Chapter 8

Using Aviation Insurance Data to Enhance General Aviation Safety: Phase One Feasibility Study

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The Aviation Safety Foundation Australasia commissioned the Monash University Accident Research Centre to undertake a study to assess the feasibility of using data held by aviation insurers in support of the development of an electronic database for storing accident and incident data. This chapter reports on some of the outcomes of the feasibility study, which included the following tasks: a review of the various sources of aviation safety data in Australia; a review of publicly available general aviation accident analyses; a review of the human error models that underpin the accident investigation process; and an analysis of a subset of claims held by the participating aviation insurers. While some inconsistencies in the insurance data were noted, further stages of the project aim to develop procedures to enhance the consistency of the insurance data such that it will contain sufficient information to permit a meaningful understanding of the causal and contributory factors involved in general aviation accidents and incidents.

Background

In 2003–2004 the Aviation Safety Foundation Australasia (ASFA) had in its business plan a project to investigate the collection, declassification, and analysis of General Aviation (GA) safety-related data that are held by aviation insurance companies with a view to supporting the development of ASFA’s Research and Development (AVSAFE) database. ASFA commissioned the Monash University Accident Research Centre (MUARC) to undertake a study assessing the feasibility of achieving this aim. This chapter primarily reports on some of the outcomes from the feasibility study. The initial research was partitioned into a number of components, including: a) a review of publicly available analyses of GA accidents and incidents; b) a review of the models of human error that underpin the accident investigation process; c) a review of the various sources of aviation safety data in Australia; and d) an analysis of a subset of claims held by the participating aviation insurers. Due to the word limits of this chapter, components a) and b) are discussed only briefly in the following
Existing analyses of GA accident data

An examination of publicly available analyses of GA accidents and incidents was undertaken, with a focus on the data variables that were considered. In addition to providing an understanding of how aviation safety data are reported, it was important to review such reports to examine the recommendations for resolving the identified safety issues, where such recommendations were made. A definition of GA for the AVSAFE project was also derived from this review.

The publicly available analyses of GA accidents and incidents were primarily restricted to fatalities only. The reports reviewed shared some similarities in how data were reported. It is common to see reports that conclude that a substantial proportion of accidents (up to 85 per cent) are attributable to human error, and sometimes specifically attributable to pilot-error or maintenance error. However, the analysis of human error is not a focus of these current analyses of groups of accidents. This is an important issue for consideration in the context of the AVSAFE database.

The reports reviewed used consistent measures of exposure. Epidemiological studies of aviation accidents typically incorporate some measure of exposure (Li, 1994), such as flight hours documented during an investigation or self-reported flying hours. It is important to have a measure of exposure to interpret the relative risks associated with particular activities. In the reports on GA accident data reviewed during this project, the common measure of exposure was the total number of hours flown by GA per 100,000 hours.

The Bureau of Transport of Regional Economics (BTRE) publishes annually the number of hours flown in GA in Australia, defined as all non-scheduled flying activity in Australian-registered aircraft other than that performed by the major domestic and international airlines. All owners of VH-registered aircraft (with the exception of the Australian domestic and international airlines) are surveyed annually and asked to report hours flown by each aircraft in various categories of operation, as well as total landings per aircraft. The survey typically achieves a response rate consistently around 70 per cent, with estimates made for the remaining aircraft for which no response is received (BTRE, 2003). The survey results are merged with details from the civil aircraft register held by the Civil Aviation Safety Authority, which gives access to other information such as aircraft type, engine and fuel type, country and year of manufacture.

In this study it became apparent that there are some inconsistencies in the definitions of GA adopted by the various organizations involved in reporting of GA accidents. For example, the Nall Report includes only fixed-wing aircraft (AOPA Air Safety Foundation, 2004), while the U.S. National Transportation Safety Bureau incorporates additional categories, such as rotorcraft, gliders, balloons and blimps, as well as registered ultra light, experimental, or amateur-built aircraft (NTSB, 2004). It is thus important to establish a definition of GA that will be used for the AVSAFE research project. The definition of GA adopted is that used by the BTRE, namely that...
the GA sector is made up of all non-scheduled flying activity in Australian-registered aircraft (CASA VH-registered), other than that performed by the major domestic and international airlines. The major categories of flying are private, business, training, aerial agriculture, charter and aerial work (BTRE, 2005a, 2005b). In addition, the sport aviation segment of GA includes operations involving ultra light aircraft, gliders, hang gliders and autogyros.

**Contemporary models of accident investigation**

There is broad acknowledgement that human error is a contributory factor in a significant proportion of aviation accidents. For example, it is estimated that up to 85 per cent of all aircraft accidents have a major human factors component, and human error is now seen to be now the primary risk to flight safety (Matthews, 2005). Consequently, the importance of incorporating the analysis of human error into the accident investigation processes adopted by aviation insurers was acknowledged. Contemporary models of human error and accident causation in organizational systems take a systems approach to safety and human error (Reason, 1990). Systems-based approaches, such as the Swiss cheese approach presented by Reason (1990) purport that accidents are caused by a combination of human error at the so-called sharp end of system operation and inadequate or latent conditions (e.g., inadequate equipment and training, poor designs, manufacturing defects, maintenance failures, ill-defined procedures, etc.) residing throughout the system. These latent conditions affect operator behaviour in a way that leads to errors being made. Systems approaches are particularly suited to accident investigation and analysis procedures for a number of reasons. Primarily, they facilitate the development of appropriate countermeasures that treat not only the errors made by operators, but also the latent conditions that lead to the errors being made in the first place. Without a systems approach, the typical outcome of accident investigation is the attribution of blame to the individual who made the error, and individual-based countermeasures, such as re-training, automation, training, discipline, selection and proceduralization, are developed. Systems approaches remove the blame culture that is typically associated with accident investigation in complex, dynamic systems and permit a comprehensive analysis of the errors and latent conditions involved in a particular accident. A number of systems approach-based accident investigation and analysis techniques have been developed, such as the Human Factors Analysis and Classification System (HFACS) (Wiegmann and Shappell, 2003). Such approaches, in particular HFACS, yield the type of data that is unique to this form of investigation, that is, they provide detailed information about the types of failure across different levels of system operation. Hence the data derived from such approaches provide the basis for an increased understanding of the causal factors involved in crashes. It was concluded that the data derived from such approaches could potentially be used to aid the development of countermeasures designed to reduce the occurrence of error-related GA accidents and incidents.
The capture of general aviation safety data

As stated earlier, a major component of this feasibility study was to identify the various sources of GA accident data to highlight the value of pursuing the aviation insurance data for a safety database. In Australia, the Australian Transport Safety Bureau is the organization responsible for the investigation and reporting of aviation safety occurrences, as defined by the Transportation Safety Investigation Act and associated Regulations. The ATSB collects data for fatal and non-fatal GA accidents and incidents, as do the aviation insurers, thus it is instructive to examine the data that are collected by the ATSB for differing levels of crash and injury severity. Hence this task involved an examination of the conditions under which the ATSB might investigate and the data sources yielded for safety occurrences that are both investigated and not investigated. The review indicated that the ATSB’s primary focus is on fare-paying passenger safety and that all fatal accidents (aside from those related to sport aviation) are investigated.

The ATSB and the aviation insurers have different procedures for collecting data to meet their needs. In looking at the flow of information to the ATSB, it is important to note that there are requirements to report various safety occurrences to the ATSB. The conditions under which an individual must report a safety occurrence are outlined on the ATSB’s website (ATSB, 2005). As required under the TSI Regulations, the owner, operator or crew of an aircraft must report an accident or serious incident to the ATSB as soon as practicable. Occurrences must be reported to the ATSB in writing in accordance with their status as immediately reportable events (including fatal and serious injuries, serious damage) and routine reportable events (including non-serious injury, minor damage). The report in writing to the ATSB is in the form of the Air Safety Accident and Incident Reporting (ASAIR) form. Thus, while the ATSB may not investigate all accidents and incidents, it still needs to be notified of all aviation occurrences so the information can be used in future safety analysis. The TSI Regulations available through the ATSB website list all reportable occurrences and responsible persons for reporting. For events that are classified as routine reportable (in accordance with the TSI Regulations), the data from the ASAIR form may be the only data the ATSB receives for that safety occurrence. Other events, likely to be immediately reportable, may be investigated, in which case considerably more data would be available.

It is important to note that while there are guidelines to determine which cases are investigated, there is flexibility in the interpretation of those guidelines depending on the circumstances of the case. Desk top investigations may also be conducted and may involve formal interviews and an investigation report. The flowchart presented in Figure 8.1 attempts to capture the potential data sources that might be available for GA accidents and incidents. The purpose of this flowchart is to broadly outline the type of data collected, by whom, and under what general conditions.

Broadly speaking, for operations covered by the BRTE definition of GA, the ATSB is likely to fully investigate fatal accidents. Although not illustrated in the flowchart, it is also possible that the ATSB may conduct a desk top investigation of accidents involving minor or serious injury. For accidents of this type, however, it is likely that the data yielded from the ASAIR form would be the data formally
Figure 8.1 Potential data sources for accidents and incidents in general aviation (for operations covered in the BTRE definition of GA)
captured. For incidents involving no injury there are still requirements to report to the ATSB under certain conditions outlined in the TSI Regulations.

The aviation insurers also collect information for a range of claims. Initial discussions with the participating aviation insurers were held to gain an understanding of the conditions under which insurer-appointed loss adjustors would investigate a claim. This process was also informed by the detailed analyses of insurance claim files, discussed later in the chapter. Discussions with the insurers suggested that while claim forms should be completed for all claims, loss adjustors were appointed to investigate a wide variety of claims ranging from those involving no injury but minor damage through to minor, severe, and fatal injury accidents. It is the opinion of the authors that, if these data can be structured and harnessed appropriately, there is great potential to use it to enhance aviation safety.

In many areas of safety it is commonplace to examine the characteristics and contributory factors to better understand why an event occurred and to highlight areas for potential improvement. While there are variations across domains, it is widely reported that the ratio of non-fatal to fatal accidents is such that fatal accidents represent a very small proportion of all accidents. For example, Bird’s near miss triangle, as presented by Jones, Kirchsteiger, Bjerke (1999), demonstrates that for each major accident there are a greater number of associated minor accidents (10), property damage incidents (30) and an even greater number of near misses (600). Heinrich, Peterson and Roos (1980); cited in Wierwille et al. (2002) also developed a triangle that demonstrates the relationship between near misses and fatal accidents in industrial settings. Heinrich and colleagues estimate that for every fatal accident, there are 10 major injury accidents, 100 moderate injury, 1,000 minor injury, and 10,000 associated near miss scenarios.

In GA in Australia there are on average less than 10 fatal accidents per year (ATSB, 2004), so much time is needed to achieve sample sizes that permit robust statistical analyses of a wide variety of accidents and incidents. For these reasons safety analysts in many domains have studied the characteristics and causal factors for non-fatal accidents to provide a larger data set. In many areas the characteristics and causal factors for non-fatal accidents are similar to those for fatal accidents, and thus the study of non-fatal accidents can significantly aid the understanding and thus prevention of fatal accidents through countermeasure development and implementation. In other areas non-fatal causal factors are quite different from fatal accidents, suggesting that the two extremes of injury severity have quite different causes (e.g., Haworth, 2003). Here the study of non-fatal and fatal accidents must be done independently. It is the opinion of the authors that the data collected by the aviation insurers potentially represents a valuable dataset of safety-related cases that could be used not only to understand the contributory factors in those accidents and incidents, but may also yield data to assist in the understanding and prevention of fatal accidents.
Examination of the data held by aviation insurers

An analysis of the GA accident and incident data currently held by the participating aviation insurers was conducted. Specifically, the research team was interested in identifying what information was collected, how often each data item was collected, and how the collection of data varied across injury severity. Due to the resource and time constraints associated with the project, only a subset of claims from each insurer involved were analysed. For this purpose, a surrogate database containing the data from the insurers’ hard copy claim files was constructed. Three aviation insurers committed to this stage of the AVSAFE research project. The aim was to collect 25–30 cases from each insurer. MUARC requested from each insurer a complete sample of consecutive finalized claims over a defined period. The time period defined to produce the required sample was dependent upon the number of claims managed by each insurer, and thus varied. All claims were finalized from 2002 onwards. Key components of each claim file were the Insurance Claim Form and the Assessor Report. Briefly, the insurance claim form is completed by the assured and submitted to the insurer. The insurer then determines whether an assessor will be appointed to investigate the claim. The presence of other documents within each claim was also noted, including CASA maintenance forms and ATSB ASAIR forms. Claim files often contained considerable correspondence between the insurer, the insured, and the assessor. The contents of this correspondence was not noted as it would have been too resource intensive to analyse.

Initially, a subset of claims from three aviation insurers was examined to determine the completion rates for each item contained within the claims forms. The data from insurance assessors was then analysed. Data from the three insurers were then combined to form a unified database, which contained a total of 73 cases. The majority (88 per cent) of the cases involved no injury, 7 per cent involved minor to severe injury, and 5 per cent involved fatal injury.

The number of cases involving no injury far outweighed the number involving minor/serious and fatal injuries. A key issue therefore is how to best capture the non-injury data to maximize the potential for improving aviation safety. As discussed earlier, in many areas the characteristics and causal factors for non-fatal accidents are similar to those for fatal accidents, and thus the study of non-fatal accidents can significantly aid the understanding and therefore prevention of fatal accidents through countermeasure development and implementation. While 11 per cent of the sample involved injury to at least one person, there are a number of claims that did not involve injury but that have the potential to cause injury. The study of these cases could significantly improve the understanding of GA crashes. Injury is defined as a bodily lesion at the organic level resulting from acute exposure to energy (which can be mechanical, thermal, electrical, chemical or radiant) interacting with the body in amounts or rates that exceed the threshold of physiological tolerance (Krug, 1999). Furthermore, the most important correlates of pilot fatalities in GA are factors related to impact forces (Wiegmann and Taneja, 2003). While many claims involved incidents while taxiing, including wing clips and clipping signs, these incidents occurred at low speed and therefore involved reduced energy exchange and the potential risk for injury, while present, is relatively low. Incidents of this type are
classified as non-safety-related for the purposes of the following discussions. This should not be read as suggesting that these incidents are not of great interest to the project, but rather as a means of differentiating between the potential injury severity. As such, safety-related claims in this chapter refer to those claims that involve injury or have the potential to cause injury. These claims form the basis of subsequent discussions.

A distinction was made between safety-related and non-safety-related cases to capture those incidents that could potentially contribute to an increased understanding of GA crashes. An analysis of the proportion of claims that were investigated by the aviation insurers was then conducted. Almost all of the claims defined as safety-related (95 per cent) were investigated by insurance assessors, whereas 61 per cent of non-safety-related claims were investigated. In the opinion of the authors, this finding suggests that if insurance data could be captured in appropriated formats, and almost all safety-related claims are investigated, a powerful dataset would be available for the identification of safety trends and for the setting of research agenda to target the development of potential countermeasures.

Next, to investigate the potential application of contemporary accident investigation and analysis approaches in the analysis of existing insurance data, an analysis of the eight crashes involving injury was conducted using the HFACS accident and incident investigation approach. In summary, it was concluded that there is potential for the application of HFACS-type approaches in the collection and analysis of such data. The analyses indicated that HFACS-type approaches are useful as they allow for the classification of both the unsafe acts that led to the incident and also the contributory factors involved, which in turn reduces instances of apportioning blame solely on the aircrew. However, it was also noted that significant development of current GA incident reporting procedures, and redevelopment of the error and latent conditions classification schemes employed within the HFACS framework, is required. In particular, it was concluded that the level of detail contained in the insurance data were insufficient in most cases, and that a portion of the HFACS approach may be inappropriate when used in a GA context, due to its origin from within the military and civil aviation domains. In conclusion, the authors recommend that a comprehensive analysis of GA accident data using the HFACS approach would yield a valuable data set highlighting the different active error types and the various latent or contributory factors involved in specific types of GA accidents.

**Conclusion**

Based on the findings of the research conducted, it was concluded that there are a number of shortcomings and inconsistencies in the manner in which aviation insurer-based GA accident and incident data are collected, classified, stored, analysed, and reported. The existing data collected by the aviation insurers does not, in the opinion of the authors, currently contain sufficient information to comprehensively understand the nature and causation of GA accidents and incidents. The existing information collected does, however, provide the basis for the most promising
means of collecting quality data for the AVSAFE project. Based on the findings of the research conducted during this feasibility work, a series of recommendations were developed and presented to the sponsor.

ASFA has recently commissioned MUARC to continue the development of the AVSAFE database. The work to be conducted in 2006 will include the following: clarification of the data requirements for insurance claim forms and the development of a standard claim form template; the analysis of a much larger sample of aviation claims to report on safety patterns and to inform the modification of HFACS to non-fatal GA accidents and incidents; the development of a standardized template for insurer-appointed loss adjustors; and the development of the database. It is anticipated that insurance data collected from 2007 onwards will be fed into the AVSAFE database and subsequent analyses conducted to identify safety issues and to provide avenues for further research and strategic countermeasure development to promote the safety of GA operations.

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