises or has the potential to compromise the safety of the flight but does not cause difficulty controlling the aircraft:

(i) a weather phenomenon;

(ii) operation outside the aircraft's approved flight envelope;

(i) failure or inadequacy of a facility used in connection with the air transport operation, such as:

(i) a navigation or communication aid; or

(ii) an air traffic control service or general operational service; or

(iii) an airfield facility, including lighting or a manoeuvring, taxiing or take-off surface;

(j) misinterpretation by a flight crew member of information or instructions, including:

(i) the incorrect setting of a transponder code; or

(ii) flight on a level or route different to the level or route allocated for the flight; or

(iii) the incorrect receipt or interpretation of a significant radio, telephone or electronic text message;

(k) breakdown of coordination, being an occurrence in which traffic related information flow within the air traffic service system is late, incorrect, incomplete or absent;

(l) failure of air traffic services to provide adequate traffic information to a pilot in relation to other aircraft;

Note The information may have been incomplete, incorrect, late or absent.

(m) a traffic collision avoidance system resolution advisory being given to the pilot of the aircraft;

(n) an occurrence arising from the loading or carriage of passengers, cargo or fuel, such as:

(i) the loading of an incorrect quantity of fuel, if the loading of the incorrect quantity is likely to have a significant effect on aircraft endurance, performance, balance or structural integrity; or

(ii) the loading of an incorrect type of fuel or other essential fluid, or contaminated fuel or other essential fluid; or

(iii) the incorrect loading of passengers, baggage or cargo, if the incorrect loading has a significant effect on the mass or balance of the aircraft; or

(iv) the carriage of dangerous goods in contravention of Commonwealth, State or Territory legislation; or

(v) the incorrect securing of cargo containers or significant items of cargo; or

(vi) the incorrect stowage of baggage or cargo, if the incorrect stowage is likely to cause a hazard to the aircraft or its equipment or occupants, or to impede emergency evacuation; or

(vii) a significant contamination of the aircraft structure, systems or equipment, arising from the carriage of baggage or cargo; or

(viii) the presence of a violent or armed passenger;

(o) a collision with an animal, including a bird.

Aircraft operations other than air transport operations

(2) For the purposes of the definition of routine reportable matter in subsection 3 (1) of the Act, the following investigable matters, in relation to an aircraft operation (other than an aircraft operation mentioned in subregulation 2.1 (2) or an air transport operation), are prescribed:

(a) an injury, other than a serious injury, to a person on board the aircraft;

(b) a flight crew member becoming incapacitated while operating the aircraft;

(c) airprox;

(d) an occurrence in which flight into terrain is narrowly avoided;

(e) the use of any procedure for overcoming an emergency;

(f) an occurrence that results in difficulty controlling the aircraft, including any of the following occurrences:

  (i) an aircraft system failure;

  (ii) a weather phenomenon;

  (iii) operation outside the aircraft's approved flight envelope;

(g) fuel exhaustion;

(h) the aircraft's supply of useable fuel becoming so low (whether or not as a result of fuel starvation) that the safety of the aircraft is compromised;

(i) a collision with an animal, including a bird, on a licensed aerodrome.

B.3.3 Civil Aviation Regulations 1988

Part 4B Defect reporting

51 Reporting of defects in Australian aircraft - general

(1) Where a person who, in the course of his or her employment with an employer, is engaged in the maintenance of an Australian aircraft becomes aware of the existence of a defect in the aircraft, the person shall report the defect to his or her employer.

(2) Subject to subregulation (3), if a person engaged in the maintenance of an Australian aircraft becomes aware of the existence of a major defect in the aircraft, the person must report the defect to the holder of the certificate of registration for the aircraft and to CASA.

Penalty: 25 penalty units.

(3) A person is not required to report a defect under subregulation(2) if:

(a) the person was engaged in the maintenance as an employee; or

(b) the person is the holder of the certificate of registration for the aircraft.

(4) If the holder of the certificate of registration for an Australian aircraft becomes aware of the existence of a defect in the aircraft, he or she must:

(a) have an investigation made of the defect; and

(b) if the defect is a major defect - have a report made to CASA with respect to the defect and to any matters revealed by the investigation.

Penalty: 25 penalty units.

51A Reporting of defects in Australian aircraft: major defects

(1) This regulation applies to major defects:

(a) that have caused, or that could cause, a primary structural failure in an aircraft; or

(b) that have caused, or that could cause, a control system failure in an aircraft; or

(c) that have caused, or that could cause, an engine structural failure in an aircraft; or

(d) caused by, that have caused, or that could cause, fire in an aircraft.

(2) If a person connected with the operation of, or the carrying out of maintenance on, an Australian aircraft discovers a defect in the aircraft, being a defect of a kind to which this regulation applies, the person must report the defect to CASA immediately.
Penalty: 50 penalty units.

(2A) An offence against subregulation (2) is an offence of strict liability.
Note For *strict liability*, see section 6.1 of the *Criminal Code*.

(3) ...

(4) ...

51B Defects discovered in complying with directions by CASA

(1) If a person discovers a defect in an aircraft in the course of complying with an airworthiness directive or a direction given by CASA under regulation 38, the person must report the defect to CASA.
Penalty: 25 penalty units.

(2) An offence against subregulation (1) is an offence of strict liability.
Note For *strict liability*, see section 6.1 of the *Criminal Code*.

52 Defects discovered in aircraft components

(1) This regulation applies if:

(a) a person engaged in the maintenance of an aircraft component becomes aware of a defect in the component; or

(b) a person engaged in the maintenance of an aircraft becomes aware of a defect in an aircraft component that the person proposed to install in the aircraft in the course of that maintenance; or

(c) a person who holds a certificate of approval that covers the maintenance of aircraft components becomes aware of a defect in an aircraft component that he or she owns; or

(d) a person who holds an Air Operator's Certificate becomes aware of a defect in an aircraft component that he or she owns and intends to install in an aircraft used in operations under that Air Operator's Certificate.

(2) If the person owns the aircraft component:

(a) the person must have an investigation made of the defect; and

(b) if the defect is such that, if the component were installed in an aircraft, the safety of the aircraft might be affected or the aircraft might become a danger to person or property - the person must have a report made to CASA in relation to the defect and any matters revealed by the investigation.

Penalty: 25 penalty units.

(3) If the person does not own the aircraft component the person must:

(a) have a report made to the owner of the component in relation to the defect; and

(b) if the person thinks that the defect is such that, if the component were installed in an aircraft, the safety of the aircraft might become affected or the aircraft might become a danger to person or property - have a report made to CASA in relation to the defect.

Penalty: 25 penalty units.

(4) After the owner of an aircraft component receives the report mentioned in paragraph (3) (a):

(a) the owner must have an investigation made of the defect; and

(b) if the defect is such that, if the component were installed in an aircraft, the safety of the aircraft might be affected or the aircraft might become a danger to person or property - the owner must have a report made to CASA in relation to the defect and any matters revealed by the investigation.

Penalty: 25 penalty units.

(5) An offence against subregulation (4) is an offence of strict liability.

Note For *strict liability*, see section 6.1 of the *Criminal Code*.

B.3.4 Civil Aviation Safety Regulations 1998

21.003 Reporting failures, malfunctions, and defects

(1) The holder of a type certificate, a supplemental type certificate, an APMA or an ATSO authorisation, or the licensee of a type certificate or supplemental type certificate, must report to CASA any failure, malfunction, or defect in any of the following that has resulted in any of the occurrences listed in subregulation (4):

(a) an aircraft, aircraft engine or propeller, or any other part or article manufactured by it;

(b) a manufacturing process specified by it.

Penalty: 25 penalty units.

(2) The holder of a type certificate, a supplemental type certificate, an APMA, or an ATSO authorisation, or the licensee of a type certificate or supplemental type certificate, must report to CASA any defect in any aircraft, aircraft engine or propeller, or in any part, or article manufactured by it that has left its control and that could result in any of the occurrences listed in subregulation (4).
Penalty: 25 penalty units.

(4) The following occurrences must be reported as provided in subregulations (1) and (2):

(a) fires caused by a system or equipment failure, malfunction, or defect;

(b) an engine exhaust system failure, malfunction, or defect which causes damage to the engine, adjacent aircraft structure, equipment, or components;

(c) the accumulation or circulation of toxic or noxious gases in the crew compartment or passenger cabin;

(d) a malfunction, failure, or defect of a propeller control system;

(e) a propeller or rotorcraft hub or blade structural failure;

(f) flammable fluid leakage in areas where an ignition source normally exists;

(g) a brake system failure caused by structural or material failure during operation;

(h) a significant aircraft primary structural defect or failure caused by any self-generating condition (for example, fatigue or corrosion);

(i) any abnormal vibration or buffeting caused by a structural or system malfunction, defect, or failure;

(j) an engine failure;

(k) any structural or flight control system malfunction, defect, or failure which causes an interference with normal control of the aircraft or which derogates from the flying qualities;

(l) a complete loss of more than one electrical power generating system or hydraulic power system during a given operation of the aircraft;

(m) a failure or malfunction of more than one attitude, airspeed, or altitude instrument during a given operation of the aircraft.

(5) This subregulation applies to:

(a) failures, malfunctions, or defects that the holder of a type certificate, a supplemental type certificate, an APMA or an ATSO authorisation, or the licensee of a type certificate or supplemental type certificate:

(i) has reasonable grounds for believing were caused by improper maintenance, or improper usage; or

(ii) has reasonable grounds for believing were reported to CASA by another person under Part 4B of CAR 1988; or

(iii) has already reported under the accident reporting provisions of the Air Navigation Act 1920; and

(b) failures, malfunctions, or defects in aircraft, aircraft engines, propellers, or other parts or articles:

(i) manufactured by a foreign manufacturer under a type certificate of the kind mentioned in regulation 21.025 or 21.027 or issued under regulation 21.029, or a letter of ATSO design approval under regulation 21.617; or

(ii) imported into Australian territory under regulation 21.500, 21.500A, 21.502 or 21.502A.

(6) For subregulations (1) and (2), a report must:

(a) be given to CASA, in writing, within 3 working days after the person required to make the report becomes aware, or could reasonably be expected to have become aware, that the failure, malfunction, or defect required to be reported has occurred; and

(b) ...

(7) Whenever the investigation of an accident or service difficulty report shows that an article manufactured under an ATSO authorisation is unsafe because of a manufacturing or design defect, the manufacturer must, upon request of CASA, investigate the defect and report to CASA the results of its investigation and any action taken or proposed by the manufacturer to correct that defect.
Penalty: 25 penalty units.

(8) If action is required to correct the defect in an article manufactured under an ATSO, the manufacturer must submit to CASA the data necessary for the issue of an appropriate airworthiness directive.
Penalty: 10 penalty units.

(9) An offence against subregulation (7) or (8) is an offence of strict liability.
Note For *strict liability*, see section 6.1 of the *Criminal Code*.

(10) It is a defence to a prosecution under subregulation (1) if the failure, malfunction or defect is of a kind to which subregulation (5) applies.
Note A defendant bears an evidential burden in relation to the matter mentioned in subregulation (10) (see subsection 13.3 (3) of the *Criminal Code*).
Source FARs section 21.3 modified.

B.3.5 Civil Aviation Advisory Publication 51-1(1)

1. Definitions

Major defects in relation to an aircraft, means a defect of such a kind that it may affect the safety of the aircraft or cause the aircraft to become a danger to person or property.

...

Defect means an imperfection that impairs the structure, composition, or function of an object or system.

Appendix A: Examples of Major Defects

Listed below are some representative examples of major defects. The list is not exhaustive and there may be other defects that can be considered major. If you have any doubts about whether the defect is in fact a major defect, seek advice from CASA SDR Unit:

(a) fires during flight, including whether or not the related fire warning system operated correctly;

(b) false fire warning during flight;

(c) smoke, toxic or noxious fumes inside the aircraft;

(d) an engine exhaust system that causes damage during flight to the engine, adjacent structure, equipment or components;

(e) unscheduled engine shut-down;

(f) on a multi-engine helicopter, loss of drive from one engine;

(g) inability to feather or unfeather a propeller, to shut-down an engine or to control thrust;

(h) fuel system malfunction affecting fuel supply and distribution;

(i) significant contamination or leakage of fuel, oil or other fluids;

(j) use of incorrect fuel, oil or other fluids;

(k) landing gear failing to extend or retract, or inadvertent opening or closing of landing gear doors during flight;

(l) brake system defects that result in loss of braking when the aircraft is in motion on the ground;

(m) malfunction, stiffness, slackness or limited range of movement of any flight controls;

(n) significant failure or malfunction of the instrument, electrical, hydraulic, pneumatic, ice-protection, radio, navigation system or emergency equipment;

(o) uncontrollable cabin pressure, except the inability to pressurise immediately after take-off due to doors not being fully closed;

(p) cracks or corrosion in primary structure;

(q) any malfunction, failure or defect affecting the performance of any system or component essential to the safe operation of the aircraft;

(r) under CAR 51B, any defect found as a result of an AD where no limits are specified or the defect is outside any limits specified in the AD;

(s) malfunction of systems or components, including auxiliary power units (APU), essential to the safe operation of those aircraft approved for extended twin engine operations (ETOPS) irrespective of the type of operation being, or intended to be, conducted;

B.4 Regulations of Japan

B.4.1 Ordinance for Enforcement of Civil Aeronautics Act[a]

(Reporting of events where it is considered that accidents nearly occurred.)
Article 166-4. The events in the Article 76-2 of the Act to be specified by Ordinances of the Ministry of Land, Infrastructure, Transport and Tourism are the following:

(i) Take-offs or aborted take-offs on a closed or engaged runway.

(ii) Landings or attempted landings on a closed or engaged runway.

(iii) Overrunning, undershooting, or running off the side of runways (limited to cases where the aircraft became unable to move on the ground by itself).

(iv) An event leading to an emergency evacuation in which an emergency egress system is utilized.

(v) An event in which the flight crew took an emergency maneuver to avoid a collision or contact with terrain or water surface during flight.

(vi) Engine damage (limited to cases where its fragments penetrated its cowling, or when its internal structure was heavily damaged.)

(vii) Sustained halt, or loss of power or thrust produced by an engine (more than one engine for multiple-engine aircraft) during flight (except for cases when an engine was shut off intentionally in powered gliders).

(viii) An event when the operation of the aircraft could not be continued because of damage to propellers, rotors, gears, rudders, ailerons, or flaps.

(ix) Multiple malfunctions of one or more aircraft systems seriously affecting the operation of the aircraft.

(x) Fire or smoke in an aircraft or fire in the fire control area of an engine.

(xi) Unusual drop in air pressure in an aircraft.

(xii) Critically low fuel quantity that resulted in taking emergency actions.

[a]Translated by the author.

(xiii) Unusual meteorological situations including disturbance of airstream, malfunctioning equipment, or flight exceeding operating limitation speed, limit load factor, or operating limitation altitude, which affected maneuvering of the aircraft.

(xiv) Flight crew incapacitation in flight.

(xv) An event where parts detached from the aircraft collided with persons.

(xvi) Any situations equivalent to the items listed above.

(Reporting of events which affect safety)

Article 221-2. The events in Article 111-4 of the Act to be specified by Ordinances of the Ministry of Land, Infrastructure, Transport and Tourism are the following:

(i) Accidents listed in Article 76 Paragraph (1) of the Civil Aeronautics Act.

(ii) Events stipulated in Article 76-2 of the Civil Aeronautics Act.

(iii) Events which occurred during operation of aircraft, as listed below.

(a) An event when an aircraft sustained structural damage (except for cases when the repair for the aircraft does not fall under the category of major repair or minor repair listed in the table in Article 5-6.)

(b) An event when an aircraft system which is of importance for safety malfunctioned.

(c) An event when an emergency system or equipment malfunctioned.

(d) An event when a significant deviation from the planned path or altitude or operations beyond operating limitations occurred.

(e) Events other than those listed from (a) to (d) requiring an emergency maneuver or emergency action for safety.

(iv) Other than those listed from (i) to (iii), aircraft structural damage, a failure of an emergency system, incorrect installation of aircraft equipments or parts, or other events which affected the safe operation of aircraft.

B.4.2 Advisory Circular 6-001[b]

The occurrences to be reported to the JCAB are as follows:

1. Explosion, fire, smoke, unusual smell, or toxic or noxious fumes.
2. False fire warning during flight.
3. Engine shutdown during flight of more than one engine.
4. Failure of main structure of an engine, failures which occurred simultaneously in multiple engines during flight, or critical failure of fuel, exhaust, thrust, or thrust reverse system of engines.
5. Failure of propeller control system or structural failure of propellers.
6. Leakage of fuel, lubricant oil, or hydraulic fluids (including the leakage in fuel-dumping system)
7. Failure of gears or flaps.
8. Failure or malfunction of battery, hydraulic power unit, or other power units, and their power distribution systems.
9. Malfunction of pressurization system or use of emergency or backup oxygen system, which caused a significant change of the flight plan.
10. Failure of wheels, brake system or tires, which poses a danger to the operation on the ground.
11. Icing which exceeded the capacity of de-icing and anti-icing (including performance degradation considered to be caused by icing.)
12. Alarm which indicates that hatches or doors are not completely closed during flight.
13. Damage to aircraft structure caused by cracks, corrosion, buckling or separation or the case in which multiple fasteners loosen or come off, any of which requires major repair.
14. Detachment of aircraft parts.

[b]Translated by the author.

15. Failure, malfunction, or defect of aircraft control system, which affects maneuvering (including the fixity of the control system or the augmentation of the maneuvering power considered to be caused by icing.)

16. Failure, malfunction, or defect of equipment or aircraft systems, which required emergency maneuvers.

17. Emergency evacuation systems or components (evacuation doors, emergency evacuation lighting systems, and evacuation slides or rafts) that are found defective, or that fail to perform the intended functions during an actual emergency or during training, testing, maintenance, demonstrations, or inadvertent deployments (limited to those related to air transport services or aerial work services).

18. Failure of functions of aircraft systems or components, which are critical for airworthiness but cannot be checked during normal flights (cabin altitude alert system, oxygen masks for passengers, over-speed warning system, stall warning system, and ram air turbines) (limited to those related to air transport services or aerial work services).

19. Other failures, malfunctions, or defects, which affect, or could affect the operation of the aircraft.

Items 1 to 16 must also be reported to the organizations responsible for aircraft or aircraft components design.

B.4.3 Advisory Circular 6-002[c]

The occurrences to be reported to the JCAB are as follows:

1. Fires caused by a system or equipment failure, malfunction, or defect.
2. An engine exhaust system failure, malfunction, or defect which causes damage to the engine, adjacent aircraft structure, equipment, or components.
3. The accumulation or circulation of toxic or noxious gases in the crew compartment or passenger cabin.
4. A malfunction, failure, or defect of a propeller control system.
5. A propeller or rotorcraft hub or blade structural failure.
6. Flammable fluid leakage in areas where an ignition source normally exists.
7. A brake system failure caused by structural or material failure during operation.
8. A significant aircraft primary structural defect or failure caused by any autogenous condition (fatigue, understrength, corrosion, etc.).
9. Any abnormal vibration or buffeting caused by a structural or system malfunction, defect, or failure.
10. An engine failure.
11. Any structural or flight control system malfunction, defect, or failure which causes an interference with normal control of the aircraft or which derogates the flying qualities.
12. A complete loss of more than one electrical power generating system or hydraulic power system during a given operation of the aircraft.
13. A failure or malfunction of more than one attitude, airspeed, or altitude instrument during a given operation of the aircraft.
14. Detachment of aircraft parts.

Other occurrences should also be reported if they are considered to be useful for early detection or prevention of failures or for improvement of inspection or maintenance techniques.

[c]Translated by the author.

Appendix C

Guidance on the Categorisation of Transport Safety Matters Provided by Australian Transport Safety Bureau

In the Australian Transport Safety Bureau (ATSB), the Investigation Authority in Australia, each investigation of "transport safety matter" (accident, serious incident, and incident) is categorized on a Level 1 to 5 in order of priority. Below is a guidance on the categorization of transport safety matters provided by the ATSB.

Level 1

- An accident involving one or more High Capacity Air Transport (scheduled and non-scheduled) passenger aircraft with fatalities.
- An accident involving one or more High Capacity Air Transport (scheduled and non-scheduled) passenger aircraft without fatalities
  - where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future High Capacity Air Transport accidents.

- A serious incident (as defined by ICAO) involving one or more High Capacity Air Transport (scheduled and non-scheduled) passenger aircraft

  - where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future High Capacity Air Transport (scheduled and non-scheduled) accidents.

Level 2

- An accident involving one or more High Capacity Air Transport cargo aircraft with fatalities and serious injuries.

- An accident involving one or more High Capacity Air Transport cargo aircraft without fatalities and serious injuries

  - where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future High Capacity Air Transport cargo aircraft accidents.

- An accident involving one or more Low Capacity Air Transport (scheduled) passenger aircraft with a significant number of fatalities (for example, it may involve more than five fatalities) and serious injuries.

- An accident involving one or more Low Capacity Air Transport (scheduled) passenger aircraft without fatalities or with a relatively low level of fatalities (eg less than five) and serious injuries

  - where there was a significant risk of more fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future Low Capacity Air Transport (scheduled) accidents.

- A serious incident (as defined by ICAO) involving one or more Low Capacity Air Transport (scheduled) passenger aircraft

  - where there was a significant risk of multiple fatalities (eg more than five) and serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future Low Capacity Air Transport (scheduled) accidents.

- An accident involving one or more Low Capacity charter (non-scheduled) aircraft with fare-paying passengers and multiple fatalities and serious injuries (for example it may involve more than five fatalities)
  - where a substantial commitment of investigative resources is likely to significantly mitigate future Low Capacity Air Transport (scheduled) and charter (non-scheduled) accidents.

Level 3

- An accident involving one or more Low Capacity Air Transport passenger (scheduled) or charter (non-scheduled) aircraft with fatalities and/or serious injuries not classified as a level 2 investigation.
- An accident involving Air Transport cargo operations with fatalities.
- An accident involving one or more training aircraft with fatalities.
- An accident (as defined by ICAO) without fatalities involving one or more High or Low Capacity Air Transport aircraft not classified as a level 1 or 2 investigation and where investigation is likely to significantly mitigate future accidents.
- An accident involving one or more general aviation aircraft (other than sport aviation) with fatalities.
- An accident involving one or more charter or other general aviation aircraft
  - where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources would significantly mitigate accidents.
- A serious incident (as defined by ICAO) involving one or more High or Low Capacity Air Transport passenger aircraft not classified as a level 1 or 2 investigation and where investigation is likely to significantly mitigate future accidents.
- A serious incident (as defined by ICAO) involving one or more Air Transport cargo, charter or training aircraft where investigation is likely to significantly mitigate future accidents.

- An incident involving one or more High or Low Capacity Air Transport aircraft where investigation is likely to significantly mitigate future accidents.

Level 4

- An accident involving a foreign aircraft covered by Article 26 of the Chicago Convention that is not being investigated as level 1, 2, or 3.
- An accident (as defined by ICAO) involving one or more charter or general aviation aircraft (other than sport aviation) without fatalities
  - where a limited commitment of investigative resources could significantly mitigate future aviation accidents.
- An accident or serious incident (as defined by ICAO) involving Australian designed and manufactured aircraft types on the Australian Register with international safety implications not being investigated as level 1, 2, or 3.
- An accident or serious incident (as defined by ICAO) involving one or more High or Low Capacity Air Transport aircraft not being investigated as level 1, 2, or 3.
- A serious incident (as defined by ICAO) involving one or more non Air Transport aircraft
  - where a limited commitment of investigative resources could significantly mitigate future accidents.

Level 5

- An accident (including with fatalities) or serious incident involving a sport aviation aircraft unless foreign and required to be investigated under Article 26 of the Chicago Convention.
- An accident involving aircraft without fatalities
  - where the potential safety lessons do not, after initial review, justify the commitment of investigative resources. Basic incident data will be filed for statistical purposes.
- A serious incident or incident involving aircraft

– where the potential safety lessons do not, after initial review, justify the commitment of investigative resources. Basic incident data will be filed for statistical purposes.

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Appendix D

Australian Government's Seven Principles for Best Practice Consultation

In 2006, the Australian Government adopted a government-wide policy on consultation, which sets out best practice principles to be followed by all agencies when developing regulations. The seven principles for best practice consultation which are contained in the policy are shown below.

Continuity - Consultation should be a continuous process that starts early in the policy development process.

Targeting - Consultation should be widely based to ensure it captures the diversity of stakeholders affected by the proposed changes. This includes state, territory and local governments, as appropriate, and relevant Australian Government departments and agencies.

Appropriate Timeliness - Consultation should start when policy objectives and options are being identified. Throughout the consultation process, stakeholders should be given sufficient time to provide considered responses.

Accessibility - Stakeholder groups should be informed of proposed consultation and be provided with information about proposals through a range of means appropriate to

these groups.

Transparency - Policy agencies need to explain clearly the objectives of the consultation process and the regulation policy framework within which consultations will take place, and provide feedback on how they have taken consultation responses into consideration.

Consistency and Flexibility - Consistent consultation procedures can make it easier for stakeholders to participate. However, this must be balanced with the need for consultation arrangements to be designed to suit the circumstances of the particular proposal under consideration.

Evaluation and Review - Policy agencies should evaluate consultation processes and continue to examine ways of making them more effective.

Appendix E

Voluntary Reporting Systems in the World

The voluntary reporting systems have been widely applied throughout the world. Table E.1 lists the voluntary reporting systems in the world. The list is not totally inclusive.

In 1988, the International Confidential Aviation Safety Systems (ICASS) Group was formed to promote confidential reporting systems. The reporting systems written in boldface in Table E.1 are current members of the ICASS Group.

The ICASS Group holds meetings periodically to exchange information and discuss the future development of the confidential reporting systems. The principal objectives of the ICASS Group are:

- To provide advice and assistance in the start up and operation of a confidential reporting system.
- To facilitate the exchange of safety related information between independent confidential aviation reporting systems.
- To identify solutions to common problems in the operation of such systems.

Membership with full voting rights are available to reporting systems which are:

- Confidential
- Independent of commercial and regulatory interests
- Operating on a national or international level

Table E.1: Voluntary reporting systems in the world [21], [105]

State	Name		Start-up Year
U.S.	**Aviation Safety Reporting System (ASRS)**		1976
	Aviation Safety Action Program (ASAP)		1994
	Voluntary Disclosure Reporting Program (VDRP)		1990
U.K.	**Confidential Human Factors Incident Reporting Programme (CHIRP)**		1982
Australia	**REPCON**		1988
	Aviation Self Reporting Scheme (ASRS)		2004
Japan	**Aviation Safety Information Network (ASI-NET)**	for Large Aircraft	1999
		for Small Aircraft	2004
Brazil	**Flight Safety Confidential Report (RCSV)**		1997
Canada	**SECURITAS**		1995
China	**Sino Confidential Aviation Safety System (SCASS)**		2004
France	**Confidential Events Reporting System**		2000
Germany	EUCARE		1992
Russia	**Voluntary Aviation Safety Reporting System (VASRP)**		1992
Singapore	**SINgapore Confidential Aviation Incident Reporting (SINCAIR)**		2004
South Korea	**Korean Confidential Incident Reporting System (KAIRS)**		2000
Spain	**Safety Occurrence Reporting System (SNS)**		2007
Taiwan	**Taiwan Aviation Confidential Reporting System (TACARE)**		2000

The ICASS Group has been recognized by ICAO. States planning to institute confidential reporting systems are referred to the ICASS Group for assistance in design and implementation stages of new systems [24], [105].

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