United Firefighters Union of Australia

Supplementary Submission to the Senate Inquiry into the provision of rescue, firefighting and emergency response at Australian airports

Rural and Regional Affairs and Transport References Committee

Submitted 14 April 2019

Recommendations

Recommendation 1: that the flawed methodology of using a threshold of passenger movements per year to determine the establishment of ARFF provision be reviewed for the purpose of replacing it with a system that provides greater ARFF coverage at more Australian Airports.

Recommendation 2: that an independent review of current ARFF staffing levels be conducted to establish an appropriate minimum staffing level by Airport Category, and that this review include consideration of the NFPA 403 standard.

Recommendation 3: that minimum ARFF staffing levels at Australian airports be established through legislation rather than regulation or operational procedure. Any subordinate regulation should only address issues that do not relate to staffing levels or other critical factors.

Recommendation 4: that a minimum ARFF level of staffing at Australian airports be established based on those contained in NFPA 403 as ARFF best practice.

Recommendation 5: that an optimum ARFF level of staffing at Australian airports be established at each individual site based on implementation of a Task Resource Analysis (TRA) as endorsed by both ICAO and NFPA. The process for conducting TRAs are to include the active participation of the UFUA Aviation Branch, as the as the employee representative body of the extensive applied experience of ARFF personnel, at all stages of the process. All aspects of the TRA process and outcomes are to be transparent and readily available to all stakeholders.

Recommendation 6: That any review of CASR 139H Regulations or the MOS 139H be conducted by a steering committee of ARFF and firefighting experts, including the UFUA as the employee representative body for ARFF personnel.

Recommendation 7: That any Regulatory review has written into their Terms of Reference that ICAO SARPs are followed as closely as practicable, including all recommended practices.

Recommendation 8: That any review of Australian ARFF regulations should seek to adopt the proven and internationally respected standards in NFPA 403 wherever possible as ARFF best practice.

Recommendation 9: That a Passenger Facilitation Charge be considered to fund and expand ARFF services in circumstances where there is insufficient funding from other sources.

Introduction

The United Firefighters Union of Australia ("**the UFUA**") is a registered federal union of career firefighters and other personnel employed by fire services in Australia.

The UFUA has eight branches consisting of Tasmania, South Australia, Victoria, ACT, New South Wales, Western Australia, Queensland and an Aviation sector branch. Each branch has a high level of union membership with the majority of branches averaging around 95 percent membership of the relevant workforce.

In February 2019 the UFUA commissioned the Centre of Full Employment and Equity ("**CofFEE"**) to research and examine issues relevant to the Senate Inquiry into the provision of rescue, firefighting and emergency response at Australian airports. The subsequent report ("**the Report**"), which is attached to this supplementary submission, covers the following:

- the current system of Aviation Rescue and Fire Fighting ("**ARFF"**) at Australian airports;
- the regulatory system governing ARFF in Australia and the international system of compliance to standards;
- the requirements of ARFF services and compares the Australian standards with international best practice;
- how Australian standards comply with the international standards and recommendations;
- the cost of ARFF provision at Australian airports and reviews the pricing model used to finance ARFF services in Australia; and
- the economic benefits of tourism and shows the links between air transport and tourism, particularly in Australia. It goes on to examine the safety of air transport, people's perception of the safety of air transport and the possible consequences of a reduction in Australia's reputation as a safe place to travel.

The Report as a whole provides a detailed and substantiated overview of ARFF services in Australia. The UFUA respectfully highlights in particular the below key points, as contained in the Report:

Section 3 "Regulatory system of ARFF provision" presents the delay in establishing ARFF provision at Proserpine Airport despite it having reached the 350,000-passenger movement threshold in the2016-17 financial year.

The Report further suggests ARFF provision be extended to secondary capital city airports that see a large volume of aircraft movements.

Additionally, the Report covers the ineffectiveness of maintaining standards under the current regulatory system due to the exemptions process and examples of non-compliance with current regulations and standards. The Report recommends a greater degree of oversight and transparency regarding the rationale behind the application and granting of exemptions, and of addressing of non-compliance.

Reference is also made to the 450 differences listed by Airservices between ICAO SARPS and Australian ARFF regulations and practices. It is noted that, while the majority are probably not safety issues, the sheer number of differences creates a real risk of serious safety concerns hidden among a multitude of somewhat trivial differences.

Section 4 covers ARFF best practice and presents a comparison between a variety of standards with those of the minimum standards established by CASA for:

- the provision of a dedicated ARFF service at an airport (4.3)
- the number of ARFF vehicles required per category of airport (4.4); and
- the quantity of water, foam and agent (4.5).

The Report finds that in all instances CASA's minimums fall below those recommended by the recognised best practice of the National Fire Protection Administration ("**NFPA**") 403.

Section 4.6 compares Airservices' minimum staffing levels to those recommended by the NFPA[1], finding Airservices' minimum levels fall below those established by NFPA. Of particular concern here is the absence of a Task Resource Analysis ("**TRA**") methodology by Airservices in establishing staffing numbers. The TRA approach is recommended and outlined by both ICAO and NFPA. The NFPA standard is that staffing levels shall be established through a TRA based on the needs and demands of the airport. The TRA and Workload Assessment are used to examine the effectiveness of staffing levels and to analyse ***two levels of ARFF staffing, a minimum level and an optimum level***. The NFPA also provides a minimum number of ARFF-trained personnel that are required to be readily available to respond to an incident, based on the minimum response times and extinguishing agent discharge rates and quantities required. The staffing levels determined by the TRA shall not be lower than the values specified in the NFPA standards.

Section 4.7 of the Report makes reference to the use of high reach extendable turrets, which despite universal acceptance of their superiority in controlling post-crash fires and the fact the technology has been in use for decades, are not fitted to any of Airservices' ARFF vehicles.

Section 5 covers Australia's compliance with ICAO standards. In particular, the Report notes that there are nineteen out of 462 differences listed regarding the provision of ARFF at aerodromes, and of these nineteen differences, nine are classified as 'less protective or partially implemented / not implemented'.

Section 6 breaks down the cost of ARFF provision in Australia, the current pricing structure and alternative models of funding ARFF services. The Report refers to a number of studies that demonstrate passengers are willing to pay more for the provision of ARFF services.

Section 7 details the relationship between tourism and air travel, the economic benefits of tourism, its impact specifically to the Australian economy and Australia's aviation safety record. Of particular note is a quotation from the Australian Safety Transport Bureau (page 59 the Report), which states:

> "Australia holds one of the best safety records in the world. … However, a single fatal accident involving a high capacity [regular public transport] jet aircraft would lead to a major worsening in Australia's international position with respect to [regular public transport] fatality rates and there is no room for complacency."

The Report subsequently examines the perception of air safety and its effect on demand before assessing the economic loss to Australia from a potential air transport accident. It notes that while the public's perception of air safety is a subjective matter, there is evidence that people avoid airlines involved in accidents and that demand for all air travel falls when there are accidents.

The lack of confidence in travellers following a serious aviation accident also translates in dollar terms. An attempt to measure the effect a serious aviation accident would have on

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[1] UFUA's original submission to this Inquiry contained a comparison between Airservices and NFPA staffing levels (Table 4) based on the NFPA 403 2014 edition. We wish to update the NFPA figures to those contained in the CofFEE report which are based on the most recent 2018 edition of NFPA 403.

Australia’s tourism industry showed that total Gross Value Added would fall by almost $2.8 billion, based on a seven per cent fall in international tourists and a twelve per cent fall in domestic tourists.

The UFUA also submits two further recommendations to the Inquiry:

Recommendation: that a minimum ARFF level of staffing at Australian airports be established based on those contained in NFPA 403 as recognition of best practice.

Recommendation: that an optimum ARFF level of staffing at Australian airports be established based on implementation of a Task Resource Analysis (TRA) as endorsed by ICAO at each site. The process for conducting TRAs are to include the active participation of the UFUA Aviation Branch, as the as the employee representative body of the extensive applied experience of ARFF personnel, at all stages of the process. All aspects of the TRA process and outcomes are to be transparent and readily available to all stakeholders.

Dated this 14 April 2019.

ATTACHMENT:

The University of Newcastle Centre of Full Employment and Equity “The provision of rescue, firefighting and emergency response at Australian Airports”, April 2019

Centre of Full Employment and Equity

The provision of rescue, firefighting and emergency response at Australian airports

Report prepared for the United Firefighters Union of Australia

Michael Flanagan and William Mitchell[i]

April 2019

Centre of Full Employment and Equity
University of Newcastle, Australia
Home Page: http://www.fullemployment.net
Email: coffee@newcastle.edu.au

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Executive Summary

Section 1 Introduction

This study was commissioned by the United Firefighters Union of Australia (UFUA) to research and examine issues relevant to the Senate Inquiry into the provision of rescue, firefighting and emergency response at Australian airports. Included in the report is a detailed overview of the current system of Aviation Rescue and Fire Fighting (ARFF) at Australian airports; a review of the regulatory system governing ARFF services; an examination of international best practice of the requirements of ARFF services; an evaluation of how Australia complies with international standards; a review of the pricing model used to finance ARFF in Australia; and an analysis of the link between air transport and tourism and how tourism may be affected in the event of an air transport accident.

Section 2 Overview of Aviation Rescue and Fire Fighting (ARFF) in Australia

ARFF is a branch of fire fighting and rescue that deals specifically with fires and rescue situations arising from aviation incidents. ARFF personnel respond to multiple types of incidents involving aircraft at and in the immediate vicinity surrounding airports, with their primary role being to optimise the chance of survival of occupants of an aircraft that has crashed and to protect property and equipment from the effects of fire.

In Australia, ARFF services are required to be provided at airports that receive scheduled international passenger air services, or airports with over 350,000 passenger movements on scheduled passenger air services in a 12 month period. The obligation of airports to have an ARFF service readily available is a requirement of the International Civil Aviation Organisation (ICAO), of which Australia is a signatory. ARFF services are provided at 28 of the 195 certified airports around Australia, with Airservices Australia (ASA) responsible for ARFF services at 26 of these. The Act stipulates that ASA must regard the safety of air navigation as the most important consideration.

ARFF services are categorised according to the size of aircraft that use the airport. The different categories determine the resources provided to the ARFF service, including the number of vehicles, staffing levels and quantity of agent. As well as responding to aircraft incidents on or in the immediate vicinity of the airport, ARFF personnel respond to a number of calls for a variety different reasons. Aircraft incidents include crashes, engine fires and fuel spills, while other incidents ARFF personnel respond to include emergency medical response (first aid) calls, motor vehicle accidents, hazmat incidents, other fires and alarms.

Section 3 Regulatory system of ARFF provision

The Civil Aviation Safety Regulations 1998 (CASR), made under the Civil Aviation Act 1988, set out the regulations for the civil aviation sector in Australia. The Civil Aviation Safety Authority (CASA) is responsible for issuing and enforcing the regulations. Section 9 of the Civil Aviation Act sets out CASA’s functions: to maintain, enhance and promote the safety of civil aviation, with particular focus on preventing aviation accidents and incidents. Subpart 139.H of the CASR specifies the requirements for the provision ARFF services. CASA publishes the Manual of Standards (MOS), which is a policy manual and the means by which CASA meets its responsibilities under the Act for promulgating aviation safety standards.

The CASR and MOS broadly align with international standards outlined by the ICAO. Differences between Australian and ICAO standards are published in the Aeronautical

Information Publication, as required by ICAO. In addition, Australia is required to file a note of difference with ICAO. CASA has the authority to grant exemptions from provisions of the CASR under Subpart 11.F.

ASA was established under the Air Services Act 1995. It is a corporate Commonwealth entity under the Public Governance, Performance and Accountability Act 2013 (ASA, 2018a). ASA is responsible for providing safe, secure, efficient and environmentally responsible air navigation and aviation rescue and fire fighting services. ASA provides terminal navigation (TN), ARFF and en route navigation services at airports around Australia, for which it charges aircraft operators appropriate charges. Charges are set subject to notification to the Australian Competition and Consumer Commission (ACCC), which reviews ASA pricing every five years.

In 2015 the Australian Government asked the Department of Infrastructure and Regional Development (DIRD) to provide policy advice on potential improvements to the efficiency and clarity of ARFF services requirements. The primary regulatory change, accepted by the Minister, was the removal of threshold numbers of passengers at which to establish and disestablish ARFF services at airports. Instead, trigger events would require CASA to perform a risk review to determine if establishment/disestablishment were to occur. The trigger events recommended were an airport receiving scheduled international passenger services or where passenger movements on scheduled passenger air services were above 500,000 over a 12 month period. Higher thresholds for disestablishment were also recommended. This change would have seen ARFF services removed from up to seven airports, and airports not yet with ARFF but with increasing passenger numbers having to wait further years to qualify for ARFF services to be established. After first accepting the new threshold passenger movements, they were returned to the 350,000 level in June 2018. There remains a time lag from when individual airports pass the threshold to when an ARFF service is able to be provided, with Proserpine passing the threshold in 2016-17 but not expecting an ARFF service until mid 2020.

The ICAO was set up following the Convention on International Civil Aviation, also known as the Chicago Convention, signed in 1944. The ICAO sets out Standards and Recommended Practices (SARPs) for Aerodromes in Annex 14 to the Convention on International Civil Aviation, with Rescue and Fire Fighting at airports dealt with in Chapter 9.2 of Volume 1 of the Annex. It is a requirement by ICAO that Member States notify the ICAO of any differences between their national regulations and practices and the SARPs, particularly where such a difference is important for the safety of air navigation. ICAO monitor the implementation of the SARPs of Member States through the Universal Safety Oversight Audit Programme (USOAP).

CASA has provided ASA with a variety of exemptions from standards and regulations, six of which refer to ARFF. Aside from these six, it was recently revealed at Senate hearings that ASA are non-compliant with a further two regulations despite not receiving an exemption. There appears scope for an extra layer of oversight that may be useful in reviewing situations such as these and exemption applications and providing recommendations on their necessity, appropriateness and most importantly, their impact on safety standards. CASA's Aviation Safety Advisory Panel consists of Technical Working Groups (TWG), set up to deal with particular sectors of the industry and to offer advice. Despite a TWG on ARFF being approved, it has yet to be established.

The USOAP, set up by ICAO to monitor compliance with their SARPs, has evolved into a Continuous Monitoring Approach, where the emphasis is on the availability of information on the safety performance of Member States being provided to other Member States. The notification of differences is at the heart of the CMA, yet the degree of non-compliance is not clearly apparent when comparisons are made between countries. Button *et al*. (2004) point out the problem with the ICAO structure is that it relies heavily on voluntary involvement and application by its Member States and the ICAO has no formal mechanisms for imposing penalties on non-compliant States even if they are identified. Similarly, Spence *et al*. (2015) claim the ICAO is powerless to enforce its SARPs.

Section 4 International best practice of ARFF services

As well as the ICAO, the international, non-profit National Fire Protection Administration (NFPA) publishes standards related to all types of fire fighting. As with the ICAO, the NFPA develop and review their standards through a public process overseen by a Technical Committee or Panel. Many of the standards developed by the NFPA have been adopted at locations around the world, however they are not binding unless the Authority Having Jurisdiction (AHJ) has adopted them and committed to the particular standard. In practice the NFPA standards are more stringent than the ICAO standards in relation to ARFF. CASA regulations closely align with ICAO SARPs. The Federal Aviation Authority (FAA), the authority responsible for regulation of all aspects of civil aviation in the United States, include requirements in their Code of Federal Regulations, which often reference the NFPA standards, but in practice are generally more relaxed. The Civil Aviation Authority (CAA), the United Kingdom's independent specialist aviation regulator, base their standards on the ICAO SARPs.

Airports are categorised based on the length of the longest aeroplane (and their maximum fuselage width) to use the airport during the busiest consecutive three months of the preceding 12 months. If the longest aircraft to use the airport does not reach 700 movements it is not deemed the 'critical' aircraft and the category can be set one category below the designated category. This is known as remission and is allowed by CASA, ICAO, FAA and CAA, but not referenced by NFPA.

CASA only requires ARFF at Level 1 airports, which are airports receiving scheduled international passenger air services or those above the threshold passenger numbers referred to above. All airports with ARFF in Australia correspond to Category 6 or above. A survey of similar countries and their requirements for airports to be serviced with ARFF found all other countries had less restrictive obligations than Australia, such that if Australia adopted any of the alternative systems, ARFF would be required at many more airports around the country.

The methodology for rescue and fire fighting at airports is based on the critical area concept, which is the critical area to be protected in any post-accident fire that would permit the safe evacuation of aircraft passengers and crew, and is determined by the size of the aircraft. The theoretical critical area (TCA) is the area within which it may be necessary to control the fire, while the practical critical area (PCA) is representative of actual aircraft accident conditions, and is two-thirds of the TCA. Quantities of extinguishing agent are calculated to be sufficient to control the PCA (Q_1) and complete extinguishment depending on the aircraft size (Q_2). Not only do the NFPA use the maximum aircraft size as opposed to the average aircraft size (ICAO SARPs), they provide for extra water to be used for interior fire fighting (Q_3). CASA follows the ICAO standards for quantity of agent (performance level B).

THE ICAO and NFPA both recommend staffing levels to be determined by a Task Resource Analysis (TRA), a process where possible worst-case scenarios are simulated to determine resource requirements. In addition the NFPA recommends minimum staffing levels. ASA use an old TRA methodology to determine staffing levels not endorsed by the ICAO and uses staffing levels below that recommended by the NFPA.

CASA use response times that align with the ICAO SARPs, specifically that the operational objective is two minutes to any point on the runway, and three minutes to any part of the movement area. The NFPA recommendation is slightly more relaxed at three and four minutes respectively. Response times assist airports and ARFF services in planning the number and locations of fire stations required at an airport.

Section 5 Australia's compliance with ICAO standards

The SARPs concerned with ARFF services are contained in section 9.2 of Annex 14. In addition ICAO Document 9137-AN/898 Airport Services Manual, Part 1, Rescue and Fire Fighting, provides material to assist States in the implementation of the specifications in Annex 14 and thereby help to ensure their uniform application. The basic standard (9.2.1) is that rescue and fire fighting equipment and services shall be provided at an aerodrome.

Australia first received an audit from the ICAO in 2008, under the old system, at which time it received an Effective Implementation (EI) score of 82.63 per cent. An off-site validation activity was performed in 2016, at which time Australia's overall Effective Implementation (EI) was 85.27 per cent, which would have placed it 48th out of Member States in today's rankings. In 2017 Australia received a visit from ICAO officials as part of an ICAO Coordinated Validation Mission (ICVM), where ICAO officials worked with Australian officials to improve Australia's compliance to ICAO SARPs. Following the ICVM Australia increased its EI score to 94.98, placing it currently eighth for overall EI.

Australia received a score of 95.71 for the Aerodromes and Ground Aids (AGA) area, under which ARFF is grouped, which is tenth out of Member States. There were 26 actions listed as 'High Priorities' in the ICVM final report, one of which had reference to ARFF:

> Ensure full implementation of Annex 14, Volume I requirements for the provision of rescue and firefighting (RFF) services at aerodromes, which take into account the aerodrome location and the surrounding terrain (ICAO, 2018b, p. 1-3).

In the current version of the AIP published in April 2018, there are 462 differences listed for Annex 14 Volume 1 (ASA, 2018b). Nineteen of these differences are in regards to the provision of ARFF at aerodromes, nine of which are classified as 'less protective or partially implemented / not implemented' in relation to the ICAO SARPs.

Section 6 The cost of provision of ARFF in Australia

ASA is funded through levies they place on their customers, specifically the airlines who use the airports where their services are utilised. This system of provision and charging of ARFF services is unique to Australia. ASA charge levies for each of their three main services: Enroute services; Terminal Navigation (TN) services; and ARFF services. Previously there has been a level of cross-subsidy from other service lines towards ARFF services, but this was to be phased out in the 2016 pricing proposal, which has not yet been put into effect.

The charging of fees for ARFF services has changed over the years, with much discussion over whether all airlines pay a network fee, or a location specific and/or category based price is paid. The idea of a network price allows for cross-subsidy so the whole system is supported on a needs basis and the costs of the system are borne equally by all locations. The location specific argument is based on the idea of 'user pays', where the price at a particular location would be determined by the cost base at the location so as to be cost recoverable. Large international airlines lobby against the network price system as they subsidise small, regional airlines, arguing that network pricing distorts the economic efficiency of the system and advocate for a user pays system. Conversely, small airlines, regional airports and their representatives argue that safety is a need that should not be based on location and that location specific pricing will jeopardise vital air services to regional communities and potentially leave stranded assets. The current arrangements incorporate both elements of network charges and location specific/category based charges.

In the early 1990s the General Aviation (GA) community successfully lobbied for the withdrawal of ARFF services from GA capital city secondary airports, citing their costs as prohibitive. In 2017-18, two of the top three and five of the top ten airports in the country for aircraft movements were airports that primarily catered for GA and recreational flights, Moorabbin, Bankstown, Jandakot, Parafield and Archerfield. As such, over 1.1 million aircraft movements a year, more than three thousand per day just at those five airports, are not covered by ARFF services.

In the late 1990s, the ASA adopted location specific pricing for ARFF services following a review of the economic efficiency of their charges. Following encouragement from the ACCC, ASA implemented a hybrid system in the first part of the 2000s, which is still the basis of ARFF charges today. Around the same time the House of Representatives Standing Committee on Transport and Regional Services recommended ASA introduce a universal service charge to reduce the wide disparity in ARFF charges and to reduce the overall impact of the charges on regional aviation costs. The Committee considered that aviation rescue and fire fighting services should be a right of all Australians and that location specific pricing was not a fair system as it put a different price on safety depending on location, rather than need.

The current pricing structure uses a hybrid model, consisting of:

- A base level service network charge, which is the same charge for all Category 6 aircraft and below at all locations
- A higher level location and category specific charge to reflect the additional investment and operating cost driven by higher category aircraft

ASA employs the ACCC's building block pricing model, which takes into account efficient cost components required to provide a service. From this ASA calculate a maximum allowable revenue (MAR), which is the sum of operating expenditure, depreciation, return on capital and an allowance for tax. Based on 2015-16 information, the 26 ASA ARFF services operating at airports in Australia were required to raise revenue of $237 million. As the MAR includes other components, these costs are inflated in terms of the simple yearly operating cost to provide ARFF services.

If a standard network fee was charged to cover the costs of the current ARFF services across Australia, based on the maximum allowable revenue for 2015-16, each passenger would be charged $3.26. This would cover the costs of the 26 existing ARFF services. That cost would increase when new services were introduced at airports without existing ARFF services to cover the extra operating costs. There would also be set-up costs for these new services. A charge such as this would be similar to a Passenger Facility Charge (PFC) that exists in the US. The US PFC is a charge of up to $4.50 added to each passenger's flight which is used by airports to fund projects that enhance safety, security, or capacity; reduce noise; or increase air carrier competition.

In 2014 the Department of the Prime Minister and Cabinet published a Best Practice Regulation Note on the value of a statistical life, stating that willingness to pay is the appropriate way to estimate the value of reductions in the risk of physical harm. In 2014 dollars the estimate of the value of a statistical life was $4.2 million, with the value of a statistical life year being $182,000.

Carlsson *et al*. (2004) find that people are willing to pay more than two times as much to reduce the risk of flying as they would to reduce the risk of travelling by taxi (given the same baseline cost). Similarly, Braithwaite (2001) asked respondents how much *extra* they would be willing to pay to ensure ARFF services would be at the airports where they took off and landed. Almost 85 per cent were willing to pay something extra, with almost 40 per cent (the highest response) willing to pay whatever is necessary. A recent report into the impact an increase in airport charges would have on demand for air travel found that there are generally low price elasticities (InterVistas, 2018).

Section 7 Effect on tourism of aviation accident

Tourism and air travel are inexorably linked, and are becoming increasingly so. This is especially the case in Australia, as Australia's location in the world makes air travel almost essential to international tourists. Further, domestic tourism is strongly linked to air travel due to the sparse nature of the country and the ease and flexibility of travel, particularly between large cities, due to the advent of low cost carriers. Domestically, over 57 per cent of people travelling interstate in Australia travel by air transport. A key target of Tourism Australia's strategic policy, Tourism 2020, was increasing international and domestic aviation capacity to transport greater tourist numbers. Away from the major cities the use, availability and affordability of air travel is an ongoing issue with many Government inquiries examining the impact of aviation on regional Australia, including the impact on regional tourism.

The economic benefits of tourism have long been established. Put in its simplest terms, a visitor or tourist who visits or stays outside their usual environment generates additional expenditure beyond that generated by local consumers who spend money in their usual environment. Thus the tourist adds tourism-related value to the economy that is not present had they not visited. Domestic tourism increases a country's total national spending just as other internal transactions do. The tourist destination will increase its gross regional product, which contributes to the nation's gross domestic product. International tourism acts as an export, improving a country's external sector balance.

Tourism is an industry that contributes to and requires input from many sectors of the economy. In National Accounting, the direct contribution of travel and tourism is calculated as the output generated from tourism-characteristic sectors, such as airlines, airports, travel agents, hotels and leisure and recreation services that deal directly with tourists. This is known as direct contribution. The total contribution of tourism to the economy consists of the direct effects, supplemented by the indirect effects, which are the flow-on effects that occur to the changes in supply that result from spending of the tourism industry's receipts on goods and services from other industries.

In the 2016-17 financial year, tourism contributed $55.3 billion toward the country's GDP, which represents 3.2 per cent of total GDP. In terms of Gross Value Added (GVA), direct tourism contributed $50.6 billion in nominal price terms in 2016-17, 3.1 per cent of total GVA. The number of jobs in the economy attributable to the tourism industry was just under 600,000 in 2016-17. The indirect effects of tourism to GVA were estimated for 2016-17 to be $47.9 billion, or 2.9 per cent of national GVA, with another 327,000 jobs attributable to indirect tourism effects.

Airports themselves have a direct effect on a nation's economy, with the total economic contribution of airports in Australia for 2016-17 being $29.7 billion, which creates almost 200,000 jobs. Further, total tourism activity facilitated by the aviation sector contributed $32.3 billion, which was equivalent to 1.9 per cent of the total economy. Further, total tourism activity facilitated by the aviation sector supported 339,700 jobs across Australia, or 1.8 per cent of total employment. International tourism contributes the largest proportion of the economic contribution of tourists facilitated by the aviation sector, as most international tourists arrive by aeroplane ($21.6 billion), while domestic tourism activity facilitated by the aviation sector contributed $10.6 billion in 2016-17 (Deloitte Access Economics, 2018).

Australia has an excellent record for airline safety. However, a number of accidents and other serious and not-so-serious incidents do occur each year, some involving commercial air flights and some involving fatalities. Over the decade 2008-2017 there were 337 aviation fatalities in Australia, 40 of which were in 2017, which is above the average for the decade. There were only 20 fatalities in 2018, which is the lowest number ever recorded by the ATSB. Over the decade to the end of 2017, 83 per cent of the more serious accidents and incidents involved general aviation aircraft. Yet, around 70 per cent of all reported incidents involved aircraft conducting commercial air transport operations. The majority of air transport passengers, particularly tourists, fly on high capacity RPT aircraft. Despite having a perfect fatality-free record since the introduction of jet-powered aircraft, high capacity RPT aircraft were the subject of over 50 per cent of all incidents from 2008-2017. Further, the ATSB investigated 330 incidents involving high capacity RPT aircraft during this period, with another 19 investigations in 2018.

The public perception of the safety of the aviation sector has always been a crucial industry concern in Australia and around the world. Research literature has found that potential passengers switch airlines away from those that have been involved in an accident, the so-called ‘Rainman’ effect, with the safety record of an airline being a significant driver of air travel demand. Further, airlines involved in accidents have seen their equity value decrease, with rivals also dropping in value for large accidents, but increasing for minor accidents. Taken as a whole airlines values have been found to decline after a fatality. Further, it has been found that demand for air travel falls as fatality rate increases, with a greater impact on domestic travel.

Modelling based on an air transport accident is used to show the potential impact on Australia’s economy as a result of a loss in tourism after an aviation accident. Assuming a 7 per cent reduction in international tourists and a 12 per cent reduction in domestic tourists, it is found that Australia’s GVA would reduce by $2.8 billion, over 2.8 per cent of the total contribution of the tourism sector to GVA, with almost 30,000 job losses.

Section 1 Introduction

1.1 Purpose of the report

The Senate moved on 5 December 2018 that matters be referred to the Senate Rural and Regional Affairs and Transport References Committee for inquiry and report on the provision of rescue, fire fighting and emergency response at Australian airports. The Centre of Full Employment and Equity (CofFEE) was commissioned by the United Firefighters Union of Australia (UFUA) in February 2019 to research and examine issues relevant to the inquiry.

The Senate Inquiry is wide-ranging, but asks for particular reference to:

a) the current standards applicable to the provision of aerodrome rescue and firefighting services relating to community safety and the emergency personnel safety;
b) the standards for the provision of emergency response at Australian airports, including emergency medical response and response to structure fires and other incidents;
c) the comparison of safe systems of emergency response standards and systems of work for firefighting and rescue operations for structure fires, aircraft rescue, emergency medical response and other emergency incidents;
d) the consideration of best practice, including relevant international standards;
e) the mechanisms and criteria for the review of the provisions of safety standards for the provision of rescue and firefighting services, if any;
f) a review of Airservices Australia policy and administration of aviation rescue and firefighting services;
g) the effectiveness and independence of the regulator, the Civil Aviation Safety Authority (CASA), to uphold aviation rescue and firefighting safety standards;
h) the impact on Australia's national and international reputation and aviation safety record as a result of any lowering of aviation rescue and firefighting services; and
i) any other related matters.

1.2 Outline of the report

The report is structured as follows:

- Following this introduction is an overview of the current system of aviation rescue and fire fighting (ARFF) at Australian airports.
- Section 3 reviews the regulatory system governing ARFF in Australia. It also looks at the international system of compliance to standards.
- Section 4 provides a detailed examination of the requirements of ARFF services and compares the Australian standards with international best practice.
- Section 5 evaluates how Australian standards comply with the international standards and recommendations.
- Section 6 provides an estimation of the cost of ARFF provision at Australian airports and reviews the pricing model used to finance ARFF services in Australia.
- Section 7 presents the economic benefits of tourism and shows the links between air transport and tourism, particularly in Australia. It goes on to examine the safety of air transport, people's perception of the safety of air transport and the possible consequences of a reduction in Australia's reputation as a safe place to travel.
- Finally, a conclusion summarises the key findings.

Section 2 Overview of Aviation Rescue and Fire Fighting (ARFF) in Australia

Aviation Rescue and Fire Fighting (ARFF) is a branch of fire fighting and rescue that deals specifically with fires and rescue situations arising from aviation incidents. ARFF personnel respond to multiple types of incidents involving aircraft at and in the immediate vicinity surrounding airports, with their primary role being to optimise the chance of survival of occupants of an aircraft that has crashed and to protect property and equipment from the effects of fire.

In Australia, the functions of an ARFF service are defined in the Civil Aviation Safety Regulations as:

a) to rescue persons and property from an aircraft that has crashed or caught fire during landing or take off; and
b) to control and extinguish, and to protect persons and property threatened by, a fire on the aerodrome, whether or not in an aircraft.

There are a number of reasons special ARFF services are required to be readily available to deal with aviation incidents. The first is that the type of situation that arises from an aircraft incident is quite different to that which may face emergency responders to accidents involving other types of transport. Specifically, the large amount of fuel that can potentially ignite poses a very real and immediate danger in any aircraft incident. Second, the potential for mass fatalities is very real and hence the speed with which fire fighters must respond to an aircraft incident is of paramount importance. To this end, aviation fire fighters must be located within an airport or very nearby to reduce the risk of catastrophe. Third, the apparatus and the personal protective equipment used by aviation fire fighters is very specialised and requires advanced training.

In Australia, ARFF services are required to be provided at airports that receive scheduled international passenger air services, or airports with over 350,000 passenger movements on scheduled passenger air services in a 12 month period. This means presently in Australia there are ARFF services at 28 of Australia's 195 certified airports. ARFF services are provided by Airservices Australia (ASA) at 26 of these. The Norfolk Island Administration is responsible for providing ARFF services at Norfolk Island International Airport and the Department of Defence is the provider at Newcastle Airport (which is also a RAAF Base, situated at Williamtown).

ASA is a government owned organisation established under the Air Services Act 1995. It has a range of functions outlined in the Act, including providing services and facilities for the safety, regularity and efficiency of air navigation; the promotion and fostering of civil aviation; and cooperation with the Australian Transport Safety Bureau in relation to investigations that relate to aircraft incidents. The services ASA provides includes air traffic services; aeronautical information, radio navigation and telecommunications services; and aviation rescue and fire fighting services. The Act stipulates that ASA must regard the safety of air navigation as the most important consideration.

The obligation of airports to have an ARFF service readily available is a requirement of the International Civil Aviation Organisation (ICAO), of which Australia is a signatory. The ICAO was set up following the Convention on International Civil Aviation, also known as the Chicago Convention, in 1944. ARFF in Australia was established in 1947 and has predominantly been provided by the Commonwealth Government, through various entities acting under an authorising Act of Parliament. Sydney Airport's ARFF service is one of the oldest and longest continually running services in the world.

While currently there are 28 ARFF services situated at airports around Australia, this number has changed over the years. In 1961 there were 36 ARFF units around Australia, with a further 5 in Papua New Guinea (Gascoigne, 1989). Deregulation and airport privatisation saw the introduction of greater competition in the aviation industry and the push for lower cost fares, which has increased passenger numbers. Cost rationalisation has also seen the push to make the provision of aviation safety services, such as ARFF, cost recoverable.

In July 1991 the Civil Aviation Authority, the regulatory authority at the time, announced it would remove ARFF services from capital city secondary airports, such as Bankstown, Essendon and Jandakot. In the years after, ARFF services have been provided on the basis of passenger numbers that use an airport. The latest increase in the provision of ARFF occurred in 2014-15 when it was introduced at Coffs Harbour, Ballina, Gladstone and Newman airports. Figure 1.1 shows the locations of airports with current ARFF services.

Figure 1.1 Aviation rescue and fire fighting services locations

Source: ASA website, accessed 14 March 2018: http://www.airservicesaustralia.com/about/our-facilities/aviation-rescue-fire-fighting/

Currently, after a regulatory review in 2015-16, once airports pass the threshold for passenger numbers, or receive scheduled international passenger air services, a risk review is carried out to determine whether an ARFF service is required (see Section 3). If it is deemed to be necessary, the ARFF service is categorised according to the size of aircraft that use the airport (see Section 4). The different categories determine the resources provided to the ARFF service, including the number of vehicles, staffing levels and quantity of agent. The airports in Australia that fit into the various categories are shown in Table 1.1.

The primary purpose of ARFF services is to respond to aircraft incidents on or in the immediate vicinity of the airport. However, ARFF personnel respond to a number of calls for a variety different reasons. Aircraft incidents include crashes, engine fires and fuel spills, while other

Table 1.1 ARFF levels of service at Australian airports

Category 6	Category 7	Category 8	Category 9	Category 10
Ayers Rock	Alice Springs	Avalon	Adelaide	Melbourne
Ballina	Hamilton Island	Cairns	Brisbane[a]	Sydney
Broome	Hobart	Canberra	Perth[a]	
Coffs Harbour	Launceston	Darwin		
Gladstone	Mackay	Gold Coast		
Karratha	Sunshine Coast			
Newman	Townsville			
Port Hedland				
Rockhampton				

Source: ASA website, accessed 14 March 2018: http://www.airservicesaustralia.com/services/about-our-aviation-fire-service/arff-levels-of-service/
Notes: a - Following a Senate Inquiry hearing on 14 March 2019, the ASA website downgraded the Category status of both Brisbane and Perth airports from Category 10 to Category 9

incidents ARFF personnel respond to include emergency medical response (first aid) calls, motor vehicle accidents, hazmat incidents, other fires and alarms. They also support local fire brigades in mutual aid calls including bushfire emergencies. In 2017-18 ARFF personnel responded to almost 7,000 calls nationally, over 450 of which were aircraft incidents (Table 1.2).

Quick response of ARFF services to incidents is of paramount importance in averting a catastrophe. Hence, their readiness (or preparedness) to attend an incident at a moment's notice is important and is recorded, as is their actual response time to an incident. In 2014-15 and 2015-16 the failure to achieve 100 per cent response time of 3 minutes on the aerodrome movement area was due to one incident in each year, both involving abnormal landings.

Table 1.2 ASA ARFF national performance indicators, 2013-14 – 2017-18

Year	ARFF Airports	Operational staff	Aircraft incidents	Total call responses	Readiness rate (%)	Response time rate (%)
2017-18	26	843	452	6900	99.9	100
2016-17	26	877	430	NA	NA	100
2015-16	26	856	395	7000	99.94	99.78
2014-15	26	853	NA	6702	99.94	99.64
2013-14	22	669	NA	7200	99.9	NA

Source: Airservices Australia Annual Reports, 2014-2018
Notes: NA Not available

ARFF training for staff is delivered at the Airservices Learning Academy in Melbourne. The training involves theory sessions and practical activities on the purpose built Hot Fire Training Ground where future ARFF staff practice on a full-size mock-up of an aircraft fuselage, similar to those found on an Airbus A380 and Boeing 767. The training program includes a Certificate II qualification and aims to provide aviation fire fighters with the skills and knowledge they will need for the situations they will face, including response to aviation incidents, operating breathing apparatus and other specialised equipment, and working as part of the team. Training continues on the job at regular intervals.

Section 3 Regulatory system of ARFF provision

3.1 Civil Aviation Safety Authority (CASA)

The Civil Aviation Safety Regulations 1998 (CASR), made under the Civil Aviation Act 1988, set out the regulations for the civil aviation sector in Australia. The Civil Aviation Safety Authority (CASA) is responsible for issuing and enforcing the regulations. CASA was established in 1995 and is a corporate Commonwealth entity, under the Public Governance, Performance and Accountability Act 2013. Section 9 of the Civil Aviation Act sets out CASA's functions. CASA's stated purpose is to maintain, enhance and promote the safety of civil aviation, with particular focus on preventing aviation accidents and incidents. It is also responsible for fostering the efficient use of, and equitable access to, Australian-administered airspace. Section 9A of the Act makes clear the emphasis CASA places on safety:

> In exercising its powers and performing its functions CASA must regard the safety of air navigation as the most important consideration (Civil Aviation Act 1988).

Among CASA's powers are to regulate aerodrome rescue and fire fighting services. Part 139 prescribes the requirements for aerodromes used in air transport operations. Subpart 139.H specifies the requirements for the provision of aviation rescue and fire fighting (ARFF) services. It also puts in place a safety framework, sets minimum service standards and sets establishment and disestablishment criteria for ARFF.

The CASR sets out the purpose of ARFF is to rescue persons and property from aircraft that have crashed or caught fire at or near an aerodrome. There is also the expectation ARFF services will respond to other fires at an aerodrome. Part 139.H details the requirements for ARFF, defining minimum service standards including:

- criteria for establishment and disestablishment of ARFF services;
- provision of ARFF services outside of the criteria;
- interface arrangements with State or Territory fire brigades and other third party providers;
- quality control;
- ARFF service personnel recruitment;
- training establishments; and
- applicants organisation (CASA, 2019).

CASA publishes the Manual of Standards (MOS) (CASA, 2005), which is a policy manual and the means by which CASA meets its responsibilities under the Act for promulgating aviation safety standards. The MOS is a legislative instrument, which outlines detailed technical material (aviation safety standards) that are deemed necessary for the safety of air navigation in Australia. The responsibility for technical matters in the MOS is the responsibility of the National Operations and Standards Division (formerly the Aviation Safety Standards Division).

The CASR and MOS broadly align with international standards outlined by the International Civil Aviation Organisation (ICAO, see below), however there are some differences between them, some of which are in relation to the delivery of ARFF services at Australian airports. The MOS recognises this and sets out that "where there is a difference between a standard prescribed in ICAO documents and the MOS, the MOS standard shall prevail" (CASA, 2005, p. 1-2). Differences are published in the Aeronautical Information Publication, as required by ICAO.

CASA has the authority to grant exemptions from provisions of the CASR under Subpart 11.F. This can include an exemption from a requirement in the CASR to comply with the MOS, or some other referenced document. Most exemptions are granted through a process of application from a person or organisation and may be in relation to an aircraft or aeronautical product, an operation, or an authorisation. The process followed by CASA for exemptions is set out in Advisory Circular AC 11-02(2). CASA requires exemption applications 3 months prior to when they are required to commence, but exemptions can be made in exceptional circumstances where the application can be made in any reasonable way.

3.2 Australian Transport Safety Bureau (ATSB)

The Australian Transport Safety Bureau (ATSB) is the prime agency in Australia for the independent investigation of civil aviation accidents, incidents and safety deficiencies. It is governed by the Transport Safety Investigation Act 2003 and investigates for the purpose of "no blame" safety improvements, not for the purpose of taking administrative, regulatory or criminal action.

The ATSB is governed by a Commission, separate from policy makers, industry operators and regulators such as CASA. The ATSB follows Annex 13 to the Convention on International Civil Aviation (Chicago Convention), which prescribes international principles for aircraft accident and incident investigation, reflected in the Transport Safety Investigation Act. As the primary focus of the ATSB is the safety of the travelling public, the ATSB also investigates safety issues based on occurrence trends in the hope of averting a future accident (ATSB, 2019).

3.3 Airservices Australia (ASA)

Airservices Australia (ASA) was established under the Air Services Act 1995. It is a corporate Commonwealth entity under the Public Governance, Performance and Accountability Act 2013 (ASA, 2018a). ASA is responsible for providing safe, secure, efficient and environmentally responsible air navigation and aviation rescue and fire fighting services.

Their functions under the Air Services Act include:

- providing facilities for the safe navigation of aircraft within Australian-administered airspace;
- promoting and fostering civil aviation in Australia and overseas; and
- providing air traffic services, aviation rescue fire fighting services, aeronautical information, radio navigation and telecommunications services.

ASA is governed by a Board whose members are appointed by the Minister for Infrastructure, Transport and Regional Development, consisting of eight members. The Board determines the objectives, strategies and policies of ASA, ensuring it fulfils its statutory functions.

ASA provides terminal navigation (TN), ARFF and en route navigation services at airports around Australia, for which it charges aircraft operators appropriate charges. Charges are set subject to notification to the Australian Competition and Consumer Commission (ACCC), which reviews ASA pricing every five years. Overall ASA had 3,534 employees in 2018, 843 of which were employed in aviation rescue and fire fighting at 26 airports around the country (see Section 1).

3.4 Aviation Rescue and Fire Fighting Services Regulatory Policy Review

There have been a number of reviews and audits into the operation and regulations of the civil aviation industry over the years. These have come from within the industry, for example CASA post-implementation reviews, as well as from government itself in the form of safety reviews and as part of the national commission of audit. For a review of relevant recent reviews into the industry and its effects on the regulation and provision of ARFF services, see Quirk (2016).

In 2015 the Australian Government asked the Department of Infrastructure and Regional Development (DIRD) to provide policy advice on potential improvements to the efficiency and clarity of ARFF services requirements. DIRD released a public policy paper (DIRD, 2015) and invited responses from affected parties, from which there were eleven respondents. The review proposed a number of regulatory changes particularly with regard to:

- the approach to establishing and disestablishing ARFF services at airports;
- the regulatory role at non-ARFF airports;
- ARFF services' roles and responsibilities; and
- removing red tape.

The recommendations in the DIRD review were accepted by the Minister in December 2016. The primary change was the removal of threshold numbers of passengers at which to establish and disestablish ARFF services at airports. Previously ARFF were required at airports receiving scheduled international passenger air services, and/or airports which had 350,000 passenger movements on scheduled passenger air services over a 12 month period. Similarly, disestablishment would previously occur if there was a withdrawal of scheduled international passenger air services or passenger movements on scheduled passenger air services fell below 300,000 and remained there over a 12 month period. Following the regulatory review, the approach to the establishment and disestablishment of ARFF services changed, whereby a trigger event would require CASA to perform a risk review to determine if establishment/disestablishment were to occur. For the establishment of ARFF services at an airport, the trigger events were an airport receiving scheduled international passenger services or where passenger movements on scheduled passenger air services were above 500,000 over a 12 month period. Similarly, the trigger events for disestablishment were the withdrawal of scheduled international air services from an airport, or passenger movements falling below 400,000 and remaining there for a 12 month period. This change would have seen ARFF services removed from up to seven airports, and airports not yet with ARFF but with increasing passenger numbers, having to wait further years to qualify for ARFF services to be established.

Other reforms included the allowance that if a new ARFF service was deemed necessary at an airport, given these rules, a graduated service (at a level lower than the ARFF category of services required) would be acceptable prior to the establishment of full operations. Further, there a caveat included that a fire fighting related service provided at an airport that is not required to have an ARFF service, is not an ARFF service within the meaning of the CASR; and hence would not be subject to the regulatory framework or regulation by CASA. Areas and facilities to be the responsibility of ARFF services were listed as aviation-related infrastructure, which may include infrastructure identified in an agreement between an ARFF service and a state/territory fire authority. State and territory fire authorities are not required to hold separate CASA approval to assist an ARFF service provider in the provision of ARFF. Responsibilities of the airport operator in facilitating the provision of ARFF were clarified.

In June 2018, following the appointment of a new Minister, there was a change to the ARFF establishment and disestablishment passenger thresholds. Remaining is the requirement that receipt or withdrawal of scheduled international passenger air services and/or the number of passenger movements on scheduled passenger air services act as a trigger for a risk review by

CASA before the establishment or disestablishment of the service. However, the trigger thresholds were returned to the previous levels of over 350,000 passenger movements at which a review will be conducted into establishing ARFF services, and below 300,000 passenger movements for a review to be conducted to disestablish ARFF services.

Despite the availability of passenger numbers at airports publicly available each year, there remains a time lag from when individual airports pass the threshold to when an ARFF service is able to be provided. The airport at Proserpine passed the 350,000 passenger threshold in 2016-17, having been less than 2,000 short of this the previous year. Passenger numbers increased by almost a further 120,000 the next financial year, yet the safety case approved by the regulator will not see an ARFF service present at Proserpine airport until second quarter 2020, almost three years after the 12 month period that the airport passed the threshold passenger numbers. In the interim, ASA have been working with the local fire brigade to improve their response to emergencies at the airport (Commonwealth of Australia, 2019b).

3.5 International Civil Aviation Organisation (ICAO)

The International Civil Aviation Organisation (ICAO) was set up following the Convention on International Civil Aviation, also known as the Chicago Convention. The Convention, of which Australia is a signatory, was signed in December 1944 by 52 states and the ICAO came into being in April 1947. Later that year the ICAO became a specialised agency of the United Nations. The ICAO was originally created to promote the safe and efficient development of civil aviation around the world.

The ICAO sets out Standards and Recommended Practices (SARPs) for Aerodromes in Annex 14 to the Convention on International Civil Aviation. These standards were first adopted in May 1951. ICAO signatories (Member States) use these standards and recommendations to ensure their civil aviation operations and regulations conform to global norms. ICAO also monitors compliance of its signatories.

Rescue and Fire Fighting at airports is dealt with in Chapter 9.2 of Volume 1 of Annex 14. Annex 14, Chapter 9.2.1 states that rescue and fire fighting equipment and services shall be provided at an aerodrome, and the level of protection provided shall be appropriate to the aerodrome category as determined by aeroplane length and fuselage width. The standards outline that "the principal objective of a rescue and fire fighting service is to save lives in the event of an aircraft accident or incident occurring at, or in the immediate vicinity of, an aerodrome." (ICAO, 2018a, 9-3). The ICAO publishes an Airport Services Manual (Doc 9137-AN/898) which is meant to provide assistance to countries in the implementation of the specifications set out in Annex 14 (ICAO, 2015). In doing so it thereby also ensures the uniform application of the standards.

It is a requirement by ICAO that Member States notify the ICAO of any differences between their national regulations and practices and the Standards outlined in Annex 14. Further, Member States are invited to extend this practice to any differences between their own practices and Recommendations in Annex 14, particularly where such a difference is important for the safety of air navigation. Member States are then required to list any differences between their own regulations and practices and the ICAO SARPs through GEN 1.7 in the Aeronautical Information Service.

Part of the charter of the ICAO is to monitor the implementation of civil aviation safety in countries around the world. Member States are subject to oversight processes to monitor their adherence to ICAO standards, through the Universal Safety Oversight Audit Programme (USOAP). This was initiated in 1999 in response to concerns about the adequacy of aviation safety oversight around the world, which initially consisted of cyclical audits of a country's regulations. In 2010 the ICAO oversight function evolved to a Continuous Monitoring Approach (CMA), which is based on the concept of continuous monitoring and incorporating the analysis of safety risk factors. The aim of the current approach is to move to a systemic, ongoing process of gathering safety information (ICAO, 2010).

3.6 Effectiveness of regulatory system

3.6.1 National

Airservices Australia (ASA) have applied for a variety of exemptions from CASA, which have been granted and are currently in effect. Exemptions from CASA are listed on their website under their Current rules for legislative and non-legislative instruments. There are currently six exemptions listed under non-legislative instruments that apply to ASA in relation to ARFF. Briefly, these are:

- CASA EX17/19 – Use of Operational Foam during ARFFS Training
  This exempts ASA from completing core competency training for the application of foam onto a fire within a 90-day period.
- CASA EX123/18 – Aerodrome Fire Alarm Monitoring
  This exempts ASA from requiring an aerodrome's fire alarms to terminate at the ARFF Fire Station Communication Centre.
- CASA EX80/18 – Aerodrome Reserve Supply (Complementary Agent and Expellant Gas Cylinders)
  This exempts ASA from maintaining on the aerodrome a reserve supply of foam concentrate, complementary agent and expellant gas cylinders equivalent to 200% of the quantities required in vehicles.
- CASA EX73/18 – Aerodrome Rescue and Fire-fighting Service (Competency Maintenance Program Trial)
  This exempts ASA from meeting certain training requirements outlined in the MOS.
- CASA EX60/17 – Aerodrome Rescue and Fire Fighting Service qualifications
  This exempts ASA from requiring that an officer in charge has an Australian Fire Competency Advanced Diploma.
- CASA EX131/16 – Aerodrome Rescue and Fire Fighting Service operations manual
  This exempts ASA from requiring an approval in writing by CASA before a change to their operations manual can come into effect.

Most of the exemptions have certain conditions attached that must be adhered to by ASA.

In relation to ARFF, the process of granting an exemption appears to be a matter of ASA applying for the exemption, and CASA's technical experts, of which there are two for ARFF, reviewing the application before granting it. This is also the procedure for a risk assessment or safety case. A lack of confidence in this process has been expressed at recent Senate Estimates and Inquiry hearings (for example, Commonwealth of Australia, 2019a; 2019b). There appears scope for an extra layer of oversight that may be useful in reviewing applications such as these and providing recommendations on their necessity, appropriateness and most importantly, their impact on safety standards. Indeed, a greater degree of transparency into the rationale behind the requesting and granting of exemptions would assist in ensuring a more robust procedure.

The Aviation Safety Advisory Panel (ASAP) of CASA was established to provide informed, objective, high-level advice from the aviation community on issues that have, or may have, a significant implication on aviation safety and the way CASA performs its functions. The ASAP Terms of Reference provide for Technical Working Groups (TWG) to be established to deal with specific issues within a particular sector of the industry and to offer advice. TWGs may also be established by CASA to provide input on technical issues and proposals. There are a range of TWGs established that deal with aspects of aviation safety, however, while a TWG on ARFF has been approved, it has yet to be established. Indeed, a group such as this may be useful in providing additional oversight in the application of regulation relating to ARFF in Australia.

Senate estimates hearings provide a level of oversight, but usually it requires a senator involved in the hearing to be cognisant of the happenings on the ground. In Senate estimates hearings in February 2019, it was reported that ASA is non-compliant with two requirements in the MOS for which exemptions had not been granted (Commonwealth of Australia, 2019a). The first concerned rescue power saws that are used to force entry into an aircraft, fuselage, locked structures or vehicles involved in accidents. ASA have removed them from ARFF services on safety grounds, despite the MOS requiring them to be available for use. CASA were made aware of this and six months later were still in consultation with ASA about the impacts of withdrawing that equipment and the safety implications of doing so (Commonwealth of Australia, 2019b).

Further, at the same estimates hearing it was revealed that ARFF services were not complying with the Australian standard for hose testing, which means ASA was non-compliant with a CASA regulation. ASA have notified CASA of this and are moving toward meeting the Australian standard.

The question of safety or appropriateness of equipment is one for the experts in the field to deal with. However, the process in place for dealing with these issues, appears quite flexible and malleable to the wants of the two organisations involved. In both of these cases of non-compliance, CASA had not provided exemptions, yet ASA were operating without meeting the Australian standards/regulations. Indeed, had a Senator not been aware of these cases of non-compliance they may well have passed unnoticed for some time.

3.6.2 International

Australia attended the Convention on International Civil Aviation (Chicago Convention) in December 1944 and was one of the original 52 signatories to the ICAO becoming an official agency of the United Nations when it came into force on 4 April 1947. It has been active in providing committee members and contributing to policies over the years. It has also participated in the Universal Safety Oversight Audit Programme (USOAP) on occasions over the years.

Australia has been involved in two audits from the ICAO. Australia’s first audit was in 2008 under the old system, at which time it received an Effective Implementation (EI) score of 82.63 per cent. Australia filed a notification of difference with the ICAO to reflect their regulatory system varied from the SARPs. This resulted in Australia providing a corrective action plan to address the Findings and Recommendation (F&Rs), where Australia committed to considering the issue as part of a review (ICAO, 2009).

Australia’s second audit was in the form of an ICAO Coordinated Validation Mission (ICVM), where the ICAO sent a team to evaluate the progress of Australia on resolving its F&Rs. On completion of the ICVM, Australia earned an overall EI score of 94.98, ranking it eighth in the world in terms of overall compliance. However, Australia drops to tenth in the area of Aerodromes and Ground Aids (AGA), which covers the operation of ARFF services at airports. Further, in advice to assist Australia prioritise its remedial actions, the ICAO is still listing as a high priority the "full implementation of Annex 14, Volume 1 requirements for the provision of rescue and firefighting services at aerodromes" (ICAO, 2018b, p. 1-3).

It is a requirement by ICAO that Member States notify the ICAO of any differences between their own regulations and practices and the ICAO SARPs:

> Any State which finds it impracticable to comply in all respects with any such international standard or procedure, or to bring its own regulations or practices into full accord with any international standard or procedure after amendment of the latter, or which deems it necessary to adopt regulations or practices differing in any particular respect from those established by an international standard, shall give immediate notification to the International Civil Aviation Organization of the differences between its own practice and that established by the international standard (Article 38 of the Chicago Convention).

Member States are also required to publish their differences through GEN 1.7 in the Aeronautical Information Publication (AIP). In Australia's case this is published by Airservices Australia (ASA, 2018b), and in the current version of this publication, there are over 450 differences listed for Annex 14 Volume 1. The majority of these are listed as "Different in character or other means or compliance" or "Less protective or partially implemented / not implemented." A quick glance at these differences though, does not reveal how serious the difference is. In many cases it is simply that something defined in the Annex is not defined in Australian legislation. Judging by Australia's relatively high compliance score, the majority of these are not strictly safety issues. Hence, a real possible safety issue, such as non-provision of ARFF services at aerodromes which deal with large aircraft and considerable numbers of passengers, is hidden among a multitude of somewhat trivial differences.

The CMA oversight system currently used by the ICAO is seen as beneficial to Member States as it is cost-effective, resource-efficient and sustainable. The emphasis of the CMA is on the availability of information on the safety performance of Member States being provided to other Member States. This notification of differences is at the heart of the CMA, yet the degree of non-compliance is not clearly apparent when comparisons are made between countries. For example, for the AGA area of compliance, Australia has an EI score of 95.7 per cent, yet lists over 450 differences with the ICAO SARPs. Norway and Finland, by comparison, have AGA EI scores of 96.67 and 91.3 per cent but only list 14 and 15 differences respectively. Hence, this system does not appear to address the contrasting manner in which countries approach their notification obligations.

Button *et al.* (2004) point out the problem with the ICAO structure is that it relies heavily on voluntary involvement and application by its Member States. The ICAO has no formal mechanisms for imposing penalties on non-compliant States even if they are identified. Spence *et al.* (2015) investigate the link between compliance with international safety standards (the ICAO SARPs) and air accidents and fatalities. They discuss the powerlessness of the ICAO, citing an earlier study where two-thirds of 32 countries reviewed substantially failed to meet ICAO standards:

> Ultimately ICAO has a significant lack of authority to enforce its own policies. It relies on the assumption that the individual member states will do everything they can to maintain the system the way it is designed (Spence *et al.*, 2015, p. 3).

Section 4 International best practice of ARFF services

4.1 Introduction

The Airport Services Manual (Doc 9137-AN/898) published by the International Civil Aviation Organisation (ICAO) states that the principal objective of an ARFF service "is to save lives in the event of an aircraft accident or incident at, or in the immediate vicinity of, an airport. The ARFF service is provided to create and maintain survivable conditions, to provide egress routes for occupants and to initiate the rescue of those occupants unable to make their escape without direct aid" (ICAO, 2015, p. 1-1). The document sets out proposals for how countries can best implement the international Standards and Recommended Practices (SARPs) outlined in Annex 14 to the Convention on International Civil Aviation.

The methodology for rescue and fire fighting at airports is based on the critical area concept. This was formed by the Rescue and Fire-Fighting Panel that was first convened in 1970 and met subsequently in years hence, with the concept adopted by the ICAO in 1976. Prior to this, the determination on the level of protection to be provided at airports was based on fuel load and passenger capacity of aircraft. The critical area concept is founded on the critical area to be protected in any post-accident fire that would permit the safe evacuation of aircraft passengers and crew, and is determined by the size of the aircraft. This concept provides the basis for ARFF standards.

The ICAO publish their Standards in Annex 14 to the Convention on International Civil Aviation. While these are the international standard, countries publish their own standards and, as we have seen in the previous section, where these are different need to make a notification to the ICAO.

As well as the ICAO, the international, non-profit National Fire Protection Administration (NFPA) publishes standards related to all types of fire-fighting. The NFPA is a global, self-funded organisation which advocates for the elimination of death, injury, property and economic loss due to fire, electrical and related hazards. In particular NFPA 403, Standard for Aircraft Rescue and Fire-Fighting Services at Airports, is the principal standard governing ARFF. As with the ICAO, the NFPA develop and review their standards through a public process overseen by a Technical Committee or Panel. Many of the standards developed by the NFPA have been adopted at locations around the world, however they are not binding unless the Authority Having Jurisdiction (AHJ) has adopted them and committed to the particular standard. In practice the NFPA standards are more stringent than the ICAO standards in relation to ARFF.

The Federal Aviation Administration (FAA) is the authority responsible for regulation of all aspects of civil aviation in the United States. Among their powers is the authorisation to certify airports, which they do for airports that receive scheduled air carrier services with aircraft having more than nine seats and unscheduled air carrier services with aircraft having more than 30 seats. The requirements for certification are set out in Title 14 Code of Federal Regulations (CFR) Part 139, Airport Certification. The requirements concerning aviation rescue and fire fighting are set out in Sections 139.315, 139.317 and 139.319. In addition, the FAA publish Advisory Circulars which contain research outcomes and recommendations of the various ARFF requirements. Some of these include standards but these standards can only have regulatory effect if referenced in a FFA regulation. CFR requirements are generally more relaxed than NFPA standards, but the Advisory Circulars often reference the NFPA standards as providing appropriate guidance.

The Civil Aviation Authority (CAA) is the United Kingdom's independent specialist aviation regulator. They are a public corporation established by Parliament. Among their powers are to grant aerodrome licences according to the Air Navigation Order (ANO). The ANO requires that most public transport flights take place at a licenced aerodrome, or a Government aerodrome. Guidance to aerodrome operators is provided in policy document Civil Aviation Publication (CAP) 168 (CAA, 2019). Chapter 8 of CAP 168 provides the minimum requirements relating to ARFF provision. The UK standards in general align fairly closely to ICAO SARPs.

In essence, ARFF standards are provided to ensure rapid intervention to aircraft crashes in or near airports, to minimise loss of life, injury, aircraft, property and equipment. Kreckie (2011) argues the consensus standards of the NFPA are provided to indicate a 'best practice' in any number of categories. The standards of the various jurisdictions around the world, including the ICAO provide a minimum standard that Kreckie (2011) argues has no correlation to 'world class'. Instead, regulations and standards provide a foundation for prudent emergency planning and a common sense approach. The following shows a comparison between the CASA standards and the standards set out by the ICAO, the NFPA, the FAA and the CAA.

4.2 Classification of airports

4.2.1 CASA classification

CASA divides airports into Level 1 and Level 2, as set out in the Manual of Standards (MOS) (CASA, 2005). Level 1 airports are defined as those:

- From or to which an international passenger air service operates; and
- Any domestic aerodrome through which more than 350,000 passengers passed through on air transport flights during the previous financial year.

Level 1 aerodromes are required to have an ARFF service at a level appropriate as outlined below. As we saw in Section 2, for new domestic airports to be considered to require ARFF services, once their passenger numbers reach 350,000 this triggers a risk review to be completed by CASA, after which an ARFF service may be recommended, with an allowance for a graduated service lower than the determined appropriate service for an unspecified period of time. Similarly, if passenger numbers fall below 300,000 and remain below this level for a 12 month period, a risk review will be conducted relating to disestablishment of an ARFF service. The MOS stipulates that the level of protection provided must be in accordance with ICAO Standards, Chapter 9 of the Annex 14 to the Chicago Convention.

Level 2 aerodromes are defined as being where the number of annual passengers on air transport is less than 350,000. Level 2 aerodromes may provide a level of ARFF, which will be subject to an audit if published in Enroute Supplement Australia (ERSA) and form part of the Aerodrome Emergency Plan (AEP). The AEP must be in accordance with ICAO Standards, Chapter 9, of Annex 14 to the Chicago Convention. However, Level 2 airports are not required to have an ARFF service.

There are 10 aerodrome categories in the MOS, with all Level 1 Australian airports with ARFF services classified at category 6 or above, as shown in Table 4.1.

The airport category is based on the length of the longest aeroplane (and their maximum fuselage width) to use the airport during the busiest consecutive three months of the preceding 12 months. If the longest aircraft to use the airport does not reach 700 movements it is not deemed the 'critical' aircraft and the category can be set one category below the designated category in Table 4.1 (known as remission).

4.2.2 ICAO, NFPA, FAA, CAA classification

The classification of airports under the ICAO, NFPA and CAA standards are the same as under CASA. The benchmark of 700 movements during the busiest consecutive three months is also outlined in the ICAO Standards, meaning the ICAO permit remission, but is not specified by the NFPA. Remission is also allowable under the CAA.

The FAA uses four classifications based on seating capacity for service type. Class I, II and III are for airports which receive aeroplanes with less than 31 scheduled passenger seats. Class IV is divided into five Indexes, based on aeroplane size as outlined in Table 4.1. Further, if there are five or more daily departures of air carrier aircraft in a single index group serving the airport, the longest index group is the index required for the airport. If there are less than five daily departures of the longest index group of air carrier, the next lower index is the index required for the airport.

Table 4.1 Airport category for rescue and fire fighting

Aerodrome category		**Aeroplane overall length**	**Max fuselage width**
CASA, ICAO, NFPA, CAA	FAA Index		Not FAA
1	A	0 up to but not including 9 m	2 m
2	A	9 m up to but not including 12 m	2 m
3	A	12 m up to but not including 18 m	3 m
4	A	18 m up to but not including 24 m	4 m
5	A	24 m up to but not including 28 m	4 m
6	B	28 m up to but not including 39 m	5 m
7	C	39 m up to but not including 49 m	5 m
8	D	49 m up to but not including 61 m	7 m
9	E	61 m up to but not including 76 m	7 m
10	E	76 m up to but not including 90 m	8 m

Source: CASA, 2005; ICAO, 2018a; NFPA, 2018; CAA, 2019; Certification of Airports, 2004

The remission factor, being applied at Australian airports, is often in force at airports around the country. Cairns, Darwin and Gold Coast airports, for example, are Category 8 airports but regularly receive aircraft that are of Category 9 size. There was concern raised at a Senate hearing that Brisbane and Perth airports were classified as Category 10 airports but were infrequently unable to provide cover for that size aircraft if their Domestic Response Vehicle (DRV) was called out to an incident (Commonwealth of Australia, 2018). This was due to the fact the three crew on the DRV were included in the 14 crew needed to cover a Category 10 airport. Hence, when they were called to incidents the remaining crew was down to 11. Following a Senate Inquiry hearing in March 2019, Brisbane and Perth airports were downgraded to Category 9.

4.3 Provision of ARFF services

ICAO Standard 9.2.1 states: “Rescue and firefighting equipment and services shall be provided at an aerodrome.” NFPA standards require airport management to be responsible for the provision of ARFF services on an airport (Standard 4.1.1). As seen already CASA only requires ARFF services to be provided at airports in receipt of international passenger air services or where passenger movements through an airport are above 350,000 over a 12 month period. This means Australia has ARFF services at 28 airports, despite having 195 certified airports around the country.

In the US and UK, ARFF services are required at all certified (or licenced) airports. In the US, airports where scheduled flights with more than nine seats (or unscheduled flights with more than 30 seats) take-off or land are required to be certified. In the UK, CAP 168 prescribes "Rescue and fire fighting equipment and services shall be provided at an (licenced) aerodrome" (CAA, 2019, p. 364). There, aircraft whose total maximum weight is greater than 2,730 kg which are being used for commercial air transport of passengers or for instruction or tests for a pilot's licence are required to use a licenced aerodrome.

In preparation for the Regulatory Policy Review into ARFF services in 2015-16 (see section 3.4), the Department of Infrastructure and Regional Development published a public consultation paper that, among other things, compared the levels of ARFF service provision at airports in comparable countries, including the US and UK as above, as well as Canada and New Zealand. In all four countries, airport operators are required to provide and to finance ARFF services as part of their licencing arrangements. Canada, like Australia has passenger thresholds, above which ARFF is required at an airport, however, their passenger threshold is 180,000, just over half of Australia's threshold. New Zealand require certification at airports used by aircraft with a passenger capacity of 30 in regular passenger transport and where there are 700 movements in the busiest consecutive 3-month period.

All these other countries have much lower requirements for providing ARFF services at airports than Australia. If Australia adopted the trigger used in any of those countries, many more airports around the country would require an ARFF service.

The requirement for passenger number thresholds to be passed for an ARFF service to be implemented covers over 95 per cent of the flying public. However, it doesn't cover a large proportion of flights. Indeed, after successfully lobbying for the removal of ARFF services from secondary airports in the 1990s, most general and recreational aviation flights take-off and land at airports without ARFF coverage. When counting by aircraft movements, rather than passenger movements, two of the top three and five of the top ten airports in Australia do not have ARFF services. This means that over 3,000 flight movements a day are not covered by ARFF just at these five airports (see Table 6.1 in Section 6 for aircraft movements at these airports).

4.4 Number of vehicles

CASA and CAA follow the ICAO Recommendation on the minimum number of rescue and fire fighting vehicles required at an airport to provide adequate protection for each category, as seen in Table 4.2. Airservices Australia (ASA) operations stipulate four vehicles for Category 10 aerodromes (ASA, 2017). While this is an improvement on the three required previously, without being a MOS standard it is much easier to reverse this and require the much less safe three-vehicle requirement. The FAA allows flexibility in the number of vehicles for indexes B and C.

NFPA standards require one more vehicle than the ICAO standard at the equivalent airport categories 5, 9 and 10. In explaining this discrepancy the NFPA 403 points out the importance of having at least two fire-fighting vehicles when dealing with transport-type aircraft, due to the need to rapidly cover any burning fuel spill to protect the aircraft and its occupants from radiated heat. Further, multiple vehicles allows attacking aircraft fires from more than one point, reduces the potential seriousness of vehicle breakdown and minimises the out-of-service consequences when a vehicle is in need of routine maintenance or repairs (NFPA, 2018).

Table 4.2 Number of ARFF vehicles

CASA/ICAO/ NFPA/CAA category	**FAA Index**	**Number of Vehicles**			
		ASA	ICAO/CAA	NFPA	FAA
4	A	1	1	1	1
5	A	1	1	2	1
6	B	2	2	2	1-2
7	C	2	2	2	2-3
8	D	3	3	3	3
9	E	3	3	4	3
10	E	4	3	4	3

Source: ASA, 2017; ICAO, 2018a; NFPA, 2018; CAA, 2019; Certification of Airports, 2004

4.5 Quantity of agent

The critical area concept has most direct effect in determining the standards for the quantity of agent that should be available to ARFF services. The purpose of the critical area concept is to serve as the basis for calculating the quantities of extinguishing agents necessary to achieve protection within an acceptable period of time. At the heart of the critical area concept is the objective to seek to control that area of the fire adjacent to the fuselage, thus safeguarding its integrity and maintaining tolerable conditions for occupants until evacuation is possible. The size of the critical area has been determined by experimental means.

The ICAO distinguish between the theoretical critical area (TCA) and the practical critical area (PCA). The TCA is the area within which it may be necessary to control the fire, while the PCA is representative of actual aircraft accident conditions. The TCA is a rectangle having as one dimension the overall length of the aircraft, with the width varying with the length and width of the fuselage, calculable with a mathematical formula. The PCA is two-thirds of the TCA.

Once the PCA is calculable, the control time and extinguishment time were considered and a discharge rate and time calculated to ensure the lowest possible fire control time so as to prevent the fire from melting through the fuselage or causing an explosion of the fuel tanks. The quantities required were divided into the following two components:

- Q_1 – the quantity required to obtain a 1-minute control time in the PCA;
- Q_2 – the quantity required for continued control of the fire after the first minute or for complete extinguishment of the fire, or both.

Q_2 is a factor of Q_1 dependent on the following variables: the aircraft size, effectiveness of agent selected, time required to achieve PCA fire control and time required to maintain the controlled area fire free or to extinguish the fire.

There are two significant issues with the critical area concept and the quantity of extinguishing agents that are recommended. The first is the PCA is only two-thirds of the length of the aircraft, so if the fire does spread beyond this it is accepted there will not be enough water. The second is there is no allowance for additional water to fight any fire that may be in the interior of the aircraft.

NFPA, while supportive of the PCA, allow for more water on their vehicles for the purpose of Q_1 and Q_2 in their standards. This is based on the fact their calculations of Q_1 are based on the maximum length of an aircraft's fuselage within each category, while ICAO Q_1 is based on the average length within each category. As Q_2 is a factor of Q_1, this is also higher for NFPA compared to ICAO. Scheffey *et al*. (2012, p. 30) argue that "a margin of safety exists in the ICAO requirement only if the largest aircraft in any category is less than the midpoint of the category range."

In addition, the NFPA also make an allowance for extra water to be used in the case of an interior fire in an aircraft, an amount termed Q_3. The NFPA argue that information from recent incidents shows that water for interior fire-fighting operations, based on the need for handlines to be used, is also necessary (Scheffey *et al*., 2012). An amount of Q_3 has been included in NFPA 403 since the 1998 edition, yet is still not included in ICAO SARPs, the CASA MOS or the CAA CAP 168.

CASA and CAA follow the ICAO SARPs in amounts of fire fighting agents for Performance Levels A and B. The FAA regulations Title 14 CFR Part 139 require much lower amounts of extinguishing agent than both the ICAO and NFPA standards. Advisory Circular 150/5210-6D acknowledges the discrepancy between Part 139 and the NFPA 403, and while it references NFPA 403 in providing guidance in the quantity of extinguishing agent it notes that "Part 139 takes precedence and that NFPA 403 may, in some cases, exceed part 139 requirements" (FAA, 2004). The minimum quantities of water and the discharge rates for the various regulatory authorities are shown in Table 4.3.

Table 4.3 Minimum water quantities and discharge rates

CASA/ ICAO/ NFPA/ CAA category	**FAA Index**	**CASA/ICAO/ CAA**		**NFPA**			**FAA**	
		Water[a] (L)	Rate (L/min)	Water[a] (L)	Rate (L/min)	Water[b] (L)	Water[a] (L)	Rate[c] (L/min)
5	A	5400	3000	5700	3257	10450	380	
6	B	7900	4000	9400	4700	14150	5680	3785
7	C	12100	5300	13700	5983	18450	11355	4540
8	D	18200	7200	20000	7937	29450	15140	4540
9	E	24300	9000	26750	9907	36200	22710	4540
10	E	32300	11200	35100	12103	54000	22710	4540

Source: CASA, 2005; ICAO, 2018a; NFPA, 2018; CAA, 2019; Certification of Airports, 2004
Notes: a - Q_1 + Q_2 amounts
b - Total includes Q_3 amount, used by NFPA only
c - Maximum discharge rate for a range of water carried

4.6 ARFF staffing

CASA does not provide staffing numbers that need to be followed in the MOS, neither does the ICAO, the FAA or the CAA include these in their standards. The CASA MOS requires that during hours of operation and while any other aircraft movements that require use of a licensed aerodrome are occurring, sufficient trained personnel are to be detailed and readily available to staff the rescue and fire fighting vehicles and to operate the equipment at the discharge rates appropriate to the aerodrome category. In addition ASA Operational Procedure (ASA, 2017) provides minimum fire crew numbers necessary for the various aerodrome categories.

The ICAO recommends a Task Resource Analysis (TRA) be completed to determine the appropriate number of personnel to deliver an effective ARFF service to deal with an aircraft incident or accident (Recommendation 9.2.45). The TRA is a qualitative risk based approach, which includes a Workload Assessment that focuses on possible worst-case scenarios in order to identify the minimum number of trained personnel required to undertake the necessary tasks in real time before external services are able to attend the airport and provide assistance. The ICAO SARPs make specific note that if ARFF personnel are required to attend road traffic and structural incidents in addition to aircraft incidents, this must be taken into account when introducing appropriate procedures.

There are six phases to the TRA outlined in the Airport Services Manual (ICAO, 2015). This starts with an airport operator being clear as to the aims and objectives of the ARFF services and the tasks personnel must carry out. Next, a selection of representative realistic accidents that may occur at the airport are identified. Third, identification of the types of aircraft commonly in use at the airport is required. The fourth phase involves considering the probable location for the most realistic accident type that may occur, taking into account the location, environment, runway and taxiway, aircraft movements, infrastructure and boundary. Fifth is to combine the accident type with the aircraft identified and the location to build a complete accident scenario. Finally, a TRA facilitator with experienced airport supervisors and fire fighters, carry out the task and resource analysis using a series of simulations. The principal objective of the TRA is to identify in real time and in sequential order the minimum number of ARFF personnel required at any one time to carry out the requirements of the ARFF service.

The CAA require a TRA to be completed and the minimum level of staffing and supervisory levels resulting from the analysis should be detailed in the aerodrome manual. Their TRA allows for achieving the Principal Objective; safe and effective operation of all vehicles and equipment; continuous agent application at the appropriate rates; sufficient supervisory grades that can implement an Incident Command System; and the effective achievement of ARFF elements of the aerodrome emergency plan. The TRA process is outlined in an information paper CAP 1150 (CAA, 2014), and closely follows the ICAO method.

The NFPA standard is that staffing levels shall be established through a TRA based on the needs and demands of the airport. The TRA and Workload Assessment are used to examine the effectiveness of staffing levels and to analyse two levels of ARFF staffing, a minimum level and an optimum level. The NFPA also provide a minimum number of ARFF-trained personnel that are required to be readily available to respond to an incident, based on the minimum response times and extinguishing agent discharge rates and quantities required. The staffing levels determined by the TRA shall not be lower than the values specified in the NFPA standards, as in Table 4.4. Also in Table 4.4 are the minimum fire crew staffing for Australian airports for the different airport categories, as set out in the ASA Operations Manual.

In evidence to a Senate inquiry on the Performance of Airservices Australia (Commonwealth of Australia, 2018), the ASA Chief Fire Officer stated that TRA is not included in the Australian regulatory framework. Instead crew numbers are based on an out-of-date methodology rather than the TRA approach recommended by the ICAO, and as yet ASA has not performed a TRA at any location to determine crewing numbers (Commonwealth of Australia, 2019b).

Table 4.4 NFPA minimum staffing levels and ASA current staffing levels

Airport category	Minimum NFPA Personnel	Minimum ASA Personnel
5	6	1 + 2
6	9	1 + 4
7	9	2 + 4
8	12	2 + 6
9	15	2 + 8
10	15	3 + 11

Source: NFPA (2018), ASA (2017)

Each of the four largest airports in Australia, Sydney, Melbourne, Brisbane and Perth, have a Domestic Response Vehicle (DRV) attached to the stations. In the case of Brisbane and Perth, the three persons assigned to the DRV previously were included in the 14 staff required for Category 10 coverage in the Airservices Operations Manual. However, when the DRV was called out to respond to a job, for example a first aid call, the station was only able to cater for Category 9 coverage. This was the subject of a series of questions to ASA at a Senate Inquiry into the performance of Airservices Australia (Commonwealth of Australia, 2018), following incidences where this occurred in November at both Brisbane and Perth. At the time these two airports were supporting Category 10 coverage, yet had on a few occasions been reduced to Category 9 coverage when the DRV was called to an incident. Following a Senate hearing into the provision of rescue, fire fighting and emergency response at Australian airports in March 2019 (Commonwealth of Australia, 2019b), Brisbane and Perth airports were reclassified to Category 9 on the ASA website.

In the US there is a personnel requirement for fire fighters stipulated by the Occupational Safety and Health Administration (OHSA) policy 29 CFR 1910.134, known as the ‘two-in, two-out’ rule. This rule requires that for a fire in a confined space, a team of two fire fighters may enter the space as long as there is a safety team outside, consisting of at least another two fire fighters. This has been accepted procedure in the US and is included in NFPA 1710, a comprehensive organised approach to defining levels of service, deployment capabilities and staffing levels for fire departments (NFPA, 2016). Further, the National Institute of Standards and Technology (NIST) conducted a series of full-scale fire experiments to determine the impact of crew size, among other things, on fire fighter safety and effectiveness and found a quantitative basis for the use of four-person crews in low-hazard response, similar to that outlined in NFPA 1710 (Barowy *et al*., 2010).

The NFPA’s response strategy to ARFF operations is to not only respond to the fire and commence fire suppression, but also to aid in rescue operations. As an aircraft is a confined space, the ‘two-in, two-out’ rule is applicable to their standards. The US Department of Defense also uphold the ‘two-in, two-out’ rule for its ARFF personnel.

There is no mention of ‘two-in, two-out’ in CASA, CAA or ICAO documentation. Yet in Australia, CASR 139.710 Functions of ARFFS states:

> The functions of an ARFFS for an aerodrome are:
>
> a) to rescue persons and property from an aircraft that has crashed or caught fire during landing or take-off; and
> b) to control and extinguish, and to protect persons and property threatened by, a fire on the aerodrome, whether or not in an aircraft.

Hence, in the first case CASR’s response strategy is similar to that of the NFPA and so entry to an aircraft on fire is considered part of the core function of ARFF personnel. In the second of the functions, ARFF personnel are required to respond to structure fires and non-aircraft fires on the aerodrome, and thus may be required to enter structures and confined spaces.

Domestic Response Vehicles (DRVs) are utilised at the four largest Australian airports. These vehicles are generally the first to respond to non-aviation incidents on the airport, including alarms and emergency medical response calls, and also to structure fires, non-aircraft fires and fuel spillages. However, these vehicles are staffed by only three personnel. Hence, if the incident a DRV was responding to required entry to a structure (confined space), they would not be able to follow the ‘two-in, two-out’ principle until back-up arrived. Thus they would be putting themselves and the public using the airport facilities at greater risk.

4.7 Equipment

Along with the appropriate amount of extinguishing agent, the proper allocation of vehicles and appropriate crewing numbers, the equipment used by an ARFF service is important in allowing them to fully carry out their duty of responding to an aircraft incident. Among these are the handlines, monitors and turrets provided on ARFF vehicles. Monitors and turrets are specialised equipment required on ARFF vehicles as the speed with which the water is required to be discharged in an aircraft fire is too high for hand-held hoses. Hence, when urban brigades are suggested as substitutes for ARFF services, a minimum would be that they have this equipment. Further, specialised equipment such as high reach extendable turrets (HRETs) and low-level high performance monitors can give fire fighters greater control in their fire fighting activities.

HRETs, in particular, are important in allowing fire fighters to attack a fire from a high position and have been particularly successful in controlling internal fires to allow for safe rescue operations. HRETs are not required as part of the ICAO SARPs, but they are mentioned in the Airport Services Manual as providing fire fighters with greater flexibility in how they direct the foam stream. HRETs are defined as “a device, permanently mounted with a power-operated boom or booms, designed to supply a large-capacity, mobile, elevated water stream or other fire extinguishing agents, or both” (ICAO, 2015, p. 8-8). The advantage of these are that, as the turret is extendable, it places the nozzle in front of and below the operator, providing them with a clearer view of the application of the agent, and reducing the amount of foam overspray.

Further, HRETs may incorporate penetrating technology that allows the operator to deliver extinguishment agent through an adjustable nozzle in and around the aircraft and into the passenger compartment. They can also use skin-piercing nozzles to penetrate the fuselage. This allows operators to inject water while occupants are evacuating and/or fire fighters are entering. In addition, HRETs are able to facilitate fire attack on upper decks of multi-deck aircraft, such as the B747 and A380. This increases fire fighter safety as it reduces their need to rely on ladders to conduct interior fire suppression or rescue on these aircraft.

The NFPA makes an allowance for airports to specify HRET equipment in ARFF vehicles. The NFPA contends that use of a HRET has the greatest chance of success in rapidly cooling the interior cabin of an aircraft that is on fire in order to save non-ambulatory occupants (Scheffey *et al*., 2012). Kreckie (2011) argues that due to the diversity in age, health and physical condition of passenger demographics, there is a percentage of passengers on every flight who would be unable to evacuate an aircraft in an emergency without assistance. Scheffey *et al*. (2012) cite an evaluation of fire fighting technologies for improving occupant survivability in post-crash fires. The study looked at accidents over the past 25 years and concluded that the HRET had the potential to save approximately 12 lives per year worldwide (with a 90-percentile estimate range of 5 to 17 lives per year). Further, the authors cite a study on indirect interior fire fighting where it was found that in 15 of 84 accidents, a HRET could have been used to save lives, with an estimate of 371 potential lives saved (200 of these were in the one accident). The main advantage found of the HRET was the pace with which it can be implemented, above that of a manned fire attack. Scheffey *et al*. (2012) also cite a study that identified limitations in the use of HRET technology, such as not being able to be used on the section of fuselage obstructed by the wing; it may fix an ARFF vehicle to a position potentially filled with fuel; and it raises the centre of gravity of the ARFF vehicle increasing the potential for rollover. The authors also argue the use of the technology should be pre-planned and trained.

The FAA also makes allowance for airports to specify the provision of HRET equipment in ARFF vehicles. The FAA has conducted its own testing of the HRET technology. In one such test they found the HRET extinguished the burn area on average 53 per cent faster than a roof-mounted turret, under the same conditions. The FAA (2010) lists a range of advantages of the use of the HRET, but also recommend hands-on training and practical experience so as to understand its capabilities and limitations.

The CAA also recommend the use of HRETs and recommend simulation training should include specialist equipment such as HRETs. Further, operation of water pumps, monitors and HRETs comprise a standard Unit in the framework for competency of ARFF personnel (CAA, 2017).

Australian ARFF vehicles are not equipped with HRET technology. This is despite the almost universal acceptance of their superiority in controlling post-crash fires and the fact the technology is not new and has been in use for decades. By 2008, 650 ARFF vehicles around the world had been fitted with HRET technology (Rosenkrans, 2008).

4.8 Response times

Having required response times assists airports and ARFF services in planning the number and locations of fire stations required at an airport. Response times are measured from the time of the initial call to the ARFF service, to the time the first responding vehicle(s) is in a position to apply foam at a rate of at least 50 per cent of the discharge rate specified for the category of airport.

The CASA MOS outlines the operational directive of the ARFF service must be to achieve response times no more than three minutes to the end of each runway in optimum conditions. However, the operational objective is for the ARFF service to achieve a two minute response time to the end of each runway and a three minute response time to any part of the movement area. This aligns with the ICAO SARPs, where the standard is three minutes to any point of each operational runway, and the recommendation is two minutes; while it is three minutes to any other part of the movement area. Optimum conditions include good visibility, daytime, no precipitation and normal route being free of surface contamination. In less than optimum conditions the ICAO recommendation is to meet the operational objective as nearly as possible.

CASA also stipulates other vehicles required to deliver the amount of extinguishing agent must arrive so as to provide continuous agent application at the required rate. ICAO, on the other hand, say that these follow-up vehicles must arrive no more than four minutes after the initial call, with a recommendation of three minutes.

Interestingly, NFPA is slightly more relaxed with its response times than the ICAO SARPS. The 2014 edition of NFPA 403 increased the required response time of the first-arriving ARFF vehicle to reach any point on the operational runway and begin agent application from two minutes to three minutes. Further, the response time of the first-arriving ARFF vehicle to any part of the movement area is four minutes, as it is to reach any passenger boarding areas. Secondary vehicles must arrive such that Q_2 is able to be applied 30 seconds after Q_1 has started being applied and Q_3 after a further three and a half minutes.

The FAA's requirements are slightly different again. The response time is 3 minutes from the time of the alarm to the time the first ARFF vehicle reaches the midpoint of the farthest runway from its assigned post, or any other point of comparable distance, and begin application of extinguishing agent. All other vehicles must reach the same point within four minutes.

The CAA's response time requirements are identical to that stipulated by CASA. That is, the standard is three minutes to any point of each operational runway, but the recommendation is two minutes, in optimum visibility and surface conditions. The standard response time is three minutes to any other part of the movement area. CAA also stipulates that other vehicles required to deliver amounts of extinguishing agents should arrive no more than one minute after the first responding vehicle so as to be able to provide continuous agent application.

Section 5 Australia's compliance with ICAO standards

5.1 ICAO Standards and Recommended Practices (SARPs)

This section deals specifically with Australia's adherence to the ICAO SARPs and compares with other countries.

International standards and recommendations for aerodromes is set out in Annex 14 to the Convention on International Civil Aviation (Chicago Convention), published by the ICAO. The eighth edition of the publication came into force in July 2018, superseding all previous editions in November of that year. The document sets out Standards and Recommended Practices (SARPs) for countries and aerodrome operators. International Standards are such that their "uniform application … is recognised as necessary for the safety or regularity of international air navigation and to which Contracting States will conform in accordance with the Convention" (ICAO, 2018a, p. xiii-xiv). If member states do not comply with a Standard, notification to the ICAO is compulsory under Article 38. Recommended practices are such that their "uniform application … is recognised as desirable in the interest of safety, regularity or efficiency of international air navigation, and to which Contracting States will endeavour to conform in accordance with the Convention" (ICAO, 2018a, p. xiv).

SARPs for Aerodromes were first adopted by the ICAO on 29 May 1951. The SARPs were based on recommendations of the Aerodromes, Air Routes and Ground Aids Division, and have been the subject of subsequent amendments, which have been adopted by the ICAO in the years since. The development and effective implementation of SARPs is overseen by the Air Navigation Commission (ANC), who have established panels of experts in various disciplines. The process involves all member states being able to make proposals and to indicate approval/disapproval of suggested amendments.

The SARPs concerned with ARFF services are contained in section 9.2 of Annex 14. In addition ICAO Document 9137-AN/898 Airport Services Manual, Part 1, Rescue and Fire Fighting, provides material to assist States in the implementation of the specifications in Annex 14 and thereby help to ensure their uniform application. The basic standard (9.2.1) is that rescue and fire fighting equipment and services shall be provided at an aerodrome.

As we saw in the previous section there are a range of SARPs outlined by the ICAO that Member States must attempt to conform to, or make a notification of difference. These include the level of protection to be provided at airports, which shall be appropriate to the aerodrome category determined by the length of the largest aeroplane to use the aerodrome; the amount and discharge rate of water for foam production and complementary agents on fire fighting vehicles; and the minimum number of rescue and fire fighting vehicles for each aerodrome category. In addition there are standards governing response times, which influences the location of the fire stations.

There are further SARPs relating to a range of other aspects of ARFF. There is a recommendation of rescue equipment provided on rescue and fire fighting vehicles. There are recommendations on the provision of emergency access roads and their usage. It is recommended rescue and fire fighting vehicles be housed in a fire station. A discrete communication system should be provided for the ARFF service to link to the control tower. There are standards on the training of personnel and the provision of protective clothing and equipment, and recommendations on how to deploy trained personnel.

5.2 ICAO Universal Safety Oversight Audit Programme (USOAP)

The ICAO monitors how countries comply with their SARPs through their Universal Safety Oversight Audit Programme (USOAP). This was initiated in 1999 to improve aviation safety oversight around the world. It began as a Comprehensive Systems Approach (CSA), where countries would undergo regular audits, but has now evolved to a Continuous Monitoring Approach (CMA), where the focus is on a systematic, ongoing process of gathering safety information, which is then disseminated to other Member States.

The ICAO produces a data table listing each Member State and their compliance level with the ICAO SARPs. The table shows an overall Effective Implementation (EI) score, as well as the year of the audit, and a breakdown into Area and Critical Element. The different areas that go towards the overall EI are:

- Primary aviation legislation and specific operating regulations (LEG)
- Civil aviation organisation (ORG)
- Personnel licensing and training (PEL)
- Aircraft operations (OPS)
- Airworthiness of aircraft (AIR)
- Aircraft accident and incident investigation (AIG)
- Air navigation services (ANS)
- Aerodromes and ground aids (AGA)

ARFF is only a small part of the overall evaluation of how a country complies with the ICAO SARPs, and is included in the Aerodromes and Ground Aids (AGA) area.

5.3 Australia's participation in ICAO USAOP

Australia received an audit from the ICAO in 2008, under the old system, at which time it received an Effective Implementation (EI) score of 82.63 per cent. At this time Australia filed a difference with the ICAO to reflect their regulatory system varied from the SARPs. This resulted in Australia providing a corrective action plan to address the Findings and Recommendation (F&Rs), where Australia committed to considering the issue as part of a review (ICAO, 2009).

Australia agreed to a second safety oversight audit in 2012, which was carried out in 2017. As part of this, Australia participated in an ICAO Coordinated Validation Mission (ICVM). The ICVM is one of the activities prescribed under the CMA framework. This involved a team of experts visiting Australia and working with Australian regulators and operators to measure and improve compliance with ICAO Standards. Much of the work was on improving Australia's response to USOAP F&Rs from previous audits.

Prior to the ICVM, an off-site validation activity was performed in 2016, at which time Australia's overall Effective Implementation (EI) was 85.27 per cent. This would place Australia 48th out of Member States, on today's rankings. Prior to the ICVM in 2017, Australia had received 125 Protocol Questions (PQs), indicating those areas that were not satisfactory. By the time of the visit, Australia had successfully addressed 83 of those PQs. This resulted in Australia increasing its EI score at the ICVM to 94.98 per cent (ICAO, 2018b). This is a relatively high score, placing Australia eighth in the ICAO for overall effective implementation of ICAO SARPs. While this is a reasonable achievement, it does mean however, that Australia does not cmply with ICAO SARPs in all areas of its civil aviation program. And this is true specifically for ARFF provision, despite achieving a score of 95.71 per cent for the AGA area, where Australia's ranking drops to tenth.

In the ICVM final report, there are a list of 26 actions set out that are listed as 'High Priorities' meant to assist the Member State in prioritising its remedial actions. With regard to ARFF, there is a very general action listed:

> Ensure full implementation of Annex 14, Volume I requirements for the provision of rescue and firefighting (RFF) services at aerodromes, which take into account the aerodrome location and the surrounding terrain (ICAO, 2018b, p. 1-3).

As mentioned previously, Australia has 195 certified airports, but only has ARFF services at 28 of those airports.

ICAO requires that where a Member State's regulations and practices vary from a Standard outlined in the Annex, notification of these differences must be made. Australia publishes all differences in GEN 1.7 of the national Aeronautical Information Publication (AIP). In the current version of this publication published in April 2018, there are 462 differences listed for Annex 14 Volume 1 (ASA, 2018b). For each difference, the Annex Reference is listed, the corresponding State Reference, the Difference Level and a description of what the difference is. There are 3 levels of difference:

- Less protective or partially implemented / not implemented;
- Different in character or other means of compliance; and
- More exacting or exceeds.

The majority of the differences listed are less protective in the Australian context compared to the Annex reference.

Including the fact that Australia does not provide ARFF at all airports, there are 19 differences with regard to the provision of ARFF at aerodromes. Nine of these are less protective or partially implemented / not implemented with regard to the ICAO SARPs, eight are different in character or other means of compliance to the ICAO SARPs, and two are more exacting or exceed the ICAO SARPs. While some differences are due to definition variances, some differences are a result of the Australian standard being one category below the ICAO recommendation. See Table 5.1 for a list of all differences where Australia's standard is less protective or partially implemented / not implemented.

Table 5.1 Differences between CASA MOS and ICAO SARPs

Annex Ref	MOS Ref	Description of difference
9.2.1	CASR 139.H MOS Part 139H	Rescue and fire fighting services to Annex standards is not provided at all alternate international aerodromes. ARFFS are currently not located at the international alternates of Learmonth, Lord Howe Island, Newcastle, Kalgoorlie, Tindal, Horn Island, Christmas Island, and Cocos (Keeling) Island.
9.2.11	MOS Part 139H 2.1.3.1, Chaps 3 & 7	Legislation does not include minimum usable amounts of extinguishing agent for foam meeting performance level C, nor list the discharge rate for dry chemical powders, as listed in ICAO Annex 14 Vol 1 Table 9-2
9.2.12	MOS 139H Chap 7.1.1.1, 2.1.3.1, 3.1.2	Australian legislation permits the minimum amounts of water and foam to be one category below the largest aircraft using the aerodrome where the number of movements of the largest aircraft fall below 700 in the busiest consecutive 3 month period of the preceding 12 months
9.2.13	MOS PART 139H Chap 2.1.3.1, 3.1.2, 7.1.1.1	Australian legislation permits the minimum amounts of water and foam to be one category below the largest aircraft using the aerodrome where the number of movements of the largest aircraft fall below 700 in the busiest consecutive 3 month period of the preceding 12 months.
9.2.18	MOS Part 139H Chap 7	Australian legislation does not prescribe Foam meeting performance level C. Complimentary agents refers to Aerodrome Cat 1 45kgDCP, Cat 2 90kgDCP
9.2.19	MOS Part 139H Chap 7	Australian legislation does not specifically describe this requirement> Aust legislation refers to DOC 9137 Part 1 which refers to ISO 7202
9.2.35	MOS Part 139H Chap 6.1.3	Legislation only prescribes that roads support ARFFS vehicles and be useable in all weather conditions
9.2.36	MOS Part 139 Chap 9.1, 9.19.3 MOS 139H Chap 6, 22 26	Australian legislation does not specifically describe this ICAO recommendation. Australia does not legislate edge markers for access roads but refers to local state requirements regarding roads
9.2.45	MOS Part 139H Chap 20.1.2	Legislation does not specifically identify that a task resource analysis should be completed to determine staffing numbers

Source: ASA (2018b)

5.4 ICAO USAOP implementation by Member States

Australia is not unique in having in its national standards many variations from the ICAO SARPs. In fact no country has an overall effective implementation of 100 per cent, which implies no country is fully compliant with the ICAO SARPs. The United Arab Emirates has the highest EI score of 98.9 per cent. See Table 5.2 for a list of the 20 ICAO member states with the highest overall EI and their scores under each Area. With regard to the Aerodromes and ground aids area (AGA), which covers ARFF, Australia ranks 10th.

Table 5.2 USOAP Effective Implementation by Member States

Country	Overall	Year	LEG	ORG	PEL	OPS	AIR	AIG	ANS	AGA
UAE	98.9	2015	100	100	100	100	99.1	100	97.6	97.8
Singapore	98.6	2010	100	100	96.3	100	98.1	98.9	98.2	99.3
South Korea	98.5	2008	100	100	97.6	100	98.0	96.6	98.8	98.6
France	96	2017	100	100	100	98.3	100	96.7	86.9	96.6
Brazil	95.1	2018	95.2	100	96.3	97.5	97.7	93.3	97.0	87.6
Canada	95.1	2005	90.9	100	97.6	89.4	96.7	91.0	95.2	98.7
Ireland	95.1	2016	91.3	100	100	97.6	99.3	100	93.5	84.7
Australia	95.0	2017	80.9	100	97.5	88.9	93.2	97	99.4	96.3
Chile	94.7	2017	100	100	100	100	97.7	92.1	92.3	87.9
Nicaragua	94.6	2017	100	100	93.9	93.4	91.4	92.1	98.2	94.2
UK	93.7	2009	95.5	83.3	94.9	86.7	97.0	82.9	96.4	98.7
Venezuela	93.5	2013	95.2	100	97.6	96.5	96.2	87.6	97.6	84.9
Finland	93.3	2018	100	100	94.9	93.4	98.4	91.1	90.5	91.3
Austria	92.6	2015	90.9	81.8	100	94.1	100	68.9	100	87.0
Romania	92.2	2017	95.5	90.9	100	97.5	91.7	71.1	92.2	96.6
USA	92.2	2007	81.8	100	93.5	94.3	96.9	81.3	86.7	97.3
Dominican Republic	91.3	2017	85.7	100	95.2	80.2	98.1	94.4	94.6	87.8
Switzerland	91.0	2015	87.0	100	100	94.3	93.0	97.7	79.0	89.9
Norway	90.8	2018	77.3	81.8	98.8	86.3	99.3	95.9	77.5	96.7
Sweden	90.3	2016	95.5	100	98.7	96.7	91.2	76.1	82.7	95.4

Source: ICAO website. Accessed 12 March 2019: https://www.icao.int/safety/iStars/Pages/API-Data-Service.aspx

All countries are required to notify of differences between their standard and the ICAO SARPs. Most countries do this in an aeronautical information publication, as part of GEN 1.7. As noted in Section 3.6 there appears great variation in how thorough countries are in their notification of differences. Hence it is difficult to determine if Australia is unique in having such a large number of differences compared to other countries due to its great variance from the ICAO SARPs, or whether Australia approaches the notification process transparently and openly and details its differences in this manner.

Section 6 The cost of provision of ARFF in Australia

6.1 Introduction

Airservices Australia (ASA) is a government owned corporation, established by the Air Services Act 1995. It is designated as a corporate Government entity. ASA have many functions as outlined in the Air Services Act, including providing facilities for safe navigation of aircraft, promoting and fostering civil aviation in Australia, and providing air traffic and aviation rescue and fire fighting services.

ASA is funded through levies they place on their customers, specifically the airlines who use the airports where their services are utilised. They charge levies for each of their three main services:

- Enroute services;
- Terminal navigation (TN) services; and
- Aviation rescue and fire fighting (ARFF) services.

Prices for all three services are based on Maximum Take-Off-Weight (MTOW), measured in tonnes. Further, different prices are charged depending on the airport being used and, in the case of ARFF, the category of the aircraft. Previously, as ASA provides a suite of services, there has been a level of cross-subsidy from other service lines towards ARFF services. In the 2016 pricing proposal, this was to be phased out (ASA, 2015).

The prices charged by ASA for ARFF services must be approved by the Australian Competition and Consumer Commission (ACCC), following a pricing proposal put forward by ASA. The pricing proposal sets out the prices for the next five years and is called a Long Term Pricing Agreement (LTPA). Despite a pricing discussion paper and proposal being published in 2016, it was not implemented at the time, and prices remain as they were in 2015, at the end of the previous LTPA (ASA, 2018a).

The charging of fees for ARFF services has been a question of contention for many years. The dispute lies in the approach to charging, and whether all airlines pay a network fee, or a location specific and/or category based price is paid, dependent on the airport being used and the type of aircraft. The idea of a network price allows for cross-subsidy so the whole system is supported on a needs basis. In this way the costs of the system are borne equally by all locations. The location specific argument is based on the idea of 'user pays', where the price at a particular location would be determined by the cost base at the location so as to be cost recoverable. Under location specific pricing, large airports can cover costs much easier and therefore airlines using those airports are charged much lower costs than those at smaller, regional airports, to the point the charges at smaller airports put flight prices out of reach of customers. The current arrangements incorporate both elements of network charges and location specific/category based charges.

Unsurprisingly, different stakeholders have differing views on the way ASA should charge for ARFF services. Large international airlines lobby against the network price system as they subsidise small, regional airlines, arguing that network pricing distorts the economic efficiency of the system and advocate for a user pays system (for example, BARA, 2015). Conversely, small airlines, regional airports and their representatives argue that safety is a need that should not be based on location and that location specific pricing will jeopardise vital air services to regional communities and potentially leave stranded assets (for example, Rex, 2015; RAAA, 2015).

In the early 1990s the General Aviation (GA) community successfully lobbied for the withdrawal of ARFF services from GA capital city secondary airports, citing their costs as prohibitive. As we will see in the next section general aviation have had and continue to have much higher accident rates than the large aircraft that use the major city airports which are serviced with ARFF. Yet, large movements of smaller, evidentially less safe aircraft are not covered by rescue and fire services. In 2017-18, two of the top three and five of the top ten airports in the country for aircraft movements were airports that primarily catered for General Aviation flights, Moorabbin, Bankstown, Jandakot, Parafield and Archerfield, as shown in Table 6.1. As such, over 1.1 million aircraft movements in the year, more than three thousand per day just at those five airports, were not covered by ARFF services.

Table 6.1 Aircraft movements at top ten Australian airports, 2017-18

Airport	Over 7 tonnes	Under 7 tonnes	Helicopter	Unknown weight	Military	Total
Sydney	324,578	6,968	17,412	4	914	349,876
Moorabbin	140	210,780	38,090	33,934	12	282,956
Bankstown	1,638	201,610	40,940	16,618	110	260,916
Melbourne	243,724	648	0	2	242	244,616
Brisbane	200,180	11,650	1,440	10	762	214,042
Jandakot	778	181,576	24,664	1,694	66	208,778
Parafield	180	192,924	10,704	30	14	203,852
Archerfield	146	107,712	76,874	932	126	185,790
Perth	127,646	2,446	56	24	196	130,368
Cairns	51,522	40,954	22,932	34	824	116,266

Source: ASA Movements at Australian Airports, accessed 26 March 2019:
http://www.airservicesaustralia.com/publications/reports-and-statistics/movements-at-australian-airports/

In the late 1990s, the ASA adopted location specific pricing for ARFF services following a review of the economic efficiency of their charges. This delivered cost reductions to airlines operating to and from the major capital city airports and was done to encourage capital investment with the view to have the services privatised. Following encouragement from the ACCC, ASA implemented a hybrid system in the first part of the 2000s, which is still the basis of ASA charges for ARFF services today (ASA, 2008).

The move to a hybrid pricing scheme came around the same time as the House of Representatives Standing Committee on Transport and Regional Services report into regional aviation. Recognising the importance of tourism and the right to safety of regional airports, the report looked into the provision of ARFF services at regional airports. The Committee considered that aviation rescue and fire fighting services should be a right of all Australians and that location specific pricing was not a fair system as it put a different price on safety depending on location, rather than need. Further, they recommended that:

> the Department of Transport and Regional Services and Airservices Australia introduce a universal service charge for aviation rescue and fire fighting services at regional airports to reduce the wide disparity in the charges for those services and to reduce the overall impact of the charges on regional aviation costs (Recommendation 17, Standing Committee on Transport and Regional Services, 2003).

The response from the Government centred on their concerns to ensure cost pressures on the aviation industry were minimised. However, they appeared to support the recently introduced pricing structure that had introduced an element of cross-subsidisation as it had lowered charges at regional airports.

Indeed, while economic rationalism and cost recovery are hallmarks of the neoliberal era, the fact remains that many services are subsidised all throughout the country due to the inability of regions to afford them. Among these are essential services, of which ARFF could be considered one. In this regard the stakeholders of ARFF services are not simply the passengers and crew who fly into and out of airports around the nation, but include all Australians through the imputed benefits we receive from having a safe airline industry supported by world class ARFF services at airports. Not only does this increase our own safety when we travel to smaller regional airports, it increases the international reputation of Australia, increases the confidence in the airline industry and hence contributes to our tourism sector, a large contributor to our national income. Further, the nation benefits from having skilled and equipped emergency response capacity positioned at airports around the country, to assist in special circumstances and in times of national emergency, such as bushfires, floods and the like.

6.2 Current pricing structure

The current long term pricing agreement (LTPA) came into effect in 2011. This agreement notionally expired on 30 June 2016, yet the arrangements established in the 2011 LTPA remain in place. The LTPA usually lasts for five years, but it is not known when the next one will come into force. The LTPA must be endorsed by the ACCC, and is allowed to recover all reasonably incurred costs (including a return on capital employed) relating to the delivery of services. To that end ASA achieved a return of 11.1 per cent for the 2017-18 financial year, with a net profit after tax (NPAT) of $74.5 million, following a return of 5.9 per cent for 2016-17 with NPAT of $59 million (ASA, 2018a).

The current pricing structure uses a hybrid model, consisting of:

- A base level service network charge, which is the same charge for all Category 6 aircraft and below at all locations; and
- A higher level location and category specific charge to reflect the additional investment and operating cost driven by higher category aircraft.

Hence, all Category 6 aircraft and below are charged the same rate regardless of which of the 26 airports across the country with ARFF services they are landing at. This cross subsidy was estimated at $31 million, when the LTPA came into effect in 2011. Aircraft above this size are charged according to both the size of aircraft and the location it is landing at, as per Table 6.2.

The charging formula is the rate specified in Table 6.2 multiplied by the Deemed MTOW. MTOW is Maximum Take-Off Weight which is pre-determined for the type of aircraft.

Hence, the difference in landing charges can be stark depending on the airport the aircraft is landing at. For example, an Airbus A380 aircraft, with a MTOW of the maximum 500 tonne, landing at Perth airport is charged $4,185, while at Sydney airport it is charged $1,835. Assuming this charge is entirely passed on to the possible 525 passengers on the aircraft (in a standard seating configuration), passengers flying to Perth pay $7.97 for ARFF services, while passengers to Sydney only pay $3.50.

Table 6.2 ASA ARFF landing fee schedule effective 1 April 2017

	Aircraft Categories			
ARFF Location	**6 (and below) $/tonne**	**7 $/tonne**	**8 $/tonne**	**9 (and above) $/tonne**
Adelaide	2.32	3.26	5.27	5.27
Alice Springs	2.32	2.32	2.32	2.32
Avalon	2.32	2.32	2.32	2.32
Ayers Rock	2.32	2.32	2.32	2.32
Ballina	2.32	2.32	2.32	2.32
Brisbane	2.32	2.57	3.41	6.09
Broome	2.32	2.32	2.32	2.32
Cairns	2.32	3.69	7.67	7.67
Canberra	2.32	9.08	9.08	9.08
Coffs Harbour	2.32	2.32	2.32	2.32
Darwin	2.32	5.46	21.75	21.75
Gladstone	2.32	2.32	2.32	2.32
Gold Coast	2.32	3.79	6.46	6.46
Hamilton Island	2.32	2.32	2.32	2.32
Hobart	2.32	10.00	10.00	10.00
Karratha	2.32	8.37	8.37	8.37
Launceston	2.32	2.32	2.32	2.32
Mackay	2.32	2.32	2.32	2.32
Melbourne	2.32	2.52	3.01	4.99
Newman	2.32	2.32	2.32	2.32
Perth	2.32	2.81	4.85	8.37
Port Hedland	2.32	2.32	2.32	2.32
Rockhampton	2.32	2.32	2.32	2.32
Sunshine Coast	2.32	2.32	2.32	2.32
Sydney	2.32	2.48	2.64	3.67
Townsville	2.32	13.64	13.64	13.64

Source: ASA (2016)

ASA published an Options for Charging paper in 2005 where they put forward the pricing process and methodology options for how they would structure their charging model (ASA, 2005). As part of this, they reviewed charging arrangements for ARFF services in similar countries. They found that Australia was unique in its model of having a Commonwealth entity responsible for provision of ARFF services with costs directly recovered from airlines as a specific charge. In the US, ARFF is provided through various State Fire Municipalities, private airport owners and some contracts. Costs are recovered through a mixture of airfield charges, including a landing fee and government funding. The FAA funds a portion of training, research and development and vehicle costs, through a Passenger Facility Charge (PFC). In Canada and the UK, airports are responsible for providing ARFF and usually include a charge for ARFF as part of its landing or parking fees. Government assists with funding for regional airports. In New Zealand, airports provide and charge for the ARFF service, usually through landing fees where the ARFF component is not made explicit.

6.3 Cost to Australia of providing ARFF services

In the pricing proposal that governed the 2011 LTPA, ASA made the point that charges for ARFF services needed to be increased proportionally more than charges for Enroute or TN services, due to their shortfall at the time in recovering their service-specific costs. This was due to the price freeze that had occurred in the years earlier, during which time new ARFF services were introduced at airports that had exceeded the threshold passenger numbers. Hence, the LTPA set up in 2011 allowed for proportionally greater increases in ARFF fees, but ASA contended this would see little impact on activity as ARFF charges were the smallest component of end-user charges.

At the time, in 2011-12, the average building block costs at category 6 airports was $3.6 million annually. ASA employs the ACCC's building block pricing model, where building block costs are calculated for each airport, with allocated overheads separated out, based on the incremental costs of the higher category ARFF services compared to Category 6 as outlined by ASA (ASA, 2011). BARA (2016) contend that based on cost data provided by ASA, a Category 6 airport required $5.5 million in revenue in 2016. Assuming that information is correct, the estimated total costs of providing ARFF across Australia in 2015-16 are shown in Table 6.3.

Table 6.3 Estimated cost of providing ARFF at airports across Australia, 2015-16

Airport category	Average Cost ($m)	Number of airports	Total ($m)
6	5.5	10	55.0
7	7.3	7	51.1
8	10.0	4	40.0
9/10	18.3	5	91.5
Total		26	237.6

Source: BARA, 2016; ASA, 2011; author's calculations

The ACCC's building block model takes into account efficient cost components required to provide a service. From this ASA calculate a maximum allowable revenue (MAR), which is calculated as the sum of operating expenditure, depreciation, return on capital and an allowance for tax. Hence, the costs in Table 6.3 above are inflated in terms of simply the yearly operating cost to provide ARFF services.

6.4 Willingness to pay for ARFF services

According to the 2015-16 passenger numbers (BITRE, 2019), there were 72,804,198 passengers who touched down at one of the 26 airports that currently have ARFF services. If a standard network fee was charged to cover the costs of the current ARFF services across Australia, based on the maximum allowable revenue for 2015-16 calculated in Table 6.3, each passenger would be charged $3.26. This would cover the costs of the 26 existing ARFF services. That cost would increase when new services were introduced at airports without existing ARFF services to cover the extra operating costs. There would also be set-up costs for these new services. A charge such as this would be similar to a Passenger Facility Charge (PFC) that exists in the US. The US PFC is a charge of up to $4.50 added to each passenger's flight which is used by airports to fund projects that enhance safety, security, or capacity; reduce noise; or increase air carrier competition.

Two aspects that are closely related, as explored in section 7, are the effect on demand for air travel of price and safety. There is a wealth of literature of people's willingness to pay to reduce possible risks. In 2014 the Department of the Prime Minister and Cabinet published a Best Practice Regulation Note on the value of a statistical life. The publication stated that willingness to pay is the appropriate way to estimate the value of reductions in the risk of physical harm. The note was designed to provide guidance on cost-benefit analyses and how to treat the benefits of regulations designed to reduce the risk of physical harm. The value of statistical life is an estimate of the financial value that society would place on reducing the average number of deaths by one. Further, the value of statistical life year estimates the value society places on reducing the risk of premature death. In 2014 dollars the estimate of the value of a statistical life was $4.2 million, with the value of statistical life year being $182,000.

The willing to pay literature includes reducing risks in everyday accidents, in health outcomes, in pollution effects, and in risks from different modes of transport. Specific literature on air transport includes a study by Carlsson *et al*. (2004) who find that people are willing to pay more than two times as much to reduce the risk of flying as they would to reduce the risk of travelling by taxi (given the same baseline cost). Similarly, Koo *et al*. (2015) surveyed a cohort of young people, generally a less risk averse group, and found they would include safety along with price as the two most important factors when considering airline choice. Savage (2011) claims that airlines that operate smaller aircraft have to charge less than airlines who operate larger aircraft on the same route, due to the perception of travellers that smaller aircraft are less safe than larger aircraft.

Savage (2011) also argues that the market failure of not providing people with adequate information on safety distorts people's choices about flying. This idea is prevalent in Braithwaite (2001) who attempts to refute the claim of an aviation consultant that a supposed public belief that there are ARFF services at most airports around Australia is irrelevant because people do not care when aviation is so safe. In a survey of randomly selected Sydneysiders, Braithwaite asked how many of the 106 licensed airports around Australia did the survey respondents think had ARFF. With a choice of 6 answers, 6 per cent got it right, 2.7 per cent said a lower number, and over 91 per cent overestimated the number of ARFF services around the country, including 32.4 per cent (the highest response) who thought it was at all airports.

He then asked respondents how much *extra* they would be willing to pay to ensure ARFF services would be at the airports where they took off and landed. Almost 85 per cent were willing to pay something extra, with almost 40 per cent (the highest response) willing to pay whatever is necessary.

To increase the safety of air transport at airports around the country, in the present environment of cost recovery, would require airlines to charge their passengers more per flight. A recent report into the impact an increase in airport charges would have on demand for air travel found that there are generally low price elasticities (InterVistas, 2018). The report concentrated specifically on an increase in airport charges, despite the authors conceding the all-in fare is the basis on which passengers make their travel decision. Airport charges in Australia excludes

ARFF charges, as that is included in the base fare that airlines charge, despite the fact airlines include it with airport charges when reporting their expenditure sources. Airport charges account for, on average, 8 per cent of the domestic Australia all-in airfare, 7 per cent of the average trans-Tasman airfare and 7 per cent on international services. ARFF and navigation services, which are considered together in the report, account for considerably less than this. Nonetheless, the report concludes a 5% increase in airport charges would lead to a traffic decline of only 0.6%; and a 10% increase in airport charges would lead to a decline of traffic of about 1.2%. Indeed, if it were outlined in flight charges that the extra amount was for ARFF services to be ready at both airports the traveller is using, the willingness-to-pay of travellers for greater safety may actually result in a smaller decrease in traffic.

In relation to any price variation on account of a change in how ARFF services are charged, it is likely the change in fares would be different at each airport (given the current pricing scheme). Hence, it would be difficult to predict the overall effect on demand of a rise in ARFF charges. Nonetheless, two points can be made. First, InterVistas (2018) argue there was no discernible impact on demand for air travel when airport charges increased in 2002 around the time of the Productivity Commission's review. Second, ASA (2011) argue that services provided at the four largest airports in Australia, being Sydney, Melbourne, Brisbane and Perth, are likely to be very price inelastic, due to their positions as major hubs and core attractors, and the lack of close substitutes. This situation has not changed in the time since. Hence, airlines which use these airports and are charged relatively low ARFF charges by ASA, may indeed see little change in demand given a small price increase to fund a network price on ARFF services.

Section 7 Effect on tourism of aviation accident

7.1 Tourism and air travel

Tourism and air travel are inexorably linked, and are becoming increasingly so. This is especially the case for international tourism, as recognised by countries revising their international aviation policies to make air travel less restrictive in order to encourage greater tourism. However, it is also the case in Australia that domestic tourism is strongly linked to air travel due to the sparse nature of the country and the ease and flexibility of travel, particularly between large cities, due to the advent of low cost carriers.

The relationship between tourism and air travel has been increasingly close in recent years due to advances in aircraft technology and improvements in communications and information technology. This, along with the liberalisation of aviation policy in many countries, has led to the improvement in quality of air travel and the reduction in the price of air tickets (Forsyth, 2008). Tourist destinations are often determined by their natural resources, for example the quality of beaches, or the local culture and infrastructure, for example entertainment venues. These are often interlinked where the natural resources or culture of a place lead to infrastructure being built to stimulate demand from tourists. The air transport service afforded a tourist destination will have a large impact on its tourist numbers. The timing and frequency of flights, as well as the cost, can influence the amount of tourists arriving. Further, the design and capacity of the airports and airport infrastructure at a location can determine the type of aircraft accommodated as well as the service provided once a tourist is on the ground, particularly in terms of transfer to their destination.

Debbage and Alkaabi (2008) contend that the development of the jet engine in aircrafts triggered the mass tourism in places like Florida, Greece, Hawaii and Spain. Further, they argue that the ability of airline operators to utilise market power and economies of scale has actually shaped consumer demand and accessibility levels of tourist destinations, both large and small. Williams and Balaz (2009) go further saying the advent of low cost carriers has redrawn the map of accessibility and travel costs across Europe. They say that this phenomenon has affected the flow of migrant labour, business connectivity, investment and knowledge, as well as the success of places as tourist destinations. They argue the short term winners were the metropolitan regions with hub airports, but the longer term winners were the non-metropolitan regions which became bases for point-to-point connections. Similarly, Bieger and Wittmer (2006) argue that the evolution of air transport has actually introduced new forms of tourism. They say the ease and low cost of connections between some places has led to short-stay city tourism. This involves people having short stays in another city, including residential/second home visitors, short-stay tourists for leisure and tourists visiting friends and relatives. They say that in well-developed travel markets air transport is the main travel mode for overnight stays of more than four nights. They also argue the structure of tourism, in terms of destinations or nature of travels, has been influenced by air transport development, particularly the proliferation of low cost carriers, which has improved the air services at cities that had previously been overlooked. Galambos *et al*. (2014) claim that 51 per cent of all international tourists travel by air transport. This is of course much higher in Australia, due to the location and island nature of the country, as well as its sparseness.

In Australia air transport is interlinked with both international and domestic tourism. Being an island country, visitors to Australia must come by either air travel or over the sea. Domestically, over 57 per cent of people travelling interstate in Australia travel by air transport. As such, aviation is a strategic priority for Tourism Australia in achieving their Tourism 2020 targets, in building the resilience and competitiveness of the tourism industry in Australia, and to grow its economic contribution. These plans include communicating with the public about regional airports and their accessibility, to encourage airlines to utilise regional airports and to capitalise on aviation opportunities. A key target of Tourism 2020 was increasing international and domestic aviation capacity to transport greater tourist numbers.

Away from the major cities the use, availability and affordability of air travel is a contentious issue. An inquiry into regional aviation services was held in the New South Wales parliament in 2014, where among other deliberations, there was much discussion on the cost of air travel in small aircraft to regional airports (Standing Committee of State Development, 2014). More recently in 2017 the Western Australia government held an inquiry into the pricing of regional air carriers (Economics and Industry Standing Committee, 2017). Currently, the Federal Government's Senate Standing Committee on Rural and Regional Affairs and Transport has set up an inquiry on the operation, regulation and funding of air service delivery to rural, regional and remote communities. Among their goals is to examine the social and economic impact of aviation services on regional Australia.

Table 7.1 shows the proportion of international visitors to Australia by both modes of transport over the past few years. A change in the layout of the incoming passenger card in July 2017 has meant proportionally more people have identified with selecting 'Visiting friends and relatives' (VFRs) as the main reason for their journey in 2017-18 (ABS, 2019). International travellers who are visiting friends and relatives, while their motivation for coming to Australia may be different, contribute greatly to the tourist market in Australia. Together, international travellers on holiday or visiting friends and relatives as their main purpose made up almost three quarters of the nine and a half million international visitor arrivals in the financial year 2017-18. Unsurprisingly the vast majority of international visitors come by air transport, highlighting the importance of the aviation industry to international tourism.

Table 7.2 shows the modes of transport of domestic tourists for the 2017-18 financial year. Over 12 million Australian residents took a domestic flight for the purpose of an overnight holiday or visiting friends and relatives. This represents about half the total flights taken for the year. Air travel is proportionally more attractive to visitors who take a trip of two or more nights than just a single night, with over 30 per cent of holidaymakers and visitors to friends and relatives who stayed two or three nights, travelling by aeroplane.

Table 7.1 International visitor arrivals, by mode of transport, 2015-16 – 2017-18

Purpose of travel		2015-16		2016-17		2017-18	
		No. ('000)	%	No. ('000)	%	No. ('000)	%
Holiday[a]	Air	3,903	47.3	4,343	48.4	4,271	44.7
	Sea	45	78.9	60	78.9	58	79.4
VFR[a]	Air	2,061	25.0	2,175	24.2	2,753	28.8
	Sea	6	10.5	9	11.8	9	12.3
Business	Air	617	7.5	633	7.0	704	7.4
	Sea	1	1.8	1	1.3	2	2.7
Education	Air	730	8.8	832	9.3	875	9.2
	Sea	1	1.8	2	2.6	2	2.7
Employment	Air	381	4.6	405	4.5	320	3.3
	Sea	2	3.5	2	2.6	1	1.4
Total[b]	Air	8,254	100.0	8,980	100.0	9,554	100.0
	Sea	57	100.0	76	100.0	73	100.0

Source: DIBP Overseas Arrivals and Departures
Notes: a - Changes to the layout of the incoming passenger card in July 2017 means for 2018 the proportion of people reporting VFR as the main reason for their journey was 4% higher and 4% lower for holidaymakers.
b - Total includes other reasons not listed in the table as well as non-respondents

Table 7.2 Domestic travellers by purpose and mode of travel, for different length of stay, 2016-17

Nights		Air		Self-drive		Other		Total[a]
		No. ('000)	%	No. ('000)	%	No. ('000)	%	No. ('000)
1	Holiday	5,159	14.6	28,583	80.1	1,426	4.0	35,358
	VFR	5,049	16.7	23,183	76.9	1,930	6.4	30,163
	Total[b]	20,955	23.2	64,723	71.5	4,577	5.1	90,502
2	Holiday	678	27.5	2,007	81.3	282	11.4	2,469
	VFR	615	31.2	1,583	80.3	171	8.7	1,972
	Total[b]	1,978	37.7	4,183	79.8	613	11.7	5,242
3	Holiday	310	27.8	964	86.3	119	10.7	1,117
	VFR	391	39.6	855	86.5	114	11.5	988
	Total[b]	949	40.2	2,101	89.0	293	12.4	2,361
Total[c]	Holiday	6,486	16.0	33,007	81.4	2,056	5.1	40,551
	VFR	6,238	18.5	26,206	77.6	2,268	6.7	33,769
	Total[b]	24,460	24.4	73,004	72.8	5,775	5.8	100,269

Source: Tourism Research Australia, National Visitor Survey
Notes: a - Components may not add to total as overnight visitors may have utilised more than one mode of transport during their trip. Also includes non-respondents
b - Total includes Business travellers and Other travellers
c - Total includes travellers who stayed more than 3 nights

7.2 Economic benefits of tourism

The economic benefits of tourism have long been established. Put in its simplest terms, a visitor or tourist who visits or stays outside their usual environment generates additional expenditure beyond that generated by local consumers who spend money in their usual environment. Thus the tourist adds tourism-related value to the economy that is not present had they not visited. Domestic tourism increases a country's total national spending just as other internal transactions do. The tourist destination will increase its gross regional product, which contributes to the nation's gross domestic product. International tourism acts as an export, improving a country's external sector balance.

A tourist's spending will obviously depend on the activities they undertake while on their travels. However, there are some common sectors of the economy that benefit greatly from overall tourism. Generally, tourists all have some common spending patterns, including transport they use to travel to and around their destination(s), accommodation they use for overnight stays, food and beverages they consume while away, entertainment venues and other attractions they custom as part of their holiday. Further, individual tourists may take part in a hobby or interest and thus spend in other areas of the economy, such as retail trade from shopping excursions, they may rent or hire any matter of equipment, including cars, they may require medical goods or treatment, or undertake some education.

Tourism is an industry that contributes to and requires input from many sectors of the economy. Because of this the tourism industry does not fit nicely within the statistical framework conventionally used by countries to measure their economic activity, in Australia, termed the National Accounts. Hence, the Tourism Satellite Account (TSA) was created to aggregate tourism-related contributions that are made across the different sectors of the economy. The TSA is a standard statistical framework developed by a conglomeration of authorities throughout the world, led by the United Nations World Tourism Organisation (UNWTO). Its purpose is to enable the generation of tourism economic data that is comparable with other economic statistics, by contrasting data from the demand-side of tourism, the purchase of goods and services by visitors, with data from the supply-side of the economy, the value of goods and services purchased by industries in response to visitor expenditure. This is set out in the Tourism Satellite Account: Recommended Methodological Framework 2008, known as TSA: RMF 2008 (UNWTO *et al*., 2010).

The TSA makes use of special Tourism Related Industries, which are separate to the industries for which the National Accounts are provided. These include sectors that interact heavily with visitors, such as accommodation; cafes, restaurants and takeaway food outlets; and air, water and other transport services. However, the spending in these industries only amounts to direct tourism contribution if it is done by a visitor, a person outside his or her usual environment, where there is a direct physical and economic relationship between the visitor and the producer of the good or service demanded by the visitor.

The internal spending tourists make increase the GDP of a country. This spending, along with spending by government on travel and tourism services directly linked to visitors (for example museums or national parks), comprise the direct contribution of Travel and Tourism (T&T) to GDP. In National Accounting, the direct contribution of T&T is calculated as the output generated from tourism-characteristic sectors, such as airlines, airports, travel agents, hotels and leisure and recreation services that deal directly with tourists. This is known as direct contribution.

The total contribution of tourism to the economy consists of the direct effects, supplemented by the indirect effects, but these are not captured by the TSA. Indirect effects are the flow-on effects that occur to the changes in supply that result from spending of the tourism industry's receipts on goods and services from other industries. These inter-industry transactions occur in response to tourism consumption and produce additional spending in the economy. For example, when a visitor purchases a meal from a hotel, the hotel purchases vegetables and meat from a food supplier, the food supplier purchases these from a farming company and the farming company purchases labour and transport to deliver the produce to market (TRA, 2014). Smeral (2006) argues the consideration of indirect effects is essential in understanding the total effect tourism has on an economy. Galambos *et al*. (2014) argue that air transport along with tourism has a key position in global economic growth due to its direct, indirect and multiplier effects.

As there is much contribution to an economy through the spending generated by tourists, there follows that tourism generates many jobs in an economy. The number of jobs in an industry is another way its contribution to a country's economy is measured. Further, induced effects are often added to the total contribution of tourism, through the spending of employees who have their jobs as a result of the direct and indirect effects of tourism expenditure.

There remains much conjecture of how best to estimate tourism's contribution to a country's economy. While agreeing tourism adds much to an economy, Forsyth (2006) argues the economic benefits of tourism are overstated using measurements such as those discussed here. He advocates for a computable general equilibrium (CGE) model. Frechtling (2012), on the other hand, advocates for the use of input-output models for a country or region as a posteriori analysis, rather than as a tool to simulate a shock to the tourism economy, as criticised throughout the literature (for example, Dwyer, Forsyth and Spurr, 2006). The World Travel and Tourism Council believes the total contribution made by tourism and travel is much greater than that captured by the TSA, and so publishes estimates of the indirect and induced impacts of tourism for countries around the world (WTTC, 2018).

Tourism is increasingly seen as an important industry to help grow regional economies. Governments and policymakers at all levels see opportunities in building on a region's natural, cultural and built environment to attract visitors and stimulate economic activity, alleviating regional disparities and creating new jobs. Visitors to a region spend money in the region, helping to pay for amenity and to sustain the community. However, in regional areas it has been found that proportionally more of the tourist dollar leaks out of the region to pay for the tourism-related goods and services (Webster and Ivanov, 2014). Australia has any number of marketing campaigns aimed at encouraging tourists to regions all over the country. The many government inquiries into the cost of regional air travel (see previous section) has been driven by the realisation that safe, reliable, affordable air travel is essential in allowing regions to fulfil their potential as tourist destinations.

7.3 Economic impact of tourism on Australian economy

Noting that the best estimation approach is contested territory, in this section we deploy the TSA to provide an overview of the economic impacts of tourism in Australia.

In the 2016-17 financial year, tourism contributed $55.3 billion toward the country's GDP, which represents 3.2 per cent of total GDP. This was an increase of 6.1 per cent on the previous year, in real terms an increase of 4.9 per cent. This followed a 7.4 per cent increase in tourism's contribution to GDP in 2015-16. Over the three year period from 2013-14 to 2016-17, tourism GDP increased by 23 per cent, while the economy as a whole increased by 10 per cent.

A more accurate indicator of economic activity is gross value added (GVA), which excludes payments made through the taxation system. Under this measure, direct tourism was $50.6

billion in nominal price terms in 2016-17, which represents 3.1 per cent of total GVA. The increase on the previous year's direct tourism GVA was 6.1 per cent, as shown in Table 7.3. The largest contribution to the nation's GVA was through Air, water and other transport, closely followed by Accommodation, which both contributed over $8 billion. Retail trade was next, contributing $6.3 billion. The number of jobs in the economy attributable to the tourism industry was just under 600,000 in 2016-17. Cafes, restaurants and takeaway food services contributed the most number of jobs, at almost 168,000; next was retail trade and accommodation. In terms of economic contribution to national GVA, tourism ranks behind construction, mining, professional, scientific and technical services, health care and social assistance and manufacturing.

Table 7.3 Direct tourism gross value added and employment by tourism related industry, 2014-15 – 2016-17

	2014-15		**2015-16**		**2016-17**	
	GVA[a] ($m)	Emp ('000)	GVA[a] ($m)	Emp ('000)	GVA[a] ($m)	Emp ('000)
Tourism characteristic industries						
Accommodation	6,913	83.6	7,476	82.9	8,008	88.8
Ownership of dwellings	3,707		3,829		3,968	
Cafes, restaurants and takeaway food outlets	5,572	155.7	6,021	161.8	6,479	167.9
Clubs, pubs, taverns and bars	2,757	33.0	2,981	32.7	3,197	33.4
Rail transport	480	2.4	525	2.7	557	2.7
Taxi transport	464		459		458	
Other road transport	717	20.9	783	21.4	822	21.5
Air, water and other transport	6,901	38.2	7,496	36.6	8,027	40.0
Transport equipment rental	984		1,030		1,029	
Travel agency and tour operator services	1,703	41.1	1,820	39.0	1,929	42.8
Cultural services	561	11.1	566	10.7	606	10.4
Casinos and other gambling services	491	2.7	533	2.6	563	2.5
Sports and recreation activities	642	18.1	648	18.7	694	18.1
Tourism connected industries						
Automotive fuel retailing	244		261		272	
Other retail trade	5,665	99.4	6,058	102.3	6,323	98.8
Education and training	3,348	44.5	4,313	45.3	4,590	46.8
All other industries	2,806	23.4	2,939	23.9	3,119	24.3
Total Direct Tourism	**44,412**	**574.1**	**47,736**	**580.7**	**50,642**	**598.2**

Source: ABS Cat 5249.0 Australian National Accounts: Tourism Satellite Account, 2016-17
Notes: a - current prices

The indirect effects of tourism to gross value added, which include the flow-on effects of tourism demand in the chain of supply of goods and services to visitors, were estimated for 2016-17 to be $47.9 billion, or 2.9 per cent of national GVA. This represents a multiplier for the tourism industry overall of 1.95 and brings total tourism effects to 6.1 per cent of national GVA. The total jobs contributed as a result of tourism was over 924,000 for 2016-17, giving a jobs multiplier of 1.55. Table 7.4 shows the breakdown for each state and the whole of Australia of direct and indirect effects for both GVA and employment and the proportion of total tourism effects of each state's GVA and employment totals for 2016-17.

Tasmania relies on the tourism industry proportionally more than any other state, with it making up 9.9 per cent of its total GVA, and contributing 15.8 per cent of total jobs in the state. Tasmania has a tourism GVA multiplier of 2.05 and a jobs multiplier of 2.01. The Northern Territory also relies heavily on the tourism industry, with it contributing 9.4 per cent of the territory's total GVA and 12 per cent of its jobs. While Western Australia's tourism industry is the lowest proportionally of total GVA, it does create proportionally the same jobs as the national average.

Table 7.4 Direct and indirect tourism effects GVA and employment, by state, 2016-17

	Direct		**Indirect**		**Total**		**Total Tourism GVA as % of total GVA**	**Total Tourism Emp as % of total Emp**
	GVA ($m)	Emp[a] ('000)	GVA ($m)	Emp[a] ('000)	GVA ($m)	Emp[a] ('000)		
NSW	15,904	171.1	14,729	90.9	30,634	262.0	5.8	6.9
VIC	11,254	143.8	10,927	70.7	22,181	214.5	5.8	6.9
QLD	11,695	137.5	11,074	79.2	22,769	216.7	7.5	9.1
SA	2,812	36.0	2,765	20.5	5,577	56.4	5.9	6.9
WA	5,556	71.1	5,049	32.8	10,605	103.9	4.4	7.7
TAS	1,314	18.9	1,383	19.0	2,698	38.0	9.9	15.8
NT	1,078	9.0	1,059	7.2	2,137	16.3	9.4	12.0
ACT	1,026	10.6	892	6.3	1,918	16.8	5.6	7.7
AUS	50,641	598.0	47,878	326.6	98,519	924.6	6.1	7.7

Source: TRA, State Tourism Satellite Accounts 2016-17
Notes: a - Full-time equivalent

Recently, the Australian Airports Association engaged Deloitte Access Economics to estimate the economic and social contribution of the airport industry specifically, to the Australian economy and society (Deloitte Access Economics, 2018). Their analysis draws on the National Accounts as well as the State Tourism Satellite Account, produced by Tourism Research Australia. They use their own regional input-output model to assist in the allocation of effects to the various regions and airports.

They first estimated the economic contribution of airport core activities, which comprise the central operation of an airport facility, including its runway infrastructure, terminals and aviation safety and security. In 2016-17 they estimated the total economic contribution of airport core activities, including direct and indirect effects, to be almost $4.9 billion, which supported over 8,700 jobs.

More appropriately, they estimated the contribution of the broader airport precinct. This includes the core activities, but also takes account of the much larger range of activities that occur in the airport precinct through other businesses, such as airlines, retail, immigration and customs as well as companies operating on the airport precinct. This gives a better measure of the overall direct contribution an airport makes to the economy. In 2016-17 the total value added was estimated at almost $30 billion, while supporting almost 200,000 full-time equivalent jobs, as shown in Table 7.5.

Table 7.5 Economic contribution of airport precinct activities, 2016-17

	Direct		Indirect		Total	
	GVA ($m)	Emp[a] ('000)	GVA ($m)	Emp[a] ('000)	GVA ($m)	Emp[a] ('000)
Major airports	15,388	97.2	12,500	86.3	27,888	183.5
Major regional airports	943	6.1	424	4.2	1,366	10.3
Regional airports	318	2.4	124	1.1	443	3.6
Remote airports	25	0.2	22	0.2	47	0.3
Total	16,673	105.9	13,070	91.8	29,744	197.7

Source: Deloitte Access Economics, 2018
Notes: a - Full-time equivalent

The report also makes the link between airports and Australia's tourism industry, saying the tourism industry is heavily reliant on the aviation sector. They argue airports play a pivotal role in facilitating international and domestic tourist travel, and that the relationship between airports and economic activity extends beyond the confines of the airport precinct. To capture the size of tourism facilitated by airports, they focus on the expenditure by tourists who travel by air.

In estimating the tourist contribution facilitated by air transport, they exclude the contribution of the aviation sector itself, as well as core airport activities. They explain:

> While airports play a pivotal role in facilitating … tourist travel to Australia, it is important to note that the nexus between airports and economic activity in the tourism sector is less immediate than for economic activity occurring on airport precincts. … In general airports are one of a number of industries that help facilitate activity in the tourism sector. In this respect the connection between airports and tourism is less direct than activity occurring on their precinct (Deloitte Access Economics, 2018, p. 37).

They estimate that across Australia, total tourism activity facilitated by the aviation sector contributes $32.3 billion, which is equivalent to 1.9 per cent of the total economy. Further, total tourism activity supports 339,700 jobs across Australia, or 1.8 per cent of total employment.

International tourism contributes the largest proportion of the economic contribution of tourists facilitated by the aviation sector, as most international tourists arrive by aeroplane. It is estimated the total economic contribution of international tourists to the Australian economy is over $21.6 billion, or more than 1.3 per cent of total GVA (Table 7.6). Further, this supports 218,500 jobs.

Domestic tourism is proportionally less supported by the aviation sector, as much domestic tourism occurs without the participants using air transport. Nonetheless, domestic tourism activity facilitated by the aviation sector contributed $10.6 billion in 2016-17, or 0.6 per cent of total GVA, supporting 121,200 jobs (Table 7.7).

Despite the variation in the estimation methods of the economic contribution of tourists, the impact of tourists on the economy is significant.

Table 7.6 Economic contribution of international tourism supported by aviation sector, 2016-17

	Direct		Indirect		Total	
	GVA ($m)	Emp[a] ('000)	GVA ($m)	Emp[a] ('000)	GVA ($m)	Emp[a] ('000)
NSW	4,280	48.2	3,433	24.1	7,713	72.3
VIC	3,133	39.0	2,522	18.5	5,655	57.5
QLD	2,359	28.9	1,901	15.4	4,261	44.3
SA	505	6.6	410	3.5	915	10.0
WA	1,194	16.7	914	6.7	2,108	23.4
TAS	162	2.3	134	2.2	295	4.5
NT	148	1.5	114	0.9	261	2.4
ACT	256	2.7	174	1.4	430	4.1
AUS	12,036	146.0	9,601	72.6	21,637	218.5

Source: Deloitte Access Economics, 2018
Notes: a - Full-time equivalent

Table 7.7 Economic contribution of domestic tourism supported by aviation sector, 2016-17

	Direct		Indirect		Total	
	GVA ($m)	Emp[a] ('000)	GVA ($m)	Emp[a] ('000)	GVA ($m)	Emp[a] ('000)
NSW	988	13.2	1,033	7.2	2,020	20.4
VIC	809	13.5	867	6.3	1,676	19.8
QLD	1,664	23.2	1,674	13.5	3,338	36.7
SA	274	4.4	293	2.5	567	6.9
WA	844	13.9	811	5.9	1,655	19.8
TAS	268	4.8	286	4.6	555	9.4
NT	294	3.2	274	2.1	568	5.3
ACT	140	1.9	129	1.0	269	2.9
AUS	5,280	78.2	5,367	43.0	10,647	121.2

Source: Deloitte Access Economics, 2018
Notes: a - Full-time equivalent

7.4 Australia's aviation safety record

Australia has an excellent record for airline safety. In over 50 years of jet aircraft operations no lives have been lost and the majority of air transport operations proceed without incident. However, a number of accidents and other serious and not-so-serious incidents do occur each year, some involving commercial air flights and some involving fatalities.

Worldwide, 2017 was the safest year on record for air travel (Young, 2018). Including only larger passenger aircraft commonly used by most travellers, aviation consultants 'to70' recorded 111 civil aviation accidents, of which three resulted in fatalities with 14 people losing their life. They estimate the fatal accident rate for large aeroplanes in commercial air transport was 0.08 per million flights (one fatal accident for every 12 million flights). However, they warned that statistically this was an anomaly and indeed 2018 saw the number of accidents involving turbojet-powered aircraft rise above the recent five-year average, with 160 accidents, 13 of which were fatal, resulting in 534 fatalities (0.36 per million flights) (Young, 2019).

The Australian Safety Transport Bureau (ATSB) is the agency tasked with investigating civil aviation accidents, incidents and safety deficiencies in Australia. It is governed by a Commission, completely separate from government and policy makers, industry operators and industry regulators and thus is entirely independent. The ATSB maintains a database in which all reported safety incidents are recorded, logged, classified and assessed, called the Safety Investigation Information Management System.

Immediately reportable matters are accidents, which is the term given to incidents that involve death, serious injury, destruction of, or serious damage to vehicles or property. Also covered under immediately reportable matters are serious incidents, which is an incident where an accident nearly occurred. Routine reportable matters involve incidents that do not have a serious outcome but where transport safety was affected or could have been affected. Each year there are hundreds of accidents and serious incidents reported to the ATSB and thousands of minor incidents (Figure 7.1).

Figure 7.1 Safety occurrences in Australia, 2014-2018

Source: ATSB National Aviation Occurrence Database

Aviation activity is grouped into three operational types:

- Commercial air transport. High capacity regular public transport (RPT) flights, low capacity RPT flights, charter flights and medical transport flights.

- General aviation. Aerial work operations (including aerial agriculture, aerial mustering, search and rescue, and aerial survey), flying training, private, business and sports (including gliding) aviation (VH or foreign-registered).
- Recreational aviation. Aircraft used for recreational flying registered by a recreational aviation administration organisation (RAAO).

Hampson *et al*. (2015) argue that the most important advances in aviation safety were made decades ago and that accident rates in Australia and around the world have effectively stabilised. They note however that in the decade to 2013, the number of incidents reported to the ATSB grew by 90 per cent for commercial aviation in general, and more than doubled for high-capacity RPT. While they concede that this is partly explained by different reporting requirements during this period and partly by the increase in air traffic, the growth of incidents in high-capacity RPT is over twice the growth in the number of departures, and conclude that at least some of the increase must be real.

Despite never experiencing a fatality on a commercial jet aircraft, there have been fatalities on commercial air transport, including low capacity RPT. Most accidents, including those that involve a fatality, occur with general aviation aircraft. Table 7.8 shows the number of fatalities in Australia for each operational type over the decade 2008-2017. Over this period there were

Table 7.8 Fatal accidents and fatalities in Australia by operation type, 2008-2017

	Number of aircraft associated with a fatality	**Number of fatalities**
Commercial air transport		
High capacity RPT	0	0
Low Capacity RPT	1	2
Charter	14	28
Medical transport	0	0
Foreign registered air transport	0	0
General aviation		
Aerial work	47	54
Flying training	11	17
Private/Business	68	116
Sport aviation (including gliders)	14	16
Foreign registered general aviation	1	1
Recreational aviation		
Gyrocopters	11	13
Aeroplanes	41	50
Weight shift	30	36
Total	241	337

Source: ATSB (2018)

337 aviation fatalities in Australia. The year 2017 saw 40 aviation fatalities, which is above the average for the decade. By contrast there were only 20 fatalities in 2018, which is the lowest number ever recorded by the ATSB.

Over the decade to the end of 2017, 83 per cent of the more serious occurrences (accidents and serious incidents) involved general aviation aircraft. Yet, around 70 per cent of all reported incidents involved aircraft conducting commercial air transport operations. The majority of commercial air transport flight hours in Australia are operated by high capacity RPT. This is defined as an aircraft that is certified as having a maximum capacity exceeding 38 seats, or having a maximum payload capability that exceeds 4,200 kg. In 2016, high capacity RPT accounted for 72 per cent of total air transport flight hours. Further, in 2016, 50 per cent of the total departures in commercial air transport were by high capacity RPT.

The majority of air transport passengers, particularly tourists, fly on high capacity RPT aircraft. Despite having a perfect fatality-free record since the introduction of jet-powered aircraft, high capacity RPT aircraft were the subject of over 50 per cent of all incidents from 2008-2017. Further, the ATSB investigated 330 incidents involving high capacity RPT aircraft during this period, with another 19 investigations in 2018. Indeed, high capacity RPT aircraft continue to be involved in many accidents and serious incidents that result in serious and minor injuries, as shown in Table 7.9.

Worldwide in 2017, 55 per cent of all scheduled commercial air transport accidents were related to runway safety (ICAO, 2018c). In 2016 this was 57 per cent. Further, in 2017, 40 per cent of fatal accidents were related to runway safety. Importantly, 76 per cent of accidents where the aircraft was destroyed or substantially damaged were related to runway safety, yet only 6 per cent of fatalities were due to runway safety. Hence, the most accidents occur when ARFF services are available and it would appear they contribute to reducing the fatalities that would otherwise have occurred.

Table 7.9 Safety occurrences involving high capacity RPT that resulted in injuries, 2014-18

Year	**Injury**	**Accidents**		**Serious incidents**		**Incidents**	
		Occurrences	Injuries	Occurrences	Injuries	Occurrences	Injuries
2018	Serious	2	2	0	0	0	0
	Minor	0	9	0	0	26	51
2017	Serious	2	2	0	0	0	0
	Minor	0	2	2	7	66	106
2016	Serious	0	0	0	0	0	0
	Minor	0	0	4	4	45	78
2015	Serious	3	3	0	0	0	0
	Minor	0	0	0	0	47	59
2014	Serious	1	1	1	1	0	0
	Minor	1	1	0	0	85	94
2014-	Serious	8	8	1	1	0	0
2018	Minor	1	12	6	11	269	388

Source: ATSB National Aviation Occurrence Database

One of the main aircraft manufacturers, Airbus, have invested in technology to address one of the primary runway safety issues, being runway excursion, a lateral veer off or longitudinal overrun off the runway surface. They are confident they have discovered energy-based and performance-based technologies to address longitudinal runway excursions. However, runway excursions are the cause of only a fraction of incidents on runways and further, the success of this technology is not yet known, as only 5 per cent of their fleet have these technologies installed. Hence, it may be a while before they begin to make any difference to total runway safety incidents (Airbus, 2018). While maintenance and technology can reduce risk of aircraft accidents, Gill and Shergill (2004) find that pilots generally regarded luck as being a significant contributing factor in safety.

The ATSB compared Australia's aviation safety record to that of four other countries, using fatality rates, for the decade 1995-2004 (ATSB, 2006). They compared Australia's record to that of the United States, Canada, the United Kingdom and New Zealand, finding Australia's safety record is similar to that of those countries. Australia's fatal accident rates were comparable to those for the United States and Canada. Australia had a slightly worse safety record than the United Kingdom in relation to RPT operations, but better for non-public transport operations. Australia had a better safety record than New Zealand for all operational categories. Importantly, they close their report by saying:

> Australia holds one of the best safety records in the world. … However, a single fatal accident involving a high capacity RPT jet aircraft would lead to a major worsening in Australia's international position with respect to RPT fatality rates and there is no room for complacency (ATSB, 2006, p. 48).

7.5 The perception of air safety and its effects on demand

The public perception of the safety of the aviation sector has always been a crucial industry concern in Australia and around the world. Indeed, the genesis of the ICAO was in ensuring that international civil aviation would be developed in a safe and orderly manner and that international air services may be operated soundly. Aviation crashes are generally catastrophic, but not chronic. Nonetheless, the perception of potential travellers to the safety of their travel will affect the overall demand for air transport.

CASA last commissioned a survey on public attitudes to aviation safety in Australia in September 2014 (Galaxy Research, 2014). The researchers found that 75 per cent of Australians were very or completely confident about arriving safely if travelling on a commercial flight within Australia, with just 3 per cent saying they were not confident. Concerns about safety of flights were based around the reality that crashes happen, inadequate maintenance of aircraft and security issues. Australians were less confident about the safety of charter flights, with only 20 per cent very or completely confident. Here the main concerns were that smaller aircraft are less safe, more accidents happen with charter flights and there is less regulation of charter airline operators. 80 per cent of Australians believed commercial air flights were just as safe or more safe now than five years ago. Those who disagreed identified issues such as cost cutting and outsourcing of maintenance, security issues and increased incidents and accidents. Interestingly, despite the high confidence in commercial flights, almost half of Australians thought CASA should supervise commercial airlines more closely.

There has been a great deal of research on the perceptions of air safety to potential air travellers. Savage (2011) and Li *et al*. (2015) argue when an accident happens the media exaggerate the consequences and people then worry about airline safety management. They say safety perception is subjective and each person has their own level of safety concerns, above which they will be uncomfortable to fly. Fyhri and Backer-Grondahl (2012) agree showing that different groups of people vary systematically in their perception of risk on modes of transport, and that these differences are apparent in their general risk-preventative behaviour. Ringle *et* *al*. (2011) argue perceived safety by passengers has a significant impact on the overall customer satisfaction of travellers. They say this is particularly true for tourists (as opposed to business travellers) and negative safety experiences may lead to substitution and/or withdrawal of travel mode.

Of greater interest has been how the perception and behaviour of the public changes after an incident. Von Winterfeldt and Prager (2010) found differences in the way people changed transportation mode after terrorist attacks on public transport. Gigerenzer (2004) talks about people fearing dread risks, that is, low-probability, high-consequence events, such as aircraft crashes. He studied the US after the September 11, 2001 attacks and found people avoided air travel and substituted it for car travel. While these types of incidents are rare they can begin to inform our understanding of people's reactions to air crashes. Ito and Lee (2005a) found that the events of September 11 led to an initial demand shock of 30 per cent as well as an ongoing downward shift in demand for domestic commercial air service of 7.4 per cent over two years later. Further, the same authors (Ito and Lee, 2005b) found that demand for international air travel towards the end of 2003 was down between 15 and 36 per cent.

Deepa and Jayaraman (2017) reviewed literature on passenger confidence in air travel and cite a number of articles that claim passengers gave the greatest priority, in regards to customer satisfaction and loyalty, to the safety they perceived with an airline and safety-related service items.

The 'brand name' effect was first posited by Mitchell and Maloney (1989), where potential passengers switch airlines away from those that have been involved in an accident. Similarly, Castillo-Manzano *et al*. (2012) cite the 'Rainman' effect, being that people avoid flying with airlines that have had accidents. They say it is so-called because of the reluctance of the character Raymond Babbitt in the film Rain Man to fly on any airline other than Qantas because of their doubtful safety records. Castillo-Manzano *et al*. (2012) find evidence of this in relation to the Spanair crash of 2008 where passengers penalised the airline involved with a long-term reduction in traffic of over 20 per cent. Similar events have also caused a decline in demand for a specific airline. Malaysia Airlines saw demand drop by 40 per cent in the weeks after two separate incidents in 2014, the first where a plane disappeared and the second when a plane was shot down over Ukraine (O'Sullivan, 2014). A year later demand was still down 10 per cent from the previous year. More recently, the first fatality on a US carrier since 2009 happened on a Southwest Airline flight in 2018, causing the company a 3 per cent decrease in revenue per available seat mile in the months after (Siegel, 2018).

Ho *et al*. (2013) show that an aviation disaster has an effect on the equity value of the airline involved, saying the drop in stock prices is closely related to the level of fatality. Further, they found that the stock prices of rival airlines also suffer if the disaster is of a large scale, called the contagion effect, but benefit slightly if the fatality is minor, called the switch or substitution effect. Similar results were found by Bosch *et al*. (1998), where rival airlines would slightly benefit if they had market overlap with the affected airline, but would suffer if they had no market overlap. These results imply that overall air travel declines after a fatality.

Liu and Zeng (2007) find a similar result to the previous two researchers. They examine the impact of fatal incidents on air traffic volume, finding that demand for air travel is likely to fall as fatality rate increases. Their modelling accounted for the drop in air travel demand after September 11, concluding this specific event had no impact on the overall results. Further, they found that demand for domestic travel falls greater than for international travel given an increase in the fatality rate.

Wang and Song (2010) find that while price and income elasticities are the two most important elasticities of demand for an airline, safety record is also a significant driver of air travel demand. Similarly, Koo *et al*. (2015) find that young people, a traditionally more risk tolerant population, will consider specific safety-risk information when making decisions about flights, and that this, along with price, are the most important factors. Savage (2011) argues safety is the most important quality attribute of commercial aviation, but that market failures, particularly lack of information leads to little differentiation between airline offerings. Yet, he posits that operators of smaller aircraft, which are perceived as less safe, have to offer a lower fare than those operating large aircraft on the same routes.

Combining these two effects on demand, Carlsson *et al*. (2004) and Braithwaite (2001) find evidence that people are willing to pay more to increase the safety of air travel. In the case of Carlsson *et al*. (2004), they compare the willingness to pay for a given risk reduction in flying as opposed to travelling by taxi. People were willing to pay more than two times as much in flying for the same risk reduction (given the same baseline cost). The reasons for this result they found was that people subjectively suffered more from the risk in air travel and were willing to pay to lower this mental suffering. In the case of Braithwaite (2001), survey respondents were asked about paying extra to ensure ARFF services were available at both their take-off and landing airports, to which 85 per cent of respondents indicated they would be willing to pay something extra.

This discussion of perception of safety and consequences of air travel has not implicitly explored different types of aeroplane, aside from the CASA survey. However, we saw in the previous section that smaller aeroplanes are involved in proportionally more accidents and incidents than large aeroplanes, and certainly are involved in more fatal accidents. Smaller aeroplanes travel to regional airports, many of which in Australia do not have ARFF services. It is debatable travellers know this is the case, as found by Braithwaite (2001). His survey found that over 90 per cent of respondents overestimated the provision of ARFF services at airports. However, from the CASA survey above it is generally accepted by the travelling public that smaller aeroplanes are less safe. Indeed, at the New South Wales Parliament inquiry into regional aviation services, the Managing Director of a participating airline identified the perception of travellers of small aeroplanes as an issue in attracting demand:

> There is a public perception issue – regardless of the statistics you can put out to say that a single-engine aeroplane is as safe as a twin-engine aeroplane. If you tell a passenger that they are about to board a single-engine aeroplane, they do not like it. They have enough trouble with boarding a twin-engine 10-seater aeroplane as it is, let alone an aircraft with only one engine at the front. It is a perception issue – the perception is that there is a safety issue…. There is a perception issue to overcome in getting customers into a small aeroplane, let alone a single-engine plane. It is a difficult perception issue to overcome. (Standing Committee of State Development, 2014, p. 20)

Braithwaite's study would indicate that these travellers may not be aware that if they are travelling to or from a smaller regional airport, it is likely they would not have ARFF services at their take-off and/or landing airports. Indeed, if they were aware, this may add to the anxiety they feel travelling in these smaller aircraft.

7.6 The economic loss to Australia from a potential air transport accident

7.6.1 Discussion

We have seen throughout this section that Australia has a very good aviation safety record, having never had a fatality in a high capacity RPT aircraft, and a relatively good record compared to other comparable countries. However, we have also seen that there are a number of accidents that occur with smaller aircraft each year, some resulting in fatalities, as well as many minor incidents that occur, a percentage of which involve high capacity RPT. Earlier we examined the role of tourism on Australia's economy and the interconnectedness of air travel and tourism in Australia. Most recently we have seen that worldwide there is a tendency for the travelling public to be risk averse in terms of airlines and airports that are involved in major incidents and overall demand falls for air transport following a major accident.

The purpose of this section is to examine the possible effects of a major accident on Australia's economy, particularly from the loss of tourism that would occur from a public less inclined to engage in air travel.

On 20 August 2008, Spanair scheduled flight JKK5022 from Madrid-Barajas airport (Madrid) to Gran Canaria airport (Canary Islands) crashed as it was attempting to take-off. The aircraft, a Boeing DC-9-82 (formerly McDonnell Douglas MD-82) was destroyed as a result of the impact with the ground and the subsequent fire. There were 172 people on board, of which only 18 survived, all of whom were seriously injured. This was the aircraft's second take-off attempt, having returned to the parking stand after an external temperature probe overheated. The crash was Spain's worst civil aviation accident for 25 years.

Madrid-Barajas Airport is rated category 9 for ARFF services. The airport had three different ARFF facilities. The fire brigade from the satellite station was the first to respond to the alarm, with three heavy fire fighting vehicles and a fast intervention vehicle. They reached near to the accident site two minutes and twenty seconds after the alarm was sounded, however they could not proceed past the internal perimeter fence that surrounded the runway. It is not known how long before foam was applied to the fire, but it was reported that one of the heavy fire fighting vehicles was able to clear the fence fairly quickly, with some other vehicles managing to do the same at an unknown later time. The fast intervention vehicle did not clear the fence (CIAIAC, 2008).

Among the recommendations in the investigation that followed was that control tower personnel improve the assistance they provide to ARFF services in the event of an accident. This was in response to communication problems that existed between the tower and the ARFF service, specifically that ARFF radio traffic on the emergency frequency was not answered by the tower. There was also a recommendation that training be enhanced for ARFF personnel in the area of first aid.

The crash occurred at a time that the Global Financial Crisis (GFC) was beginning to have its effects felt across Europe, particularly in the south, Spain included. After growing strongly through 2007, Spain's economy began to contract through the second half of 2008 and into 2009. In 2009 Spain's unemployment rate rose to over 17 per cent, having been under 10 per cent in the first quarter of 2008. Similarly, GDP contracted by 3.6 per cent for the 2009 calendar year.

Due to the timing of the crash being in the middle of the worst financial crisis in 80 years, it is difficult to determine the effect the crash of the Spanair flight had on passenger numbers in Spain. At Madrid airport itself, which has the highest volume of passengers of all Spain's airports, passenger numbers were down 9.8 per cent in September 2008, the month following the crash, compared to the corresponding month in 2007, but they had been falling slightly since June of 2008 (Table 7.10). Across Spain, for the same month, passenger numbers were down 8.9 per cent in September compared to September 2007. In both cases this represented much larger falls than the previous months. The falls in passenger numbers continued to get larger through the end of 2008 and the early part of 2009.

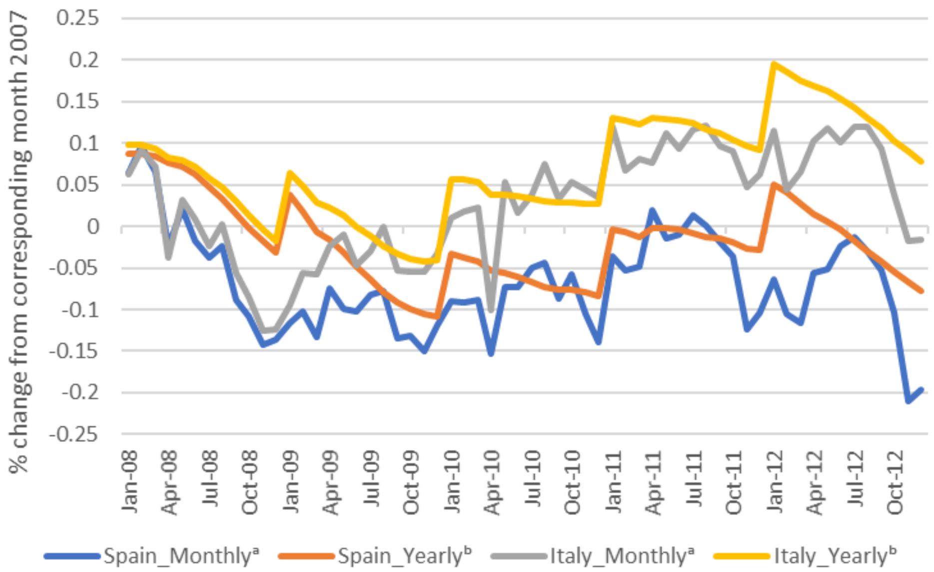
Table 7.10 Percentage change in passenger numbers from corresponding month in previous year, Madrid Airport and all Spanish airports, 2008-09

	Madrid		Spain	
	Monthly[a]	Yearly[b]	Monthly[a]	Yearly[b]
Jun 2008	-1.7	6.2	-0.3	9.4
Jul 2008	-3.7	4.6	-2.7	7.4
Aug 2008	-2.4	3.3	-2.7	5.8
Sep 2008	-9.8	3.8	-8.9	1.5
Oct 2008	-13.2	1.4	-10.8	-0.1
Nov 2008	-15.0	-0.9	-14.3	-1.8
Dec 2008	-11.8	-2.4	-13.6	-3.2
Jan 2009	-18.4	-4.4	-16.9	-4.6
Feb 2009	-16.8	-6.4	-18.1	-6.4
Mar 2009	-14.7	-8.2	-18.7	-8.3
Apr 2009	-2.2	-8.4	-5.1	-8.5
May 2009	-9.5	-9.5	-11.8	-9.7
Jun 2009	-5.2	-9.9	-8.7	-10.4
Jul 2009	-1.2	-9.8	-4.8	-10.5
Aug 2009	-0.8	-9.6	-5.4	-10.8
Sep 2009	0.6	-8.8	-5.1	-10.5
Oct 2009	3.9	-7.4	-2.6	-9.8
Nov 2009	3.3	-6.0	-0.8	-8.9
Dec 2009	5.4	-4.7	2.0	-8.0

Source: Aena Air Traffic Statistics: http://www.aena.es/csee/Satellite?pagename=Estadisticas/Home
Notes: a - Monthly total percentage change from corresponding month in previous year
b - Year ending month total percentage change from corresponding month in previous year

Italy had a similar experience to Spain with regards to the effects the GFC had on its economy. While its unemployment rate remained below that of Spain's, its GDP decreased by a larger proportion in 2009 and it had much higher debt ratios. Further, the fall in its airport passenger numbers mirrored that of Spain's initially. Figure 7.2 shows the change in passenger numbers at all Spanish and Italian airports for the period from 2008-2012. The lines show the change in the current month's passenger numbers to the corresponding month in 2007 and the change in the year-end current month numbers to the year-end corresponding month in 2007. As can be seen Spain's passenger numbers remained below the 2007 equivalent until well into 2011, while Italy's passenger numbers outdid 2007's early in 2010.

Figure 7.2 Percentage change in passenger numbers from corresponding month in 2007, Spanish and Italian airports, 2008-12



Source: Aena Air Traffic Statistics: http://www.aena.es/csee/Satellite?pagename=Estadisticas/Home, Associazone Italiana Gestori Aeroporti, http://www.assaeroporti.com/statistiche/
Notes: a - Monthly total percentage change from corresponding month in 2007
b - Year ending month total percentage change from corresponding month in 2007

Castillo-Manzano *et al*. (2012) attempted to measure the effect the Spanair crash had on air traffic on a number of different actors, including the air traffic at Madrid airport, as well as at the destination airport, the effect on Spanair's airline traffic and Spanair's airline traffic at Madrid airport. As we saw in the previous section individual airlines involved in air disasters often see a fall in their passenger numbers (Rainman effect), and this is indeed what the authors found in this case, with the number of flights operated by Spanair at Madrid airport decreasing permanently by 29 per cent. Spanair never fully recovered from the accident and collapsed in early 2012. The authors found a similar fall in airline traffic for Spanair at the destination airport, but found that in the case of the destination airport, the fall in Spanair traffic was explained by passengers choosing to fly with other airlines, with only a small reduction in overall passengers. The explanation for this is that, as Gran Canaria airport is part of the Canary Island Archipelago, there is no real travel alternative.

The authors factored in the economic crisis at the time and found this substitution effect was not so prevalent at Madrid airport, indicating that indeed there was a fall in passenger numbers. The authors estimate the fall in air traffic at 6 per cent, which decreased each month to be almost fully diminished by the end of the study period, over two years later in October 2010.

There is no study done on the fall in air traffic or passenger numbers across all of Spain. There is little doubt if there was an increase in people's aversion to fly after the Spanair accident at Madrid airport, this was also the case throughout the country. The Spanish Government declared three days of official mourning, so it is likely people in other parts of the country would have been aware of the tragedy. Further, our examination of passenger numbers at Madrid airport and all Spanish airports show that the initial fall in passenger numbers in September 2008 (compared to the September 2007) was similar across both cohorts. There was a slightly larger drop in passengers at Madrid compared to all of Spain in four of the first five months after the accident, but from then on the drop in passenger numbers across all of Spain was larger. Nor was there an examination of the proportion of the reduction in air traffic that were domestic or international flights. Liu and Zeng (2007) claim that demand for domestic air travel falls by a greater margin than for international air travel if the fatality rate from air transport accidents rises.

A comparison with Australia, should such an accident occur, is a difficult exercise, but there are some salient points to be made. First, Spanair was Spain's fourth biggest airline, but faced competition from other Spanish airlines as well as airlines across Europe. Hence, there were many substitution options for those potential passengers who blamed the airline and were willing to still fly with an alternative airline. Domestically, Australia has very little airline competition. Hence, a knock to the reputation of one of the main airlines would see some substitution to the alternative airline(s), but it would be reasonable to assume the substitution effect would be much smaller than in Spain. Ironically, the Rainman effect, named so because of reference to Australia's national airline, may actually not be as pronounced in Australia due to the small number of airline carriers in the marketplace. International travellers would have much more choice in changing airlines, however, the extent to which this would be done for regular travellers who had travelled on Australian airlines would be unknown.

Second, given the expanse of Australia and the time taken to travel using a form of transport other than air transport, substitution to other types of transport would also be fairly small. Travel between any of the country's major cities takes a minimum of a full day's travel by road or rail. Further, while the standard of road between the major cities is improving, travel to smaller cities is often on poor standard roads ill-equipped for increases in traffic. Indeed, it was found that following the September 11 2001 terrorist attacks in the US, a fear of flying prompted many travellers to substitute driving for flying, resulting in a large increase in driving deaths towards the end of 2001 (for example Blalock *et al*., 2009; Von Winterfeldt and Prager, 2010).

Third, Australia's exemplary safety record, particularly on high capacity RPT, could possibly see a disproportionate response to such an accident. Australians expect and assume a safe aviation industry. The rare aircraft crashes that occur, such as the Essendon crash in 2017, make headlines across the country and breed much discussion on the safety of Australia's aviation industry. Any such accident would generate reviews and inquiries at the highest level that would continue for months and be always reminding potential passengers of the possible dangers associated with air travel.

Fourth, the nature and cause of the accident would have a large bearing on the response of potential air transport patrons. In the case of Spanair, the flying public almost universally put the blame of the accident on Spanair (Garcia-Santamaria, 2010). This meant in a lot of cases people were comfortable to fly with another airline under the impression the same problem(s) wouldn't occur. If the accident were with the operations at an airport, or an accident showed the response to such was inadequate, it would have a much larger effect on people's mindset where substitution effects would be less likely.

While ARFF in Australia would not stop an accident like the one at Madrid airport in 2008 from happening, they are the best source of protection if an accident was to occur. The reality, as shown previously, is that the runway and surrounding area is still the most likely place an aircraft will have an accident, particularly one that does substantial damage to the aircraft.

Given the above discussion, an accident in Australia of the magnitude of the Spanair crash of 2008 would likely see a much larger fall in passenger numbers in Australia from people's aversion to flying, than that calculated by Castillo-Manzano *et al*. (2012) for Madrid.

7.6.2 Reduction in Australia's economic activity due to air transport accident

An attempt is made at estimating the predicted reduction in tourism GVA and thus the reduction in total GVA for Australia, given a reduction in people flying after an aviation accident. The following is based on an assumption that a drop in tourism will affect GVA in a proportional way. This may not be the case in practice, as direct tourism GVA is calculated as direct tourism output less the intermediate consumption required to produce the direct tourism output and some sectors may be affected more than others. A full description of the process the ABS follows to calculate GVA from consumption is provided in the Tourism Satellite Accounts Explanatory Notes (ABS, 2017).

The following uses data from the 2016-17 financial year, with the Deloitte Access Economics report providing the economic contribution of international and domestic tourists. Following the discussion above, the following assumptions are made:

- International visitors fall by 7 per cent.
- Domestic tourists who travel by air transport fall by 10 per cent.

International tourism

Direct contribution of international tourists to GVA: $12,036m
Direct contribution of international tourists to Employment: 146,000 jobs
Effect on GVA of reduction of 7% of international visitors: $843m
Effect on Employment of reduction of 7% of international visitors: 10,220 jobs

Domestic tourism

Direct contribution of domestic tourists who use air transport to GVA: $5,280m
Direct contribution of domestic tourists who use air transport to Employment: 78,200 jobs
Effect on GVA of reduction of 12% of domestic tourists who use air transport: $634m
Effect on Employment of reduction of 12% of domestic tourists who use air transport: 9,384 jobs

Total tourism

Total reduction in direct GVA as a result of an air traffic accident: $1,477m
Total reduction in direct Employment as a result of an air traffic accident: 19,604 jobs

A serious air transport accident will directly cause a reduction in tourism that will reduce Australia's Gross Value Added by an estimated $1.477 billion. This will also result in the direct loss of over 19,000 jobs. Including the flow-on effects of this reduction in tourism, Australia's Gross Value Added will reduce by almost $2.8 billion, over 2.8 per cent of the total contribution of the tourism sector to GVA, with almost 30,000 job losses (Table 7.11).

Table 7.11 Direct, indirect and total effects of reduction in GVA as a result of a serious air transport accident, 2015-16 dollars

		Direct		Indirect		Total	
		GVA ($m)	Emp[a] ('000)	GVA ($m)	Emp[a] ('000)	GVA ($m)	Emp[a] ('000)
Inter-national	Original GVA 2016-17	12,036	146.0	9,601	72.6	21,637	218.5
	Accident reduction	843	10.2	672	5.1	1,515	15.3
	GVA after accident	11,193	135.8	8,929	67.5	20,122	203.3
Domestic	Original GVA 2016-17	5,280	78.2	5,367	43.0	10,647	121.2
	Accident reduction	634	9.4	644	5.2	1,278	14.6
	GVA after accident	4,646	68.8	4,723	37.8	9,369	106.6
Total	Original GVA 2016-17	17,316	224.2	14,968	115.6	32,284	339.7
	Accident reduction	1,477	19.6	1,316	10.3	2,793	29.9
	GVA after accident	15,839	204.6	13,652	105.3	29,491	309.9

Source: Deloitte Access Economics, 2018; authors' calculations
Notes: a - Full-time equivalent

It must be noted that this analysis only looks at tourism, and excludes the impact the reduction in air transport demand would have on the aviation sector, core airport activities and some airport precinct activities. Indeed, a reduction in air transport demand would have an effect on the economic contribution of all these sectors and the overall effect on GVA would indeed be much greater.

Section 8 Conclusion

This report has provided a detailed review and evaluation of many aspects of Aviation Rescue and Fire Fighting (ARFF) in Australia, as a contribution to the Senate Inquiry into the provision of rescue, fire fighting and emergency response at Australian airports. ARFF is a specialised branch of fire fighting designed specifically to respond to aircraft crashes and fires and to protect persons and property in danger. The need to respond in a timely manner with appropriate equipment is of paramount importance to prevent catastrophe when such an accident occurs.

There are 28 airports around Australia with ARFF services, 26 of which are provided by Airservices Australia (ASA), a Commonwealth entity with responsibility also for terminal and en route navigation services. ASA must provide ARFF services according to the Civil Aviation Safety Regulations (CASR), in particular Subpart 139.H, which are administered and enforced by the Civil Aviation Safety Authority (CASA). The policy manual outlining aviation safety standards are the Manual of Standards (MOS).

CASA has authority to issue exemptions to ASA on regulations in the CASR or standards in the MOS, which it does following application by ASA. Recently it has been found there have been two occasions of ASA not complying with Australian standards, yet not having received an exemption from CASA. This is a concern given there appears little oversight on these matters unless they are raised at Senate hearings.

The International Civil Aviation Organisation (ICAO) sets out international Standards and Recommendations (SARPs) for all areas of civil aviation, including the provision and requirements of ARFF services. ICAO utilise an oversight programme where Member States that are not compliant with the SARPs are required to notify of a difference and this information is available to other Member States. However, aside from this, ICAO has little power to enforce their SARPs and rely on cooperative participation from Member States. In Australia’s case, the MOS outlines that if there is a difference between the ICAO SARPs and Australian standards, the MOS shall take precedence.

The MOS outlines the requirement that ARFF services will be provided at airports with scheduled international passenger air services or where 350,000 people pass through an airport on scheduled passenger air services over a 12 month period. Following a regulatory review in 2015-16, when an airport passes the passenger threshold a risk review is to be conducted before deciding whether ARFF is required. Proserpine airport passed the threshold in the 2016-17, having been less than 2,000 short the previous year, yet will have to wait until mid 2020 before having an ARFF service implemented.

This time lag is consistent with the approach of certain authorities that ARFF services are not seen as priorities. The recommendation from the Department of Infrastructure and Regional Development (DIRD) to the regulatory review of 2015-16 was to raise the threshold number of passengers to 500,000 over a 12 month period. Not only would this have seen airports take longer to have an ARFF service realised, it would have seen up to seven existing ARFF services become redundant. This is despite the DIRD report making comparisons with other similar countries, all of which had requirements such that if they were applied here, would see many more airports with ARFF services.

This occurred at a time when Australia was only providing ARFF services at 28 of 190 certified airports around the country. Indeed, when taken on aircraft movements rather than passenger movements, two of the top three and five of the top ten airports in Australia do not have ARFF services. These are secondary capital city airports that are situated near built-up areas and have many general and recreational aviation flights use their runways. Surely airports such as these, which see a large number of take-offs and landings of aircraft that are generally less safe than the larger passenger services, could benefit from the expertise of ARFF.

Despite being the international standard upon which most countries base their civil aviation standards, including ARFF standards, the ICAO SARPs are less stringent than those of the National Fire Protection Administration (NFPA), essentially providing less protection to fire fighters and those they are trying to protect. Among these standards are the number of vehicles required at Category 9 and 10 airports, and the amount of extinguishing agent required on the vehicles to be applied to a fire. NFPA standards not only require a larger amount of water on the vehicles for suppression of an aircraft fire, they also mandate an extra amount of water for interior fires, inside the cabin of crashed aircraft. ICAO and NFPA both recommend a task resource analysis (TRA) to be performed to allocate appropriate crewing levels at an airport. While these processes are similar for both organisations, the NFPA also have minimum crew numbers depending on the category of the airport. Australia's current crew numbers are based on an out-of-date methodology rather than the TRA approach recommended by ICAO. Present crew numbers at Australian airports are much lower than the NFPA recommendation of minimum numbers. Further, Brisbane and Perth airports were recently both downgraded from Category 10 to Category 9 airports as they could not maintain consistent Category 10 coverage due to ASA decisions regarding crewing arrangements with their Domestic Response Vehicles, even though they will still receive Category 10 aircraft.

Australia seemingly has a high commitment to adhering to the ICAO SARPs, as it ranks eighth of Member States in its Effective Implementation (EI). In the area of ARFF, which is covered in the Aerodromes and Ground Aids (AGA) umbrella, Australia ranks tenth. This score was after an audit process was completed by Australia in 2017, where ICAO officials visited Australia in order to assist it with becoming more compliant. Prior to the visit Australia's EI score was 85.27, which would place it 48th in today's rankings. There remains over 450 differences listed on Australia's Aeronautical Information Publication, including nine regarding ARFF where the difference is classified as 'less protective or partially implemented / not implemented.' Indeed, while obviously a large effort has gone into improving Australia's compliance with ICAO SARPs, it appears more is required.

Australia is quite unique in the way it provides ARFF services and the charging model it has to recover their costs. ASA is responsible for providing ARFF services at 26 of Australia's airports and directly charges airlines, based on the airport they are using and the size of aircraft. The pricing model has been a point of contention for many years, with options varying between a network price where the whole system is supported on a needs basis, to a location specific and/or category specific price based on the idea of user pays. Large international airlines lobby against the network price system as they subsidise small, regional airlines, while small airlines and regional airports push for a network price system arguing safety is a need that should not be based on location. The current system is a hybrid model where all Category 6 aircraft are charged the same price per tonne, but larger aircraft are charged different prices depending on the airport they are using.

The question as to who the stakeholders are for the safety of Australia's aviation sector could provide the key to how the system is financed. It can be assumed that all Australians gain some benefit from having ARFF services at airports, certainly in greater numbers than they are at present. Not only do Australians benefit from safer travel, they benefit from the tourism benefits garnered through an international reputation as a safe place to travel. Further, Australians benefit from having an extra emergency response capacity available to assist in times of national emergency.

A conservative estimate of just over three dollars per passenger landing at one of the 26 Australian airports with ASA ARFF services would cover the operating costs of those services. Any increase on this could expand the service to other airports in order of need. This is not much higher than a passenger on an Airbus A380 would pay landing at Sydney, and would be less than a passenger landing at Perth. Indeed, research shows that people's willingness to pay for increased safety on air transport is higher than for other forms of transport.

Tourism and air travel are interlinked, particularly in Australia, where international visitors nearly all arrive by air transport, and where our large and sparse country means air transport is the most convenient way for domestic tourists to travel to most destinations. Tourism provides large benefits for the country, mainly through the economic contribution of tourists. International tourists contribute to exports and domestic tourists contribute to the GDP of the country through their internal transactions.

Australia has a very good airline safety record, which has promulgated an international reputation that Australia is a safe place to travel to and around. Despite this there are many serious accidents and less serious incidents that occur each year, some of which happen to regular public transport (RPT) flights. People's perception of air safety is a subjective matter, but there is evidence that people avoid airlines involved in accidents and that demand for all air travel falls when there are accidents. An attempt to measure the effect a serious aviation accident would have on Australia's tourism industry showed that total Gross Value Added would fall by almost $2.8 billion, based on a seven per cent fall in international tourists and a twelve per cent fall in domestic tourists.

The provision of rescue, fire fighting and emergency response at Australian airports, in the form of ARFF services, is a requirement of ICAO standards. Further, it is a necessity for a society that relies so heavily on air transport for tourism and business that its airports be protected if a major aircraft accident was to occur. Moreover, the consequences of a major aviation accident where the response was inadequate would have a lasting effect on the reputation of Australia as having a safe airline industry and as a facilitator for tourism. Indeed the priority given to ARFF services should be commensurate with these considerations.

References

ABS (2017) *Catalogue 5294.0 – Australian National Accounts: tourism Satellite Account, 2016-17*, Australian Bureau of Statistics, Canberra.

ABS (2019) *Catalogue 3401.0 - Overseas Arrivals and Departures, Australia, Dec 2018*, Australian Bureau of Statistics, Canberra.

Airbus (2018) *A Statistical Analysis of Commercial Aviation Accidents 1958-2017*, Airbus SAS, France.

ASA (2005) *Aviation Rescue and Fire Fighting Services, Options for Charging*, Airservices Australia, Canberra.

ASA (2008) *Price structure options, Discussion paper*, Airservices Australia, Canberra.

ASA (2011) *Draft Price Notification*, Airservices Australia, Canberra.

ASA (2015) *Pricing Proposal 2016-2021*, Airservices Australia, Canberra.

ASA (2016) *Contract for the provision of aviation facilities and services*, Airservices Australia, Canberra.

ASA (2017) *Service Provision for Temporary Change to Category Operational Procedure, Ops-005*, Version 14, Airservices Australia, Canberra.

ASA (2018a) *Annual Report 2017-18*, Airservices Australia, Canberra.

ASA (2018b) Aeronautical Information Package, *AIP Supplement H44/18*, Supplement Annex 14 Part or Volume 1, Airservices Australia, Canberra.

ATSB (2006) *International Fatality Rates: A Comparison of Australian Civil Aviation Fatality Rates with International Data*, Australian Transport Safety Bureau, Canberra.

ATSB (2018) *Aviation Occurrence Statistics*, Australian Transport Safety Bureau, Canberra.

ATSB (2019) *Australian Transport Safety Bureau*, website accessed 8/2/2019 at: https://www.atsb.gov.au/aviation/aviation-safety.aspx.

BARA (2015) *Airservices Australia's Discussion Paper: 2016 Long Term Pricing Agreement*, Board of Airline Representatives of Australia, Sydney.

BARA (2016) *Aviation Rescue and Fire Fighting Services Regulatory Policy Review*, Board of Airline Representatives of Australia, Sydney.

Barowy, A.M., Notarianni, K., Averill, J.D., Moore-Merrell, L. and Santos, R. (2010) 'Community Risk Assessment Modeling: Results of Residential Fireground Field Experiments', *Proceedings of the Twelfth International Interflam Conference*, July, 1875-1886.

Bieger, T. and Wittmer, A. (2006) 'Air transport and tourism – Perspectives and challenges for destinations, airlines and governments', *Journal of Air Transport Management*, 12, 40-46.

BITRE (2019) *Airport Traffic Data 1985-86 to 2017-18*, Bureau of Infrastructure, Transport and Regional Economics, retrieved 20 March 2019 at: https://bitre.gov.au/publications/ongoing/airport_traffic_data.aspx

Blalock, G., Kadiyali, V. and Simon, D.H. (2009) 'Driving Fatalities after 9/11: a hidden cost of terrorism', *Applied Economics*, 41, 1717-1729.

Bosch, J-C., Eckard, E.W. and Singal, V. (1998) 'The Competitive Impact of Air Crashes: Stock Market Evidence', *The Journal of Law and Economics*, 41(2), 503-519.

Braithwaite, G.R. (2001) 'Aviation rescue and firefighting in Australia – is it protecting the customer?', *Journal of Air Transport Management*, 7, 111-118.

Button, K., Clarke, A., Palubinskas, G., Stough, R. and Thibault, M. (2004) 'Conforming with ICAO safety oversight standards', *Journal of Air Transport Management*, 10, 251-257.

CAA (2014) *Information Paper 04, Task and Resource Analysis, CAP 1150*, Civil Aviation Authority, West Sussex.

CAA (2017) *Framework for the competence of rescue and fire fighting service (RFFS) personnel, CAP 699*, Civil Aviation Authority, West Sussex.

CAA (2019) *Licensing of Aerodromes, CAP 168*, Civil Aviation Authority, West Sussex.

CASA (2005) *MOS Part 139H – Standards Applicable to the Provision of Aerodrome Rescue and Fire Fighting Services*, Civil Aviation Safety Authority, Canberra.

CASA (2019) *Civil Aviation Safety Authority*, website accessed 8/2/2019 at: https://www.casa.gov.au/standard-page/casr-part-139-aerodromes.

Carlsson, F., Johansson-Stenman, O. and Martinsson, P. (2004) 'Is transport safety more valuable in the air?', *The Journal of Risk and Uncertainty*, 28(2), 147–163.

Castillo-Manzano, J.I., Pedregal, D.J. and Pozo-Barajas, R. (2012) 'Assessing the fear of flying after a plane crash. The "Rainman" effect – Myth or reality?', *Journal of Air transport Management*, 20, 20-22.

Certification of Airports, 14 CFR § 139 (2004)

CIAIAC (2008) *Report A-032/2008 Accident involving a McDonnell Douglas DC-9-82 (MD-82) aircraft, registration EC-HFP, operated by Spanair, at Madrid-Barajas Airport, on 20 August 2008*, Civil Aviation Accident and Incident Investigation Commission, Madrid.

Civil Aviation Act 1988 (Cwlth)

Commonwealth of Australia (2018) *Senate, Rural and Regional Affairs and Transport Legislation Committee (Proof Committee Hansard), Performance of Airservices Australia*, 4 December.

Commonwealth of Australia (2019a) *Senate, Rural and Regional Affairs and Transport Legislation Committee (Proof Committee Hansard), Estimates*, 18 February.

Commonwealth of Australia (2019b) *Senate, Rural and Regional Affairs and Transport References Committee (Proof Committee Hansard), Provision of rescue, firefighting and emergency response at Australian airports*, 14 March.

Debbage, K.G. and Alkaabi, K. (2008) 'Market Power and Vertical (Dis)integration? Airline Networks and Destination Development in the United States and Dubai', in Graham, A, Papatheodorou, A. and Forsyth, P. (eds.) *Aviation and Tourism: Implications for Leisure Travel*, Routledge, New York.

Deepa, M.V. and Jayaraman, K. (2017) 'Scale Measurements for Airline Service Quality to Secure Passenger Confidence in Air Travel', *Quality Management Journal*, 24(3), 31-50.

Deloitte Access Economics (2018) *Connecting Australia: The economic and social contribution of Australia's airports*, Deloitte Access Economics, Canberra.

DIRD (2015) *Aviation Rescue and Fire Fighting Services Regulatory Policy Review, Public Consultation Paper*, Department of Infrastructure and Regional Development, Canberra.

Dwyer, L., P. Forsyth and R. Spurr (2006) 'Economic evaluation of special events', in Dwyer, L. and Forsyth, P. (eds.), *International Handbook on the Economics of Tourism*, Edward Elgar, Cheltenham, UK, 316-355.

Economics and Industry Standing Committee (2017) *Perceptions and Realities of Regional Airfare Prices in Western Australia*, Parliament of Western Australia.

FAA (2004) 'Aircraft Fire Extinguishing Agents', *AC 150/5210-6D*, Department of Transportation Federal Aviation Administration, Washington.

FAA (2010) 'ARFF Vehicle and High reach Extendable Turret (HRET) Operation, Training and Qualifications', *AC 150/5210-23*, Department of Transportation Federal Aviation Administration, Washington.

Forsyth, P. (2006) 'Martin Kunz Memorial Lecture. Tourism benefits and aviation policy', *Journal of Air Transport Management*, 12, 3-13.

Forsyth, P. (2008) 'Tourism and Aviation Policy: Exploring the Links', in Graham, A, Papatheodorou, A. and Forsyth, P. (eds.) *Aviation and Tourism: Implications for Leisure Travel*, Routledge, New York.

Frechtling, D.C. (2012) *Extending the Measurement of the Economic Impact of Tourism Beyond a Regional Tourism Satellite Account*, Paper presented to the INRouTE 1st Seminar on Regional tourism: Setting the Focus, Venice.

Fyhri, A. and Backer-Grondahl, A. (2012) 'Personality and risk perception in transport', *Accident Analysis and Prevention*, 49, 470-475.

Galambos, A., Deri, L., Dragin, A., Galambos, T. and Markovic, J.J. (2014) 'Air Travel Safety Perception Among Tourists With or Without Flying Experience', *European Journal of Economic Studies*, 7, 15-24.

Galaxy Research (2014) *Public Attitudes to Aviation Safety*, retrieved 6 March 2018 from: https://www.casa.gov.au/file/140716/download?token=_nBxTh5S

Garcia-Santamaria, J.V. (2010) 'The crisis of investigative Journalism in Spain. The journalism practice in the Spanair accident', *Revista Latina de Comunicación Social*, 65, 879-921.

Gascoigne, H. (1989) *The Airport Rescue and Fire Fighting Service*, Airways Museum, accessed 14 March 2019: http://www.airwaysmuseum.com/ARFF%20history%20Part%201.htm.

Gill, G.K. and Shergill, G.S. (2004) 'Perceptions of safety management and safety culture in the aviation industry in New Zealand', *Journal of Air Transport Management*, 10, 233-239.

Gigerenzer, G. (2004) 'Dread risk, September 11, and fatal traffic accidents', *American Psychological Society*, 15(4), 286-287.

Hampson, I., Fraser, D., Quinlan, M., Junor A. and Gregson, S. (2015) *The Future of Aircraft Maintenance in Australia: Workforce Capability, Aviation Safety and Industry Development. Final report of findings from Australian Research Council Linkage Project 110100335*, UNSW Business School, Sydney.

Ho, J.C., Qiu, M. and Tang, X. (2013) 'Do airlines always suffer from crashes?', *Economic Letters*, 118, 113-117.

ICAO (2009) *Final Report on the Safety Oversight Audit of the Civil Aviation System of Australia*, International Civil Aviation Organisation, Montreal.

ICAO (2010) 'The USOAP Evolved: Realizing the Promise of the Continuous Monitoring Approach', *ICAO Journal*, 5, 25-28.

ICAO (2015) *Doc 9137-AN/898 Airport Services Manual, Part 1 – Rescue and Firefighting, Fourth Edition*, International Civil Aviation Organisation, Montreal.

ICAO (2018a) *Annex 14 to the Convention on International Civil Aviation: Aerodromes, Volume 1, Aerodrome Design and Operations, Eighth Edition*, International Civil Aviation Organisation, Montreal.

ICAO (2018b) *Final Report of the ICAO Coordinated Validation Mission in Australia*, International Civil Aviation Organisation, Montreal.

ICAO (2018c) *ICAO Safety Report, 2018 Edition*, International Civil Aviation Organisation, Montreal.

InterVistas (2018) *The Impact of Airport Charges on Airfares*, InterVistas Consulting, Vancouver.

Ito, H. and Lee, D. (2005a) 'Assessing the impact of the September 11 terrorist attacks on US airline demand', *Journal of Economics and Business*, 57, 75-95.

Ito, H. and Lee, D. (2005b) 'Comparing the impact of the September 11th terrorist attacks on international airline demand', *International Journal of the Economics of Business*, 12(2), 225-249.

Koo, T.T.R., Caponecchia, C. and Williamson, A. (2015) 'Measuring the effect of aviation safety risk reduction on flight choice in young travellers', *Safety Science*, 73, 1-7.

Kreckie, J. (2011) 'Achieving effective ARFF in a challenging economy', *International Airport Review*, 6.

Li, C., Phun, V.K., Suzuki, M. and Yai, T. (2015) 'The effects of aviation accidents on public perception toward an airline', *Journal of the Eastern Asia Society for Transportation Studies*, 11, 2347-2362.

Liu, H. and Zeng, J. (2007) 'Airline passenger fatality and the demand for air travel', *Applied Economics*, 39(14), 1773-1781.

Mitchell, M.L. and Maloney, M.T. (1989) 'Crisis in the cockpit? The role of market forces in promoting air travel safety', *Journal of Law and Economics*, 32, 329–55.

NFPA (2016) *NFPA 1710: Standard for the Organisation and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*, National Fire Protection Association, Massachusetts.

NFPA (2018) *NFPA 403: Standard for Aircraft Rescue and fire-Fighting Services at Airports 2018*, National Fire Protection Association, Massachusetts.

O'Sullivan, M. (2014) 'Malaysia Airlines admits it has 'work to do' to win back flying public's trust', *The Sydney Morning Herald*, accessed 7 March 2018: https://www.smh.com.au/business/companies/malaysia-airlines-admits-it-has-work-to-do-to-win-back-flying-publics-trust-20141031-11ev1b.html.

Quirk, V. (2016) *Prioritising safety in the allocation of Australian Aviation Rescue Fire Fighting Services (ARFFS), Report prepared for the United Firefighters Union of Australia, Aviation Branch*, Centre of Full Employment and Equity, Newcastle.

RAAA (2015) *RAAA Submission, Airservices Australia Long Term Pricing Agreement, July 2016 to June 2021, Discussion Paper*, Regional Aviation Association of Australia, Canberra.

Rex (2015) *Regional Express Group Response to Airservices Pricing Proposal 2016-2021*, Regional Express Group, Sydney.

Ringle, C.M., Sarstedt, M. and Zimmermann, L. (2011) 'Customer Satisfaction with Commercial Airlines: The Role of Perceived Safety and Purpose of Travel', *Journal of Marketing Theory and Practice,* 19(4), 459-472.

Rosenkrans, W. (2008) 'Rescue me', *Aero Safety World*, November, 20-25.

Savage, I. (2011) 'Competition on the basis of safety?', in Peoples, J. (ed.) Pricing Behavior and Non-Price Characteristics in the Airline Industry, *Advances in Airline Economics*, 3, Emerald Books, Bingley, United Kingdom, 297-323.

Scheffey, J.L., Darwin, R.L. and Hunt, S. (2012) *A Technical Review of Methodologies for Calculating Firefighting Agent Quantities Needed to Combat Aircraft Crash Fires*, US Department of Transportation and Federal Aviation Administration, New Jersey.

Siegel, R. (2018) 'Southwest Airlines says passengers are slow to return after Flight 1380 death', *The Washington Post*, accessed 7 March 2019: https://www.washingtonpost.com/news/business/wp/2018/06/04/southwest-airlines-says-passengers-are-slow-to-return-after-flight-1380-death/?noredirect=on&utm_term=.e0151a280fa1.

Smeral, E. (2006) 'Tourism Satellite Accounts: A Critical Assessment', *Journal of Travel Research*, 45, 92-98.

Spence, T.B., Fanjoy, R.O., Lu, C. and Schreckengast, S.W. (2015) 'International standardization compliance in aviation', *Journal of Air Transport Management*, 49, 1-8.

Standing Committee of State Development (2014) *Report of Proceedings: Inquiry into Regional Aviation Services*, Parliament of New South Wales.

Standing Committee on Transport and Regional Services (2003) *Regional Aviation and Island Transport Services: Making Ends Meet, Inquiry into commercial regional aviation services in Australia and alternative transport links to major populated islands*, House of Representatives, Parliament of Australia, Canberra.

TRA (2014) *Tourism's Contribution to the Australian Economy 1997-98 to 2012-13*, Tourism Research Australia, Canberra.

UNWTO, Eurostat and OECD (2010) *Tourism Satellite Account, Recommended Methodological Framework 2008,* United Nations.

Von Winterfeldt, D. and Prager, F. (2010) *Estimating behavioral changes for transportation modes after terrorist attacks in London, Madrid, and Tokyo*, Metrans, Los, Angeles.

Wang, M. and Song, H. (2010) 'Air travel demand studies: A review', *Journal of China Tourism Research*, 6(1), 29-49.

Webster, C. and Ivanov, S. (2014) 'Transforming competitiveness into economic benefits: Does tourism stimulate economic growth in more competitive destinations?', *Tourism Management*, 40, 137-140.

Williams, A.M. and Balaz, V. (2009) 'Low-Cost Carriers, Economies of Flows and Regional Externalities', *Regional Studies*, 43(5), 677-691.

WTTC (2018) *Travel and Tourism Economic Impact 2018 Australia*, World Travel and Tourism Council, London.

Young, A. (2018) *To70's Civil Aviation Safety Review 2017*, accessed 27 February 2019 from: https://to70.com/to70s-civil-aviation-safety-review-2017/

Young, A. (2019) *To70's Civil Aviation Safety Review 2018*, accessed 27 February 2019 from: https://to70.com/to70s-civil-aviation-safety-review-2018/

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[i] The authors are Professor of Economics and Director of the Centre of Full Employment and Equity at the University of Newcastle, Australia (Mitchell) and Research Officer, Centre of Full Employment and Equity at the University of Newcastle, Australia (Flanagan).