2007

Enhancing the Collection and Analysis of General Aviation Insurance Data in Australasia Through the Use of HFACS

Michael G. Lenné

Karen Ashby

Michael A. Regan

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Michael G. Lenné
Monash University Accident Research Centre
Melbourne, Australia

Karen Ashby
Monash University Accident Research Centre
Melbourne, Australia

Michael A. Regan
Monash University Accident Research Centre
Melbourne, Australia

This paper provides an overview of a 5-stage program of work conducted over a three-year period that aims to develop a General Aviation (GA) safety database in Australia using data collected by aviation insurers. The need to standardize and enhance insurance data was recognized to support meaningful safety-based countermeasure development. Incorporating the Human Factors Analysis and Classification Scheme into the insurance assessment process is a major feature of the data enhancement process. Data collection by GA insurance assessors in Australia, using standardized and enhanced data collection methods, will begin in late 2007. Establishment of this database will allow for meaningful safety-based analyses of GA insurance incident data in the future.

Background

The Aviation Safety Foundation Australasia (ASFA) is an independent, non-Government, not-for-profit, apolitical public company whose primary function is to independently promote and facilitate safe and also complementary sound business practices across all sectors of the Australasian aviation industry. In 2004 ASFA initiated a project to investigate the collection, classification, and analysis of general aviation (GA) safety-related data that are currently held by Australian aviation insurance companies, with a view to supporting the development of an aviation safety (AVSAFE) database. The Monash University Accident Research Centre (MUARC), in Melbourne, Australia, is conducting a five-stage multi-year research program to achieve this aim.

Feasibility Study

Stage 1 of the study examined the potential for aviation insurance data to contribute to improved GA safety. A number of steps were undertaken to achieve this: 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, focussing on the insurance claim form and the assessor report. The claim form is completed by the assured and submitted to the insurer, and the insurer then determines whether or not an assessor will be appointed to investigate the claim. It was concluded from these analyses that there were a number of shortcomings and inconsistencies in the manner in which aviation insurer-based GA incident data were collected, classified, stored, analysed, and reported (Lenné, Salmon, Regan, Haworth & Fotheringham, 2006).

Incorporating the assessment of human error was deemed important for enhancing the potential for using insurance data for safety-based analyses. It is estimated that up to 85% of all aircraft accidents have a major human factors component and human error is seen to be the primary risk to flight safety (e.g., Matthews, 2005). Contemporary models of human error and accident causation in organisational systems take a systems approach to safety and human error (e.g., Reason, 1990). These purport that accidents are caused by a combination of human errors at the so-called 'sharp-end' of system operation and inadequate or latent conditions (e.g., inadequate equipment and training, poor designs, inappropriate management decisions or actions, deficient operating systems or documentation, etc) that reside 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 can contribute 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. 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-based approaches to accident investigation and analysis have been developed, such as the Human Factors Analysis and Classification System (HFACS; Wiegmann & Shappell, 2003). Such approaches 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, and have been applied in various settings including aviation and rail domains (e.g., Gaur, 2005; Krulak, 2004; Reinach & Viale, 2006; Shappell & Wiegmann, 2004). Our earlier work concluded that the data derived from such approaches could potentially be used to aid the development of countermeasures designed to reduce the occurrence and severity of GA accidents and incidents (Lenné et al., 2006).

The capture of GA incident data in Australia

A major component of the feasibility study was to identify the various sources of GA accident and incident data in Australia to ascertain the potential value of pursuing the aviation insurance data for a safety database. In Australia, the Australian Transport Safety Bureau (ATSB) is the organisation responsible for the investigation and reporting of aviation safety occurrences, as defined by the Transportation Safety Investigation (TSI) Act and associated Regulations (see ATSB, 2007). The ATSB's primary focus is on fare-paying passenger safety and all fatal accidents (aside from those related to sport aviation) are investigated. The ATSB collects data for fatal and non-fatal GA accidents and incidents, as do the aviation insurers. Thus it was 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 and are not investigated.

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. 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 & 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 form. Thus, while the ATSB may not investigate all accidents and incidents, it still needs to be notified of all aviation occurrences so that 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.

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. It was also apparent in the feasibility study that the insurance assessors were appointed to investigate a wide variety of claims ranging from those involving no injury and minor damage through to minor, severe, and fatal injury accidents. We believed that, if these data could be structured and harnessed appropriately, there was potential to use it to enhance aviation safety. Importantly, the analyses of data generated from the larger number of less severe incidents (no injury, minor injury) could be structured and published to complement the analyses of more serious GA accidents such as those published in Australia by the ATSB (e.g., ATSB, 2004) and internationally such as in the Nall Report (AOPA Air Safety Foundation, 2006).

A series of recommendations was delivered at the completion of Stage 1 that outlined the major areas of work required to ensure that an effective database, based on aviation insurance data, could be developed, and to ensure that the data provided would be collected in a format amenable to the conduct of safety-based analyses. Some of the key recommendations from the Stage 1 feasibility study are listed briefly here:

- Due to inconsistencies in the claim-related information collected by the aviation insurers, and variations in item completion rates, it was recommended that the information collected in claim forms be standardised and enhanced to support safety-based data analyses.

- Further, there were inconsistencies in the collection and reporting of data reported by insurance assessors. It was recommended that a standard assessment form be developed, and that procedures used by assessors to derive this information be standardised and enhanced to support safety-based analyses of data.
- Analysis of a small number of insurance claims using the HFACS revealed that there was great potential use of the HFACS to capture the causal factors that contribute to safety-related claims. It was recommended that the HFACS be incorporated into the insurance assessment process for GA.

This work was completed in June 2005, and further work was conducted in accordance with the five stages of the project outlined in Figure 1 below.

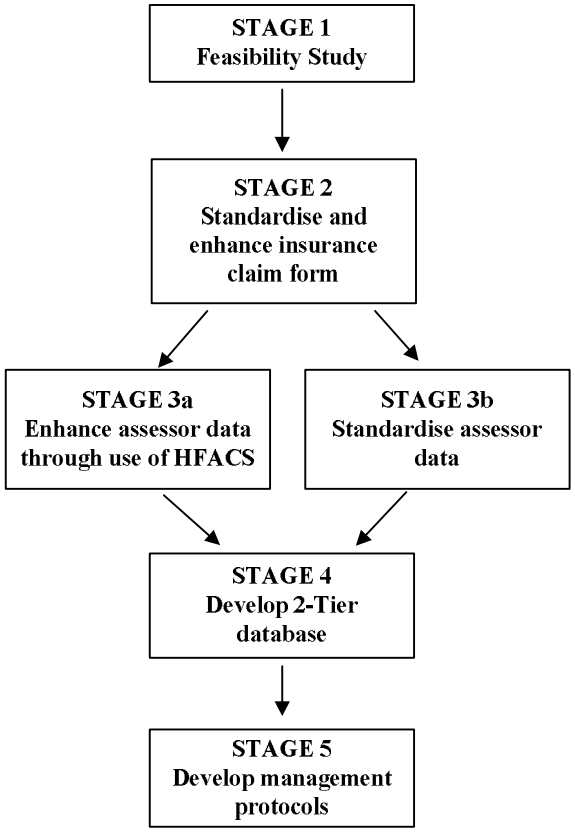

Figure 1. The five stages of the AVSAFE project

Standardising and enhancing the collection of GA insurance data

As shown in Figure 1, subsequent stages of this project aimed to standardise and enhance the data collected on insurance claim forms (Stage 2) and by insurer-appointed assessors (Stage 3). The development of a standardised insurance claim form and assessors template was informed by several processes, including analysis of: data currently collected by the aviation insurers; aviation safety data collected and reported nationally and internationally; data items contained within incident report and claim forms in other domains; and MUARC experience in database management and the analysis of safety data in other domains (the Victorian Injury Surveillance Unit at MUARC maintains, analyses, reports on, disseminates and applies injury data to injury prevention, develops countermeasures, implements prevention strategies and monitors trends and outcomes of interventions). Importantly, relevant stakeholders were involved in this process and reviewed draft and final versions of the claim form. Use of this claim form will ensure that GA insurers collect standardised data in the near future. The items included are required to facilitate a safety-based analysis of claims data, while also meeting the requirements of the aviation insurers, and enhancing consistency with other aviation safety reports (e.g., ATSB, 2004; AOPA Air Safety Foundation, 2006). The data collected in the new claim form will also complement that collected by the insurer-appointed assessors.

Incorporating the analysis of human error into GA insurance assessments

The processes adopted by the insurance assessors were addressed in Stage 3 of the project. Stage 3a reported on the analyses of existing data using the HFACS and established a process to be used by insurance assessors that would support the on-going assessment of human error in GA incidents. Just under 200 insurance claims over an 18 month period were examined in this stage of the project.

The analysis of data using HFACS revealed that just under three-quarters of all claims involved one or more unsafe acts by aircrew (69%). Skill-based (61%) and decision errors (36%) were the more prominent categories of unsafe act, followed by perceptual errors (16%) and violations (16%). Within the skill-based error category, errors related to 'poor technique/airmanship' (38%) and 'failure to see and avoid' (22%) were more frequent. Decisions to undertake inappropriate manoeuvres/procedures (17%) and decisions to undertake tasks that exceeded abilities in training (14%) were less frequent.

Preconditions for unsafe acts were evident in almost 60% of incidents, predominantly condition of operator factors (44%) and environmental factors

(24%). Unsafe supervision and organisational factors were present in very small proportions of cases, and were present predominantly in flying training operations. This is consistent with previous work (Wiegmann & Shappell, 2003), and is also likely to be indicative of the current focus of insurance investigations. Under condition of operator factors, 'loss of situational awareness' and 'poor flight vigilance' were each noted in 13% of GA incidents. Under physical/mental limitations, 'inadequate experience for situation complexity' was noted in 11% of incidents.

One quarter of incidents did not involve any identifiable human error. These cases included mechanical factors, for example, when a power loss occurred that resulted in a forced landing, yet no aircrew error could be identified, and lightning strikes, again where it could not be determined if the aircrew adhered to weather advisories. Increasing the focus on human error in future insurance investigations through the use of HFACS as an investigative tool, and the implementation of standardised data collection procedures, may address this issue.

The analysis of error and failure in existing insurance data, together with other descriptive data collected including phase of flight and incident outcome, confirmed the utility of applying HFACS to insurance data as part of an overall data-enhancement package. The key outcome from this process was the establishment of a process to provide an empirical basis for future investigation of contributory factors in GA insurance claims.

It was acknowledged that significant training would be required for the assessors in the use of the HFACS. It is anticipated that some areas of difficulty may be around the interpretation of particular error classifications and how best to code given examples. It is hoped that many of these difficulties can be resolved during the training workshops and specifically through the exercises that focus on the analysis of cases. It is recommend that a workshop be held three months after the new data collection procedures have been introduced to address any issues that have arisen using the HFACS. It will also be necessary to reconvene the insurance investigators on a twice-yearly basis such that the same example cases can be assessed by multiple investigators. This is important so that the agreement between raters can be established as a means of calibrating the investigative strategies used by the insurance investigators. Inter-rater reliabilities that fall below a defined critical level will be the trigger for additional training.

Stage 3b provided the standardised data collection template and appropriate training for insurance assessors. This work was completed in June 2006.

Current Activities

Database construction is underway (Stage 4). The AVSAFE database will be located at MUARC. Surrogate databases will be developed and installed at each insurance office. This will make the process of data management easier for the insurers. In addition it will provide a straightforward process by which the de-identified claims data can be sent to MUARC electronically. Other database management issues and protocols are also being considered. This work is due for completion by 30 June 2007.

Conclusion

The project has faced and overcome a number of challenges. Aviation insurers will begin collecting data using the newly created claim form and assessors template during 2007. De-identified aviation insurance data will be conveyed to MUARC where the database will be located. MUARC will then present comprehensive analyses of the data annually to ASFA, with brief reports to stakeholders on a more regular basis.

As the database develops and the number of cases within it grows, the sample size will become sufficient to conduct statistical analyses that are not currently possible. That is, it will become possible to more thoroughly examine the contributory factors by purpose of flight and other factors, which will in turn enable more targeted countermeasure development deriving from insurance data.

Acknowledgments

We would like to acknowledge assistance received from the Project Steering Committee, comprising representatives from the following organisations: Aviation Safety Foundation Australasia, Australian Transport Safety Bureau; Airservices Australia; QBE Aviation; Vero Aviation; Assetinsure; and BHP Billiton.

We also thank the project sponsors, the Aviation Safety Foundation Australasia, and the organisations that supported it in the conduct of this project, namely the Australian Transport Safety Bureau, Airservices Australia, and BHP Billiton. Finally we thank our MUARC colleagues Ashley Verdoorn and Carolyn Staines for their contributions to parts of the project.

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