An assessment of trends and risk factors in passenger air transport
It is no secret that the Australian aviation industry, in step with aviation worldwide, is rapidly changing and evolving. Over recent years Australian aviation has undergone enormous change, with new competitors entering the market, new aircraft types and technologies introduced, increased demand for services and shortages of skilled staff placing some operators under considerable pressure.

In the modern, dynamic environment where new risks are continually emerging, safety can only be maintained and enhanced by having in place systems to identify and effectively mitigate risks as they develop. It is no longer acceptable to rely solely on incident or accident data in an attempt to predict future risks to aviation safety. A robust risk management approach must consider changing environments and emerging trends, and aviation organisations must manage their risks in ways which are most appropriate to their current circumstances and future needs.

In late 2007 I invited representatives and members of the aviation industry, along with CASA managers and staff, to submit their ideas about what they considered to be the greatest safety risks the industry will need to address over the coming three to five years. Participants were asked to look beyond organisational-level issues and instead consider matters of a strategic and ‘whole of industry’ nature, focusing on the priority area of passenger-carrying operations.

The results of that review form the basis for this report.

The review identified four broad trends currently impacting on the aviation industry and expected to remain key influences into the future. These are:

- Unprecedented global demand for aviation services, fuelled by an economic boom in various industries and countries
- Developments in aircraft manufacture, systems and technologies which offer potential safety solutions while simultaneously adding complexity and change

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The material in this booklet is provided for general information only, and on the understanding that the Civil Aviation Safety Authority (CASA) is not providing professional advice on a particular matter. Before any action or decision is taken on the basis of the material the user should obtain appropriate independent professional advice.
International instability and increased security-related costs and compliance burdens

Increased environmental awareness, driven by global concerns about global warming and climate change

These broad trends have obvious implications for specific aviation operational tasks and associated safety support systems. The areas of aviation expected to be affected by these larger influences include new and ageing aircraft, airports and infrastructure, airspace and air traffic management, aviation personnel, regulators and administrators.

This report provides further detail on how each of these areas is potentially affected, however the business of identifying real safety solutions - where action is not already underway - will be the focus of future work. While it is appropriate and possible for CASA to address some of the risks identified in the report, a number of the issues raised are beyond the scope of one agency and solutions will require an industry-wide approach.

Although there are a number of issues facing the high capacity regular public transport sector, it is the low capacity regular public transport and charter sectors of the industry that are particularly vulnerable to the risks outlined in this report. It is these same sectors which generally have fewer resources available to help mitigate these risks.

To facilitate a collaborative approach to addressing emerging trends and risk factors, CASA intends to establish five working groups to look at the areas of aviation most likely to be affected by the changing environment. These working groups will consist of experts drawn from both industry and government. They will assist with risk identification and research and the development and implementation of intervention strategies.

CASA, as the regulator, has, and will also introduce initiatives to further strengthen the integrity of the aviation safety system in the more vulnerable sectors. These measures include:

- Applying increased surveillance to pilot and maintenance personnel capabilities in the air transport sector
- Applying increased surveillance to compliance with flight and duty times and development of Fatigue Risk Management System guidance and regulations
- Giving increased priority to the introduction of safety management systems into passenger carrying operations
- Increased focus on management responsibility and capability in the air transport sector
- Increased monitoring of the aviation industry’s organisational procedures and processes during periods of rapid expansion
- Increased attention to the operation of larger passenger-carrying aircraft at non-towered aerodromes.
- Monitoring development at and in the vicinity of airports.
- Increased assessment of ageing airworthiness issues in smaller passenger aircraft not supported by manufacturers’ instructions for continuing airworthiness
- Establishment of new flight testing capability to conduct initial assessment of new flying instructors.

I would like to thank each and every person who took the time to participate in this important study.

CASA looks forward to working with the aviation industry and other government organisations in a unified way to develop strategies and solutions that meet the challenges inherent in maintaining and improving the safety of a vital, exciting industry.

Bruce Byron AM
Director of Aviation Safety and
Chief Executive Officer
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Introduction

Under Section 9 (1) (g) of the Civil Aviation Act, CASA has an obligation to conduct regular reviews of the system of civil aviation safety. This involves monitoring the safety performance of the aviation industry to identify safety-related trends and risk factors. CASA must look beyond the operational risks which impact upon individual organisations and also consider the factors, trends and issues which may impact upon the industry in general.

Threats to aviation safety often involve factors that are not the sole responsibility of any one organisation or agency. This report - An Assessment of Trends and Risk Factors in Passenger Air Transport - is the outcome of an initiative by CASA to establish regular ongoing engagement with industry members and other safety agencies to identify broad trends and issues that have the potential to affect safety outcomes.

While CASA can and does address many safety risks directly in its role as the independent safety regulator, a truly effective approach to safety management must involve a cooperative effort between government agencies - including CASA - and members of the industry who are responsible for the day-to-day delivery of safe operations.

This review could not have been undertaken without the active cooperation of the aviation industry and the willingness of participants to provide unbiased input to benefit the industry as a whole. CASA appreciates the almost unanimous offers made by respondents to participate in the ongoing work necessary to address the issues identified in this report.

Given the diverse nature of review participants, differences of opinion about trends and their relative importance were only to be expected. These included varying opinions about the importance of the different factors influencing aviation, the likely impact of these factors and the actions needed to ensure safety.

As a result it should be made clear that this report is a compilation of opinions and is not a definitive, scientific study. It does, however, reflect the considered views of experienced aviation professionals.

Where significant differences of views were apparent in the responses provided, CASA CEO Bruce Byron provided his own perspective based on lengthy professional experience and knowledge of current aviation safety issues. Accordingly, while the input from respondents forms the basis of this
report, it may not necessarily reflect the views of all who contributed. No claim is made that the issues discussed in this document are addressed either comprehensively or exhaustively. With this in mind, it is hoped that those people involved in the review and the aviation industry in general will find this report useful in forming their own opinions, and that it will stimulate further debate, analysis, and action.
Passenger focus

In line with the expectations of the Australian travelling public, CASA directs the majority of its resources towards the safety of passenger-carrying aviation operations. The scope of this report is, therefore, limited to issues likely to affect passenger safety. On a practical level, many of the issues identified in the report are also likely to impact upon other sectors of the aviation industry and the findings may be applied as safety considerations for other aviation operations.

Specifications

The main specification in collecting information for this report was that participants were approached individually and invited to provide their responses to a range of questions. Participants were asked to limit their input to issues of a strategic nature and issues either currently affecting or likely to affect the aviation industry in the future.

Participants were not required to present formal statistical or research support for their views. They were advised that their submissions would be treated confidentially and would not be publicly attributed to any individual or organisation. Participants were also advised that CASA CEO Bruce Byron would have the right to determine the information included in the final assessment report.

Participants were free to organise and submit their responses in their own way, but were asked to consider risks in terms of the relationship between characteristics of operational tasks and support systems influenced by broader trends. In this context, support systems are defined as including both specific intentional interventions, as well as broader developments that act to contain or mitigate risks.

One example is where broad economic expansion (a wider external trend) produces major increases in aviation activity, which in turn results in a pilot shortage. In order to continue operating and meeting the demand airlines may respond by hiring less experienced personnel (changing the characteristics of the operational task), and giving rise to a number of potential safety risks.

Conversely, identified risks may be contained by various risk control measures. These could include specific interventions (such as changes to pilot training) or more general changes (such as the introduction of new technologies and automation). These interventions would not only change the nature of the job, but also the skills and experience required to conduct it safely.

Figure 1: Proposed risk framework

The framework illustrated above envisages safety problems developing when a gap arises between operational task characteristics and risk control measures. Such disparity may be the result of:

- A rapid change in an operational task for which support systems have not had time to adapt.
- A gradual change in an operational task which has been undetected or not identified as requiring additional support.
- A deterioration in support mechanisms (this may occur because the deterioration has been gradual and therefore undetected, or it may result from deliberate decisions to reduce resource allocation. Such deliberate decisions may reflect either a reduced capacity for investment by operators beset by financial difficulties or a feeling that further investment in safety is unwarranted, given the current low accident rate).

Both operational tasks and support systems are subject to broad environmental influences which may impact upon their effectiveness and interaction.

In risk terms, such ‘environmental drivers’ may be either beneficial and/or detrimental. For example, advancements in technology and flight management systems provide both a risk associated with transitioning to new procedures, while simultaneously ameliorating issues of cockpit and crew workload.
Data collection

In addition to a general invitation to the aviation industry as a whole, major representative organisations and consultative bodies were specifically invited to participate in this review and provide a collective analysis on behalf of their members and constituents.

A selection of individual experts from government and industry was also invited to participate in the review. These individuals were drawn from many sectors of the aviation industry, including:

- Major airlines
- Regional regular public transport and charter operations
- Educational and instructional facilities
- Maintenance providers
- CASA
- Other government agencies
- Service providers.

Participants were offered the opportunity to provide their responses in a variety of ways. These included providing written or email responses, lodging submissions via a dedicated website, phoning CASA or participating in personal interviews.

Report structure

This report first looks at environmental influences that have been identified as either currently influencing or expected to influence aviation safety in the future. It then examines the effects and implications of these environmental influences on operational tasks and associated support systems. The implications for industry sectors is then analysed and finally the next steps that CASA intends to take are detailed.
Broad external trends
Four broad categories of environmental drivers were consistently mentioned by participants as current or potential aviation safety risk factors. These were:
- Global demand for aviation services
- Environmental change awareness and initiatives
- Aircraft, systems and technology
- International instability and security.
Each of these categories is examined in further detail below, based on collated review findings.

Global demand for aviation services
As illustrated by the following figure provided by the Bureau of Infrastructure, Transport and Regional Economics, the Australian aviation industry is currently experiencing unprecedented growth.

As the figure illustrates, total regular public transport (RPT) passenger numbers have been growing steadily for many years, with the rate increasing from around 2002. From 1990 to 2001 passenger numbers doubled, giving an average yearly increase of about 6.7 per cent per year. From 2002 to 2006, passenger numbers increased even further by 44.7 per cent, or an average of 9.8 per cent per year. Anecdotal information obtained from industry interviews indicate similar, if not greater, growth will be recorded in the most recent period when fresh data becomes available.

Data supplied by the Bureau of Infrastructure, Transport and Regional Economics also demonstrates the differences in trends between the high capacity regular public transport sector and low capacity and charter sectors (note: low capacity aircraft refers to aircraft with up to 38 seats or 4200kg payload).

Table 1: Low capacity RPT activity data

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>Aircraft departures</th>
<th>Passengers (00,000s)</th>
<th>Hours flown</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>326,706</td>
<td>4,586,567</td>
<td>295,967</td>
</tr>
<tr>
<td>2001</td>
<td>275,364</td>
<td>3,835,330</td>
<td>249,247</td>
</tr>
<tr>
<td>2002</td>
<td>220,270</td>
<td>3,026,459</td>
<td>208,410</td>
</tr>
<tr>
<td>2003</td>
<td>204,360</td>
<td>3,001,795</td>
<td>197,172</td>
</tr>
<tr>
<td>2004</td>
<td>192,023</td>
<td>3,059,306</td>
<td>185,796</td>
</tr>
<tr>
<td>2005</td>
<td>196,760</td>
<td>2,994,059</td>
<td>193,215</td>
</tr>
<tr>
<td>2006</td>
<td>174,186</td>
<td>2,838,869</td>
<td>173,358</td>
</tr>
</tbody>
</table>
These tables show that total hours flown during the period 2000 to 2006 remained relatively static at around 800,000 per annum, with a decline in low capacity regular public transport (LCRPT) hours being offset by a comparable increase in high capacity regular public transport (HCRPT) activity. As can be seen in Figure 2, while both low capacity and high capacity passenger numbers generally increased each year at about the same level until 2000, their trends diverged after that with low capacity numbers declining while high capacity passengers increased.

These figures reflect a growing trend toward aircraft of a larger seating capacity, requiring less hours of operation to carry larger numbers of passengers. They also reflect the increased use of high capacity aircraft on regional routes, in many cases to locations which are not served by air traffic control towers.

This sustained growth appears to be generating a commensurate level of strain on operations, infrastructure and support systems within all sectors of the aviation industry. Although the aviation industry has often fluctuated in and out of cyclical ‘boom and bust’ periods, the current situation appears both sustained and expansive.

Drivers of this demand include:

- The initiation and growth of internet-based business and shopping, leading to increases in air freight operations
- The domestic resources boom having a direct effect on travel associated with mining and business activities and an indirect effect on the national economy, leading to increases in discretionary travel (such as tourism)
- The growth of the low cost carrier airline concept, which both expands existing markets and generates new ones
- The changing demographic of the airline passenger as an increasing percentage of the population uses air travel
- Advances in technologies which facilitate lower production costs and increased efficiencies with more viable routes and markets.
The International Air Transport Association predicts the world airliner fleet will double in the next twenty years. China alone is expected to increase its fleet from 1030 aircraft to 3900 by the year 2025, with passenger numbers in China estimated to increase from 160 million to 770 million per year by 2020. Locally, Qantas has been reported as upgrading its profit forecasts for the fifth time in a little more than a year and the company’s pre-tax profit in 2007-08 is expected to be approximately 40 per cent higher than last year’s figure of $1 billion. Similarly, Virgin Blue announced a 16.3 per cent increase in revenue and an associated 92.6 per cent increase in profit to $2.16m for the year ending June 30 2007. Virgin Blue has also signalled its intention to introduce a significant capacity increase over the next 18 months.

A downturn in economic optimism both globally and domestically (as reflected in financial markets) may have the potential to dampen some demand for services while increasing financial pressures on marginal operators within the industry. Preliminary evidence indicates this is a globally driven phenomenon with potentially far-reaching and unpredictable ramifications.

Environmental change awareness and initiatives

The awakening of international and domestic communities to the potential affects of global warming is expected to impact significantly upon the aviation industry. Environmental considerations have been the subject of keynote addresses at recent aviation conferences as the industry struggles with determining its responsibilities and strategies for addressing related global environmental issues.

There is now a clear recognition that aviation – responsible for around only two per cent of total greenhouse gases - does not contribute to climate change as significantly as other areas of the economy. However, unlike other industries, aviation-related emission contributions are growing due to the increasing demand for services and a lack of viable fuel alternatives. Emissions released at high altitudes may also have a more damaging impact on the environment.

The Bureau of Infrastructure, Transport and Regional Economics reports that: "Governments across the world are acting both individually and through the International Civil Aviation Organization (ICAO) to address aviation emissions. Domestically, the Government is committed to pursuing the implementation of an Australian emissions trading scheme as the primary mechanism for achieving Australia’s long term greenhouse gas emissions reductions goal of 60 per cent by 2050. A domestic emissions trading scheme would be expected to encompass emissions associated with the domestic aviation sector.

Fuel prices have already increased significantly in recent years. If limits are introduced on aviation related carbon emissions, even greater increases in costs and requirements may be required to offset emission in various ways. The requirement for fuel efficiency will be motivated not only by financial pressures, but also by the need to comply with environmental regulations.

This is expected to involve changes in the following areas:

- Improving fuel characteristics and developing new energy sources
- Improving engine performance in both new and ageing engines
- The design of new airframes
- Defining, with more precision, the characteristics of airports and infrastructure
- Improving air traffic services, such as ‘green’ constant descent approach profiles.

Aircraft, systems and technology

Technology has long been a driver of change within the aviation industry. In the decades since the Second World War, technological development has been the single most important factor in improving the safety performance of air transport. Advances in communication, navigation and surveillance in the operational environment (both in aircraft and on the ground) continue unabated with the introduction of a new generation of computers, automation and composite materials.

Examples of important technological developments include:

- Aircraft design, manufacturing and composite materials which produce lighter and faster aircraft, leading to increased global growth and demand for low cost transport
- Integrated air traffic management systems enabling more aircraft in enroute and terminal airspace
New airport infrastructure and ground facilities in support of activity growth

- New airport infrastructure and ground facilities required for new generation aircraft
- Engineering and maintenance systems to support new generation aircraft and avionics
- Security, surveillance and passenger handling devices and capabilities
- Landing and approach procedures design, coupled with integrated onboard technologies, providing unprecedented access and visibility with safer lower minimum altitudes (for example, augmented global positioning system approaches)
- The advent of the electronic flight bag providing up-to-date, comprehensive access to data and information in support of onboard systems
- Integration of aircraft systems and controls providing unprecedented utilisation of automation, communication, navigation and surveillance accuracy and integrity
- Continued improvements in simulation to support training systems
- Unmanned aerial systems and unmanned aerial vehicles for defence, security and civil applications.

Many of these developments are changing the operational task of flying in ways that provide substantial new measures to mitigate risk. In other cases, they also introduce new safety threats that must be actively managed.

International instability and security

The events of September 11, 2001, significantly changed the global aviation environment. Seven years later, the industry is feeling the longer term repercussions of the age of terrorism, global instability and security. Passenger transport operations in particular have struggled with security-related impositions and costs, including:

- Modifications to aircraft, systems and maintenance standards and procedures
- New security-related regulation and compliance requirements
- Interaction with additional government agencies and regulators
- Training, licensing and development for staff, contractors and support organisations and personnel
- Passenger, baggage and freight handling processes
- Airport security and facility upgrades
- Air traffic management systems, surveillance and procedures
- Increased financial and personnel resources for compliance and participation in the transport security regulatory and implementation process.

The aviation industry has accepted it has a direct responsibility to ensure the security of its staff, customers, and the community in general. But although necessary, security initiatives have resulted in a considerable financial and resource impost to the aviation community, arguably more so than any other industry. One potential safety ramification raised by review participants is that security requirements imposed upon operators will increase the cost and complexity of operations, in turn impacting on the capacity of operators to control traditional safety risks.
Implications for operational tasks and safety support systems

The broad external trends identified by participants have both general and specific implications for operational aviation tasks and their associated support systems. The effects of these trends are also extremely complex and interrelated. For example, some of the identified trends introduce new risks by changing the nature of operational tasks, while simultaneously providing risk mitigation through the strengthening of safety support systems.

The review identified five broad areas most likely to be affected by current and predicted trends in aviation. These are:

1. New and ageing aircraft
2. Airports and infrastructure
3. Airspace and air traffic management
4. Personnel
5. Regulators and administrators.

A closer look at how each of these areas may be affected by current and future trends follows.

Aircraft – ageing and new

Both new and ageing aircraft are affected by the growth in demand for aviation services, advances in technology and global concern about the natural environment. While an ageing fleet may potentially pose a risk to the safety of passenger-carrying operations, statistics indicate a closer look at the high capacity sector is also required. The primary issue for this sector involves adapting to the introduction of new types of aircraft.

In 2006 there were 40,835,272 passengers on Australian high capacity regular public transport flights compared with 2,838,889 on low capacity regular public transport flights. These figures show that high capacity regular public transport accounted for 93.5 per cent of total regular public transport passengers. The average high capacity regular public transport flight is longer than low capacity flights and so passenger-hours performed for high capacity regular public transport
are also proportionally greater. It is estimated that in 2006, about 96.3 per cent of regular public transport passenger hours performed were carried out by the high capacity sector. It is difficult to make a direct comparison with the charter sector since no figures exist for trip times or passengers on board. If it is assumed that the average charter trip takes less time and carries less than half as many passengers as a low capacity regular public transport flight, then a conservative estimate says that the charter sector is roughly the same size as the low capacity regular public transport sector in terms of passenger-hours performed. If so, then high capacity regular public transport could be broadly estimated to account for about 93 per cent of total passenger-hours performed in regular public transport and charter combined.

Given that the high capacity regular public transport sector dominates passenger transport, and that this sector is in the process of transitioning to several new types of aircraft, the primary passenger risks would appear to be those associated with the introduction of new aircraft.

New aircraft

Accompanying the unprecedented growth in global demand for aviation services has been a commensurate growth in the introduction of a range of new generation aircraft into the high capacity market. Australia has traditionally boasted one of the newest fleets in the world and continues to remain at the forefront. This is demonstrated through the recent or imminent arrivals of various aircraft including the Embraer 145 and 170, Bombardier Q400, Airbus 380 and the Boeing 787, in addition to later, more sophisticated versions of existing aircraft types.

New technologies and manufacturing techniques have driven down costs per seat and led to the emergence - both domestically and internationally - of what has become known as the low cost carrier. This has translated to the expansion of high performance and high capacity operations on regional routes previously the domain of low capacity regular public transport and charter operations.

While it is desirable for Australian airlines and regional communities to have access to the latest aircraft and associated technologies, issues requiring close attention include:

⇒ The increasing number of larger aircraft servicing regional locations with non-towered aerodromes and in procedural and non-controlled airspace

⇒ Oversight of the low cost carrier concept, with low cost carriers using non-traditional airline models relating to operational concepts, type, passenger demographics and country of origin safety culture

⇒ The ability of operators and organisations to obtain, train and manage appropriately skilled pilots, engineers and support personnel

⇒ The potential for unanticipated operational, maintenance and procedural issues associated with the use of new technology

⇒ The increased complexity of organisations operating multiple aircraft types.

Ageing aircraft

Outside the high capacity regular public transport sector, concerns relate to risks associated with an ageing aircraft fleet.

Bureau of Infrastructure, Transport and Regional Economics statistics show that a significant percentage of aircraft used in low capacity regular public transport and charter operations continue to age. For example, in 2006, almost 70 per cent of single engine fixed wing aircraft were more than 25 years old. Forty per cent of total single-engine fixed-wing aircraft were over 40 years old.

In addition, 8% of multi-engine fixed-wing aircraft were over 40 years old.

Not only are these aircraft continuing to age, but many are also being used more intensively due to the Australian resources boom. While it is possible to operate this fleet safely, there are a number of potential safety issues to consider:

⇒ Smaller passenger transport organisations operating ageing aircraft will need to deal with aircraft ageing and fatigue issues that have not been encountered before. Consequently there can be no certainty about the quantity or type of maintenance required to ensure a high level of safety

⇒ It may be difficult to recruit sufficient, qualified personnel to implement necessary maintenance
Increasingly, environmental concerns relating to emissions controls and engine and aircraft efficiencies will place greater operational pressures on operators of ageing aircraft. Manufacturers may decide not to support certain older aircraft, resulting in the possible grounding of aircraft used for passenger transport. Many newer aircraft are too large to be operated economically on low density routes. Even where newer aircraft were purchased, it may prove difficult to attract qualified operational personnel to maintain and operate them at levels which are viable from both a safety and economic perspective. It may also be difficult for smaller operators to buy newer generation aircraft suited to their particular needs, as manufacturers have increasingly retreated from traditional 9–19 seat aircraft production as they cater to the increasing global regional aircraft market.

In 2007, CASA advised the regional airline sector that increased focus is being placed by CASA airworthiness and structures experts on the adequacy of continuing airworthiness programs for the ageing fleet. Due to the uniquely high utilization of small passenger aircraft in Australia, CASA is assessing options for aircraft types that are not supported by manufacturer approved instructions for continuing airworthiness (ICA) or guidance from the relevant foreign National Airworthiness Authority.

Airports and infrastructure

Investment in airports and associated infrastructure is currently at a high level, fuelled by unprecedented airline activity. Despite this investment, some airports will be stretched to accommodate demand due to lag times in approvals, design, building and infrastructure construction. The privatisation of major airports has opened up a range of new practices designed to generate revenue. Aside from competition to attract new entrants, airport operators now also look to non-aviation returns on investments. Increasingly this means using land at airports for shopping centres, retail warehouses, outlets and office complexes. These developments concentrate large populations in areas of potential heightened risk and exacerbate the established trend of new suburbs progressively encroaching on airports. As a result, it is possible that the risks associated with a runway excursion type of accident are increasing, due to the increasing potential consequences.

Other substantial challenges facing the airports and infrastructure sectors include:

- Requirements to upgrade facilities and terminals to support new generation, high capacity aircraft
- Upgrading navigation aids, procedures and approach facilities (particularly at regional airports) to support technologically advanced aircraft systems and regional jet activities
- Implementing and upgrading security and passenger handling initiatives
- Increased complexity, resources and costs associated with security requirements.

Airspace and air traffic management

The contentious issue of airspace reform, in particular the National Airspace System process, has for many years polarised the aviation community in Australia. Those involved in professional and commercial operations (primarily operating under instrument flight rules) have generally been at odds with those involved in private or recreational activities which are more likely to be conducted under visual flight rules.

The National Airspace System process has led to debate around a number of safety issues. For example, some sectors of the industry cite concerns that the significant growth in regional airline activity - in many instances involving high capacity and high performance aircraft operating into regional communities - will continue to put pressure on the system. The interaction of heavy, high performance instrument flight rules aircraft with light visual flight rules recreational activity in non-towered airspace generates issues of separation assurance, wake turbulence and procedural practices which will require constant vigilance and review.

While much attention has been heavily focussed on the structure of airspace, the issues have been largely framed in terms of the National Airspace System model and this may mean that other factors associated with operations in different types of airspace have not had an opportunity to be examined in the same depth. Emerging technologies in approach design, and supporting infrastructure and avionic systems (including Area Navigation, Required Navigation Performance and Global Navigation Satellite Systems) provide opportunities for increased efficiencies and use of limited airspace.
The quest for environmental efficiencies will continue to add pressure to the complexity of airspace. This includes using constant descent or ‘green’ approaches and required reductions in holding and speed restrictions. The growing phenomena of unmanned aerial vehicles and the advent of the very light jet - both of which will push the boundaries of civil airspace use - ensure that the regulation, design and oversight of airspace will continue to require constant attention and monitoring.

As one review participant stated, "while such developments will ultimately contribute to capacity enhancement and efficiency improvement, they must also be a positive contributor to safety, not just increased capacity.”

Although congestion and access to airspace will require further consideration, it is the interaction of aircraft of vastly different size, speed and complexity in procedural airspace that will necessitate closest attention in the shorter term. While future technologies will provide new and innovative solutions and efficiencies, it will be essential to continually monitor triggers for airspace change, review procedures and assess surveillance strategies.

Members of the aviation industry also have the potential to advance surveillance, safety and security through the possibilities associated with terrain awareness and warning systems, traffic alert and collision avoidance systems, automatic dependent surveillance-broadcast and other systems.

**Personnel**

The aviation industry is currently experiencing severe shortages in many categories of personnel, both locally and internationally. This includes shortages of pilots and maintenance staff. Indicators suggest this may not yet have peaked and could continue for some time to come.

While recent global growth in aviation services has undoubtedly aggravated the situation, there are a number of precursors and industry structures which have also contributed:

- Historically, employment demand (and, as a consequence, training) has been cyclical and dependent on airline activity, providing little certainty for personnel regarding salary, tenure or career viability.
- Work in the general aviation sector has, as a rule, attracted salaries and conditions which are substantially less than airlines, given commensurate levels of responsibilities and tasks.

With limited availability of airline careers in the past, training with a view to obtaining airline employment has sometimes been seen as a gamble

- The relatively high cost of education and training has not attracted government subsidisation or fee offset schemes available to tertiary-based and trade careers.
- Airlines have traditionally recruited from other sectors of the industry rather than training for their needs. Rarely have they actively engaged the general aviation training sector to formulate a strategic approach to developing a skills base and career structure.
- The absence of an industry-wide policy providing a road map of requirements, skills, selection or promotion of aviation as a career.
- In more recent times the skills shortage has been exacerbated by lower activity in the charter sector (the traditional training ground for industry recruits).

It is becoming more widely accepted that new technologies and aircraft require a different trainee profile and associated training program. This applies to both pilots and licensed aircraft maintenance engineers alike. As a result, traditional (time-based) training practices or programs may no longer suit modern airlines and recruiting from the general aviation sector may not necessarily provide the skills the modern airline requires.

**Pilots – availability and training**

The global demand for pilots in general and experienced pilots specifically is creating unparalleled shortages. Alteon, a Boeing subsidiary, recently projected a worldwide requirement for in excess of 350,000 pilots over the next 20 years just to support new aircraft deliveries.

The commercial implications of this shortage are clear, leading to delays, reduction in flying activity and the subsequent loss of profitability currently being experienced by a number of operators. From a safety perspective, there are two additional concerns. First, these shortages may lead to attempts to pressure pilots into pushing the limits of flight and duty times in order to maintain schedules. Secondly, consideration needs to be given to the implications of hiring pilots, particularly those flying in complex aircraft and operating environments, with relatively low experience levels.

- The relatively high cost of education and training has not attracted government subsidisation or fee offset schemes available to tertiary-based and trade careers.
- Airlines have traditionally recruited from other sectors of the industry rather than training for their needs. Rarely have they actively engaged the general aviation training sector to formulate a strategic approach to developing a skills base and career structure.
- The absence of an industry-wide policy providing a road map of requirements, skills, selection or promotion of aviation as a career.
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**Pilots – availability and training**

The global demand for pilots in general and experienced pilots specifically is creating unparalleled shortages. Alteon, a Boeing subsidiary, recently projected a worldwide requirement for in excess of 350,000 pilots over the next 20 years just to support new aircraft deliveries.

The commercial implications of this shortage are clear, leading to delays, reduction in flying activity and the subsequent loss of profitability currently being experienced by a number of operators. From a safety perspective, there are two additional concerns. First, these shortages may lead to attempts to pressure pilots into pushing the limits of flight and duty times in order to maintain schedules. Secondly, consideration needs to be given to the implications of hiring pilots, particularly those flying in complex aircraft and operating environments, with relatively low experience levels.
Organisations with robust systems in place to oversight and mentor less experienced employees may well be able to manage threats to the integrity and safety of operations. Yet in recent times there has been a reduction in the availability of experienced individuals to provide operational management, mentoring and oversight in the charter and low capacity regular public transport sector due to airline recruitment.

The recent International Civil Aviation Safety Organization (ICAO) initiative to introduce a competency-based multi-crew pilot licence standard and training syllabus is seen as a positive step, with CASA supporting this development in Australia. The concept, originally designed in recognition of the changing character of the traditional pilot profile for the modern generation cockpit, may, as a secondary benefit, provide some relief in this area if it can be satisfactorily implemented.

As with traditional forms of training, the availability of appropriately skilled and experienced instructors and organisations to train and mentor new intakes is also at a minimum. The multi-crew pilot licence and associated systems monitoring role will also, like the introduction of any new technology or training regime, have implementation risks as the industry transitions and incorporates the ‘new generation pilot’ into operational flying.

Following a review of the safety performance of general aviation in 2004, CASA commenced a program of increased engagement with the flying training sector that included improved guidance, mentoring and educational products. The CASA CEO believes that the quality of flying instructors is the ‘foundation stone’ of the pilot training system that feeds the air transport sector. As the next step in influencing the quality of the system, CASA initiated the Flight Testing and Approved Testing Officer Management Program in 2007. This program will see new CASA Flight Testing Examiners conducting initial flying instructor assessments from June 2008.

Licensed aircraft maintenance engineers – availability and training

In recent years the overall number of maintenance personnel in Australia - specifically licensed aircraft maintenance engineers (LAMEs) - has slightly increased. Anecdotally, however, it appears that recent growth is generating increasing pressure on the availability of experienced maintenance personnel, particularly in certain categories of operation and in regional locations.

Professional representative bodies indicate that the average age of the LAME workforce is increasing, with the average age of LAMEs reported to be over 50. It is expected that the retirement rate will soon start to increase rapidly. There is some debate over whether training and apprenticeships - traditionally the responsibility of airlines and operators - are keeping pace.

The advent of new aircraft is also driving demand by changing the nature of the skills required. One high capacity regular public transport operator expressed concern that:

…the technology associated with the new aircraft types being introduced into the Australian market will require a significant investment in training and in some cases place increased demands on LAMEs. Availability of appropriate training infrastructure to develop these resources will be significant.

The manufacture of newer aircraft involves a greater use of composite materials and an increase in avionic hardware and software. This may mean that in the future some skill sets will be in ample supply but that there may be critical shortages of LAMEs with particular specialist knowledge.

As with pilots, a LAME shortage is not an inherent safety risk provided appropriate standards are maintained and schedules adjusted accordingly. Attention will, however, need to be given to issues of fatigue and human factors as any shortage would suggest engineers are at risk of being overworked in order to maintain existing or increased levels of flying. CASA intends to investigate the advisability of regulating duty times for maintenance personnel to ensure adequate standards are maintained, as is currently the case with pilots.

It is likely that for some larger operators there will be a greater reliance on offshore capability to perform heavy maintenance. This is primarily due to the lead time and cost required to build capability on shore. This reliance on offshore maintenance provides logistical problems and will bring challenges to ensure effective quality oversight. Although the option of sending maintenance offshore may be commercially attractive, this does little to secure the long term viability of the maintenance sector in Australia.

The shortage of skilled maintenance labour has been recognised by the Australian Government. Attempts are being made to address the labour shortfall by recruiting engineers from overseas countries and introducing other measures such as including aviation apprentices in apprentice support schemes.
Management - availability and experience
With increasing emphasis placed on outcome-based regulation and safety systems, the role of operational and administrative management has assumed greater significance in contributing to the overall safety of an organisation. This is particularly important during periods of sustained commercial and operational instability or growth, as the aviation industry is currently experiencing. The availability of skilled, resourceful and experienced individuals to undertake the roles of safety manager, check and training, chief pilots, instructors and business managers is also in short supply. The reasons for this decline in availability are generally similar to those for pilots and LAMEs. The decline in certain sectors is the result of key personnel transferring, generally, to better conditions and remuneration in larger organisations. The inability of some operators to attract and retain senior people to mentor, guide and direct the less experienced and maintain safety systems is an area of potentially increasing risk. Again, it appears for the moment that some operators in the airline and high capacity end of the industry are reasonably insulated from this particular predicament, as it commonly recruits from the general aviation and charter sectors. However, given the decades of relative stability in the airline sector prior to 2001, the industry is not well supplied with managers at middle and senior level who have had experience in managing risks associated with considerable change. CASA has taken steps to emphasise the role of senior management in influencing safety outcomes and the capabilities and behaviours of industry management are an increasing element of CASA surveillance activity. Indicators are emerging that general aviation and the low to medium capacity regular public transport and charter sectors of passenger transport are increasingly affected by a growing shortage of experienced and skilled personnel in all categories.

Regulation and industry oversight
The agencies responsible for regulating, overseeing and administering the aviation industry are not immune from the effects of the broad environmental trends that impact upon operators. These include:

- The introduction of new ‘direct entry’ training regimes and the integration of personnel into existing operational environments
- The employment of less experienced personnel in safety critical organisational areas and the need to ensure continuity and integrity of safety protocols and outcomes
- Ensuring flight and duty times and protocols are adhered to in relation to fatigue for all personnel
- The implementation and management of maintenance schedules for ageing aircraft fleet and liaison with foreign regulatory authorities and manufacturers
- Monitoring and reviewing the triggers and requirements for the augmentation of procedural and terminal airspace
- Integration of new technologies, systems and aircraft into new and existing operations, particularly as operators diversify
- Systems for entering, storing and disseminating safety critical data for use in electronic, automated and computerised flight systems. The increasing reliance on and acceptance of such systems will require comprehensive controls, procedures and oversight to ensure both accuracy and integrity are maintained.

All aviation organisations will need to move beyond any preconceived ideas that safety involves simple compliance with a fixed set of specific regulatory requirements. In a dynamic environment, there is no alternative to having an effective safety management system in place that has the flexibility to monitor, identify, and address risks on an ongoing basis. These changing dynamics are fundamentally changing the role of CASA’s surveillance, which increasingly involves not only ensuring that organisations are meeting their requirements to enact specific procedures, but also that judgements are made about how effectively operators are managing their risks in total.
Implementation and regulations

One of the key roles of CASA and other government agencies and service providers is to facilitate the development of regulations which promote the implementation of new systems and technologies. Given extraordinary advancements in communication, navigation and surveillance technologies, this expectation will require significant strategic and innovative planning.

CASA is currently transitioning the existing regulatory framework towards safety outcome-based legislation and regulation. In an industry that is constantly changing, it would be inappropriate and detrimental to safety to rely on regulations that specify standards, practices or procedures that regularly become outdated. It is critical that the regulations upon which the industry can rely are sufficiently flexible to accommodate change, while at the same time stable enough to allow for longer term planning.

Skills, training and personnel

The availability of skilled and experienced personnel, particularly in operational management positions, is crucial to the health and wellbeing of an operator’s safety system. This applies equally to government support and oversight agencies. It is reasonable to expect that the skills shortage presently impacting the industry may also impact upon the ability of CASA, Airservices Australia and the Australian Transport Safety Bureau to recruit suitably skilled and experienced operational staff, particularly from the high capacity regular public transport sector. The inability of either CASA - as safety regulator - or the Australian Transport Safety Bureau - as accident investigator - to recruit and retain individuals who have practical experience in industry management roles, would severely limit their effectiveness.

As the aviation industry increasingly implements safety management systems, CASA’s focus has shifted from only assessing procedural compliance with regulatory requirements to determining how effectively the aviation industry is managing its risks. This implies a need for changed skills and a greater requirement for people with risk management expertise, regardless of where that expertise has been acquired. Such safety experts currently work in a number of non-aviation related fields and, provided they can be appropriately supported by aviation specialists, their safety management expertise could be effectively transferred into the aviation context.

Implications for industry sectors
The broader aviation industry

The responsibility for ensuring the safety of operations rests primarily with the industry although the regulator has significant oversight responsibilities, particularly during the current period of change. In terms of meeting this responsibility a number of issues arise:

Personnel

The broader aviation industry must formulate policies and strategies to make an aviation career an attractive option. It must also reinvigorate the charter and training sector to ensure an adequate supply of skilled and experienced professionals in the future. The value of traditional training programs in the modern aviation environment must also be assessed. This could involve a substantive cultural change as established views of “what a pilot or LAME is” are challenged.

Security and environmental requirements

The aviation industry has accepted it has a direct responsibility for ensuring the security of its staff, customers and the public. However, security initiatives have had a considerable financial and resource impact. Emerging environmental responsibilities, requirements and associated initiatives are likely to escalate with greater awareness of climate change and the focus on fuel efficiencies. These factors will result in additional pressures on industry resources.

The aviation industry will need to remain vigilant to ensure security and environmental compliance does not directly or indirectly divert attention or resources from maintaining the highest levels of operational safety.

Opportunities and challenges – technical progress

Over the last 50-60 years aircraft, systems and technology have been the primary drivers in improved air transport safety performance. Such change and innovation brings challenges and responsibilities for the aviation industry and the agencies that administer, service, and regulate aviation. These include ensuring that:

- The industry is adequately skilled and is capable of utilising and harnessing the advances on offer
- Implementation is undertaken at a measured, cost effective and sustainable rate
- All participants have access to and benefit from technological advancement.

There is also a need to facilitate the growth of new innovative sectors such as unmanned aerial vehicles, while remaining cognisant of potential implications.

The advent of new technology has the potential to contribute to the mitigation of current or emerging aviation safety risks including controlled flight into terrain, skills shortages, airspace congestion and collision risks. Automation, navigation, approach design, avionics and surveillance technologies all provide real opportunities to offset a number of the risks that may be encountered in both the near and longer term.

Airline and high capacity operations

The airline sector is reaping the reward of expansive economic conditions. It is generally acknowledged that rapid expansion or the initiation of services are challenging for airlines and create risks that need to be managed including:

- Personnel shortages
- New carriers
- New aircraft, systems and technology.

The heightened profitability of the high capacity sector means that resources should be available to invest in new strategies to control and mitigate associated risks.

Examples include:

- Recruitment of experienced personnel from general aviation and overseas
- Developing new training programs and regimes, including engaging universities and associated flying training and maintenance organisations to develop programs more aligned to current skills requirements. This also includes active participation in the multi-crew pilot licence initiative.
Both the aviation industry and the regulator will need to be watchful as new carriers, aircraft, personnel and destinations are introduced in order to meet demand. It will be imperative that expansion does not translate to insufficient resources in any safety critical areas and that attention is not diverted from the prime responsibility of passenger safety.

Charter and low capacity regular public transport

Despite some minimal increases in activity in certain sectors of general aviation (such as training) over the last five years, as far as passenger carrying operations are concerned the charter and low capacity regular public transport sectors can be seen as stagnant at best.

The most recent activity data comes from the Bureau of Transport and Regional Economics. Table 3 (from the report Aviation Statistics, General Aviation, 2006 ) provides an overview.

Looking at the passenger sectors, it can be seen that the hours flown by regional airlines or charter flights in 2006 were slightly less than those flown in 1996. This is notable given the more general increase in aviation activity and in particular the increased demand for charter services associated with the mining boom in some parts of the country.

Table 3: Hours flown in general aviation and regional airline operations, by flying activity, 1996 to 2006 ('000 hours).

<table>
<thead>
<tr>
<th>Year</th>
<th>Private</th>
<th>Business</th>
<th>Training</th>
<th>Agriculture</th>
<th>Aerial work</th>
<th>Test &amp; ferry</th>
<th>Charter</th>
<th>Total GA</th>
<th>Regional Airline</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>261.6</td>
<td>182.8</td>
<td>444.9</td>
<td>1174</td>
<td>285.7</td>
<td>26.2</td>
<td>480.4</td>
<td>1 799.0</td>
<td>246.2</td>
<td>2 046.2</td>
</tr>
<tr>
<td>1997</td>
<td>266.7</td>
<td>136.0</td>
<td>449.5</td>
<td>126.4</td>
<td>207.4</td>
<td>278</td>
<td>453.7</td>
<td>1 839.3</td>
<td>272.4</td>
<td>2 111.7</td>
</tr>
<tr>
<td>1998</td>
<td>263.0</td>
<td>163.8</td>
<td>476.5</td>
<td>139.2</td>
<td>312.4</td>
<td>26.6</td>
<td>494.6</td>
<td>1 877.9</td>
<td>273.2</td>
<td>2 151.1</td>
</tr>
<tr>
<td>1999</td>
<td>275.9</td>
<td>153.3</td>
<td>448.8</td>
<td>126.3</td>
<td>308.6</td>
<td>26.6</td>
<td>504.6</td>
<td>1 842.2</td>
<td>277.3</td>
<td>2 119.4</td>
</tr>
<tr>
<td>2000</td>
<td>248.5</td>
<td>136.3</td>
<td>413.6</td>
<td>115.0</td>
<td>296.9</td>
<td>279</td>
<td>476.7</td>
<td>1 714.8</td>
<td>335.7</td>
<td>2 050.6</td>
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<tr>
<td>2001</td>
<td>261.7</td>
<td>144.9</td>
<td>406.2</td>
<td>106.7</td>
<td>294.2</td>
<td>23.2</td>
<td>466.0</td>
<td>1 702.9</td>
<td>298.0</td>
<td>2 000.9</td>
</tr>
<tr>
<td>2002</td>
<td>270.2</td>
<td>142.2</td>
<td>410.8</td>
<td>70.8</td>
<td>327.1</td>
<td>20.9</td>
<td>445.7</td>
<td>1 687.7</td>
<td>250.1</td>
<td>1 937.8</td>
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</table>

Figure 4: Charter hours flown

<table>
<thead>
<tr>
<th>Year</th>
<th>Private</th>
<th>Business</th>
<th>Training</th>
<th>Agriculture</th>
<th>Aerial work</th>
<th>Test &amp; ferry</th>
<th>Charter</th>
<th>Total GA</th>
<th>Regional Airline</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>239.7</td>
<td>143.4</td>
<td>420.3</td>
<td>69.7</td>
<td>322.5</td>
<td>21.2</td>
<td>439.2</td>
<td>1 645.9</td>
<td>234.7</td>
<td>1 880.6</td>
</tr>
<tr>
<td>2004</td>
<td>247.2</td>
<td>143.0</td>
<td>352.2</td>
<td>86.5</td>
<td>312.4</td>
<td>22.3</td>
<td>484.1</td>
<td>1 645.0</td>
<td>251.4</td>
<td>1 896.3</td>
</tr>
<tr>
<td>2005</td>
<td>239.2</td>
<td>149.1</td>
<td>415.8</td>
<td>95.0</td>
<td>318.6</td>
<td>22.3</td>
<td>482.6</td>
<td>1 722.6</td>
<td>254.7</td>
<td>1 977.3</td>
</tr>
<tr>
<td>2006</td>
<td>227.2</td>
<td>144.1</td>
<td>424.0</td>
<td>61.7</td>
<td>337.9</td>
<td>21.7</td>
<td>478.4</td>
<td>1 636.0</td>
<td>241.5</td>
<td>1 896.4</td>
</tr>
</tbody>
</table>
A reduction in flying hours (and resulting reductions in revenue) could result in a reduction in the level of resources available to the charter and low capacity regular public transport sectors to meet challenges. Emerging risks over the next three to five years for these sectors include:

- Critical shortages in experienced managers and operational personnel
- Ageing aircraft fleets
- Growing, potentially inhibitive costs and resources devoted to compliance with environmental and security requirements
- Increasing interface with larger aircraft at non-towered airports.

Many participants suggested that with limited capacity to invest in newer aircraft and technology, and with fewer experienced managers to provide guidance, this sector faces significant challenges that will need to be managed. In 2006, CASA identified the low capacity RPT sector as having the highest risk profile and in 2007 adjusted surveillance methods of 19 operators in this category to align with that of larger carriers.
Next steps

The Assessment of Trends and Risk Factors in Passenger Air Transport has identified a number of issues currently affecting the capacity of aviation operators to manage their risks or that have the potential to do so in the future.

Current CASA programs and actions that will help to mitigate identified emerging risks have been mentioned in the report. Additionally, two types of actions are required to address the issues identified in this review. Some can be directly and independently addressed by CASA. For example, the review notes that the low capacity regular public transport and charter sectors may be having a difficult time hiring sufficient numbers of pilots and that experience levels of operational personnel are dropping. To monitor this, CASA, in the course of its on-site audits, is already paying particular attention to pilot training issues and the risk that operators may be pushing staff to work longer hours than can be safely accommodated.

Comprehensive solutions to most of the issues identified in this report, however, are beyond the scope of any one agency and need to be looked at on a broader, industry-wide basis. To help achieve this, CASA will be establishing joint CASA/industry working groups to look at each of the five main areas identified by review participants:

- Aircraft
- Airports and infrastructure
- Airspace and air traffic management
- Personnel
- Government agencies.

It is expected that these groups will consist of experts drawn from industry and Government and will be tasked with:

- Identifying specific issues
- Collecting data or engaging in other research as necessary
- Coming up with intervention proposals
- Providing advice to CASA on implementation.

CASA is committed to having these groups in operation no later than 30 June 2008.
Attachment A – Consultation with the aviation industry

The following aviation industry organisations and groups were invited to participate in the assessment of trends and risk factors in passenger air transport:

- Qantas
- Virgin Blue
- Jetstar
- Airnorth
- Naverus
- Regional Express (Rex)
- Qantaslink
- Griffith University
- Queensland University of Technology
- Standards Consultative Committee
- Aviation Safety Forum
- Royal Flying Doctors Service
- CASA
- Australian Transport Safety Bureau
- Office of Transport Security, Department of Transport and Regional Services
- Airservices Australia.

The following aviation industry representative groups were invited to participate:

- AAA -Australian Airports Association
- AAFI –Australian Association of Flying Instructors
- AFAP – Australian Federation of Air Pilots
- AIPA –Australian and International Pilots Association
- AOPA- Aircraft Owners and Pilots Association
- ASF – Aviation Safety Forum
- GAPAN – Guild of Air Pilots and Navigators
- HAA -Helicopter Association of Australia
- RAAA - Regional Aviation Association of Australia
- RAA – Recreational Aviation Australia
- ASAC – Australian Sport Aviation Confederation
- ASFA – Aviation Safety Foundation Australian
- ALAAE – Australian Licensed Aircraft Engineers Association.

Submissions were also received from a range of interested individuals.
Attachment B: Guidance material provided to participants

Introduction

As part of its responsibilities as the aviation regulator, CASA develops a strategic plan and regularly reviews and reassesses it in order to ensure safety standards are maintained at the highest possible level. In doing so it relies on advice and input from the industry to assist.

Traditionally, both operators and the regulator focus on the various operational risks associated with day to day operations. While this is a necessary imperative it is important that the aviation community attempt to identify those issues which may emerge in the near to longer term (3+ years). By identifying issues and trends that impact upon the industry as a whole it enables all members of the aviation community to strategically plan and allocate appropriate resources to neutralise and mitigate the effect upon the safety of both passengers and crew.

Background

Safety problems in aviation can be seen as developing when there is a disparity between the demands of the operational task to be performed (ie the flight) and the various factors and support systems which manage these flight risks.

Operational task - characteristics of the flight itself that give rise to the risks to be controlled.

Support systems - various systems and procedures that control the risks associated with the operational task.

Attached is an indicative list of tasks which could be considered to comprise the carrying out of an operational flight and also those processes and procedures that contribute to the support system which counteracts the risks associated with the flight.

Using the list as a guide (you may have other elements that you believe are relevant) consider the following questions in order to help identify issues which may translate as an emerging risk to passenger carrying operations in the next 3 – 5 years. In addition, in contemplating the issues please focus on elements which impact on the industry, or a sector of the industry (maintenance, charter, regular public transport etc), as a whole rather than at an organisation level.

Questions

Which aspects of the operational task do you think have changed significantly in recent years and/or are expected to change significantly in the next three to five years?

Which aspects of the supporting systems do you think have changed significantly in recent years and/or are expected to change significantly in the next few years?

Do you see any emerging safety issues resulting from a disparity between the operational task and associated support systems? Patterns of disparity to consider include:

- Rapid changes in the operational task that support systems have not yet adapted to
- Slow changes in the operational task that have not been detected and therefore not stimulated adaptation
- Slow deteriorations in support systems. Please consider what, if any, impact will this have on the safety of passenger carrying operations?
- Why do you believe this is occurring?
- Why would the issue not self correct or be mitigated without undue intervention?
- Would it be confined to a particular industry sector or extend to other sectors?
- Will it impact on other factors which may in themselves become issues?
- What actions should/could be utilised to neutralise or mitigate the effect on safety?
<table>
<thead>
<tr>
<th>Operational tasks elements:</th>
<th>External support systems elements:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passengers numbers</td>
<td>Regulatory system (CASA, Department of Transport and Regional Services, International Civil Aviation Organization, Australian Transport Safety Bureau)</td>
</tr>
<tr>
<td>Type</td>
<td>Procedure</td>
</tr>
<tr>
<td>Behaviour</td>
<td>Regulation</td>
</tr>
<tr>
<td>Passenger demand for safety</td>
<td>Compliance</td>
</tr>
<tr>
<td>Aircraft</td>
<td>Course</td>
</tr>
<tr>
<td>Fleet mix</td>
<td>Surveilance</td>
</tr>
<tr>
<td>Type (faster/higher/multiple)</td>
<td>Services (air traffic control/Fightwatch/briefing)</td>
</tr>
<tr>
<td>Size</td>
<td>Support</td>
</tr>
<tr>
<td>Complexity (systems/avionics)</td>
<td>Access</td>
</tr>
<tr>
<td>Size</td>
<td>Aircraft (systems/avionics)</td>
</tr>
<tr>
<td>Complexity (systems/avionics)</td>
<td>Support systems</td>
</tr>
<tr>
<td>Quality of industry personnel (tech crew, cabin, management, safety, maintenance)</td>
<td>Documentiation</td>
</tr>
<tr>
<td>Skills</td>
<td>Navigation aids</td>
</tr>
<tr>
<td>Experience</td>
<td>Instrumentation</td>
</tr>
<tr>
<td>Availability</td>
<td>Training</td>
</tr>
<tr>
<td>Fatigue</td>
<td>🛸Aircraft</td>
</tr>
<tr>
<td>Rosters</td>
<td>🖥Surveillance</td>
</tr>
</tbody>
</table>

Support systems elements (internal support systems):

- Maintenance Standards
- Availability Cost
- Training Standards
- Suitability Access Costs
- Safety management system
- Suitability
- Support Commitment
- Management Support
- Experience Stability

Support systems elements (external support systems):

- Computerisation
- Support systems
- Instrumentation
- Training
- 🪵Airspace/air traffic services
- Services (air traffic control/Fightwatch/briefing)
- 🛩Access
- Procedures and route structure

External support systems elements:

- Regulatory system (CASA, Department of Transport and Regional Services, International Civil Aviation Organization, Australian Transport Safety Bureau)
- Procedure
- Regulation
- Compliance
- Surveilance
- Support
- 🪵Aircraft (systems/avionics)