AIRCRAFT ACCIDENT DATA SOURCES AND TRENDS

This working paper provides additional background information on sources of data on aircraft accident location and aircraft accident trends. The paper provides information on available data sources on aircraft accidents and incidents that could support further research into the occurrence of aircraft accidents in the vicinity of airports. It also presents the findings of a more detailed analysis of recent trends in aircraft accident rates to supplement the information on the general trend in aircraft accident rates presented in Chapter 7 of the project final report, titled *Aircraft Accidents and Safety Considerations*. Following an introduction, the paper contains sections addressing sources of aircraft accident data, prior studies of aircraft accident locations, accident databases for third party risk and other studies, the development of an integrated aircraft accident database, and finally an analysis of aircraft accident trends.

Introduction

Establishing appropriate land use and development controls in areas near the ends of airport runways or under the arrival and departure flight paths requires an understanding of the risk of being killed or injured in an aircraft accident that occupants of those areas would be exposed to as a result of the aircraft operations at the airport. In addition, there is some risk of property damage resulting from an aircraft accident, although this is generally considered a less serious concern than the potential for fatalities or serious injuries. The risk to those on the ground from an aircraft accident is referred to as *third-party risk*.

The analysis of third-party risk requires detailed data on the location and other relevant characteristics of aircraft accidents occurring in the vicinity of airports. Since the risk will vary with the types of aircraft using the airport, as well as the composition of the traffic and the number of annual operations using each runway, the accident data used for the risk analysis needs to be detailed enough to identify all the relevant factors. In particular, account should be taken of the occurrence of factors in a given accident that are likely to vary with the specific conditions at a given airport. For example, accidents due to aircraft icing are not likely to occur at an airport in a tropical climate, while accidents due to a collision with high terrain are not likely to occur at an airport located on a relatively flat plain. Therefore, the reliability of any analysis of third-party risk is critically dependent on the quality and comprehensiveness of the accident data used to perform the analysis.

The literature review documented in Chapter 7 of the project final report identified a number of existing databases on aircraft accident locations in the vicinity of airports:

- A Federal Aviation Administration (FAA) study of commercial aircraft accidents and incidents relative to runways.
- A study of general aviation accident locations relative to runways undertaken by the Institute of Transportation Studies (ITS) at the University of California for the California Department of Transportation.
- A study of the location of commercial aircraft accidents in the United States (U.S.) between 1974 and 1997 relative to runway ends undertaken by the Air Line Pilots Association (ALPA), International.
- A database of the location of commercial aircraft accidents worldwide assembled by the United Kingdom National Air Traffic Services, Limited (NATS).
- A database of the location of commercial aircraft accidents worldwide assembled by the Netherlands National Aerospace Laboratory (NLR).

However, the first two of these databases are now somewhat dated, and the first one in particular has fairly limited information on each accident. The third database has been subsequently updated, as discussed in more detail below, but the information on each accident is somewhat limited and it is unclear how widely ALPA would be willing to make the data available. The last two databases appear to be both comprehensive and current, but are not publicly accessible.

Therefore, this working paper reviews the primary sources of aircraft accident data, as well as providing additional documentation on the accident data assembled by past studies of aircraft accident location in the vicinity of airports or databases developed for studies of third-party risk or other airport safety issues.

The past two decades have seen a significant reduction in aircraft accident rates, as a result of a broad range of efforts directed at improving aviation safety. An overall reduction in accident rates suggests that, for a given level of aircraft operations at a particular airport, the risk of an aircraft accident occurring in the vicinity of the airport will also be less. However, this assumes that the accident rates for those categories of accidents that are likely to result in an aircraft crash in the vicinity of the airport have also declined, and the improvement in the overall accident rate is not due to reductions in the occurrence of accidents that do not affect areas in the vicinity of the airport. Conversely, if the accident rate for categories of accidents that do affect areas near the airport has declined by more than the overall accident rate, this will result in a proportionately greater reduction of third-party risk. Therefore, it is important to determine the extent to which the changes in overall accident rates are reflected in those categories of accident that contribute to third-party risk.

The remainder of this working paper comprises six sections. The next section documents the major primary sources of aircraft accident data. The following section documents the accident data assembled as part of previous studies of aircraft accident location. The fourth section of the paper documents four accident databases assembled for previous studies of third-party risk or to support analysis of airport safety issues. The fifth section presents a proposed structure for an integrated database on aircraft accidents in the vicinity of airports. The sixth section presents an analysis of recent trends in aircraft accident rates. Finally, the last section summarizes the information presented in the working paper and draws some conclusions for further research activities.

Sources of Aircraft Accident Data

Aircraft accidents and some categories of incidents are required to be reported by the aircraft owner or operator to the relevant civil aviation authority and are generally subject to some degree of investigation, depending on the severity of the accident or seriousness of the incident. Major accidents involving commercial aircraft are usually subject to extensive investigation to identify both the likely causes of the accident and potential corrective measures to prevent similar accidents from occurring in the future. In some countries, including the U.S., there are specific agencies with the responsibility of investigating all types of transportation accidents, or aircraft accidents specifically. These include:

- U.S. National Transportation Safety Board
- Transportation Safety Board of Canada
- Australian Transport Safety Bureau
- France – Bureau d’Enquêtes et d’Analyses pour la Sécurité de l’Aviation Civile
- New Zealand Transport Accident Investigation Commissions
- Spain – Comisión de Investigación de Accidentes e Incidentes de Aviación Civil
- United Kingdom Air Accidents Investigation Branch

These agencies maintain databases with detailed information resulting from the accident or incident investigations. In addition, national civil aviation authorities will also typically maintain databases on aircraft accidents within their jurisdiction in support of their regulatory responsibilities.

In order to provide a more global perspective on aviation safety, the International Civil Aviation Organization maintains an integrated database of aircraft accidents and incidents derived from reports received from individual states in a standard format. There has also been a recent effort in Europe to establish a central aviation safety data reporting system. In addition to these governmental activities, a private company, Ascend Worldwide Limited (formerly Airclaims Limited), maintains a worldwide database of information on aviation accidents, which it makes available on a commercial basis. Other organizations, including aircraft manufacturers, industry organizations involved in flight safety, and research and consulting organizations also have established aircraft accident databases, although the scope of these databases varies and they are typically not publicly available. This section reviews the principal aircraft accident and incident databases that are publicly available and contain information relevant to an assessment of third-party risk around airports.

National Transportation Safety Board

The National Transportation Safety Board (NTSB) has the responsibility for investigating all civil aviation accidents that occur in the United States. An *accident* is defined as “an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.” The data from the investigation of each accident is included in an Aviation Accident Database (AAD). The NTSB also investigates some incidents, defined as "an occurrence other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations," and includes the data for these in the AAD in the same form as accidents.

Since an accident or incident can involve more than one aircraft, with many different personnel and other factors, the AAD is a relatively complex relational database, with multiple tables providing information on the event, the aircraft involved, personnel, environmental conditions, consequences, the probable cause, and contributing factors. The various tables are listed in **TABLE 1** and the relationship between the tables is shown in **FIGURE 1**. Some of the database fields contain free text, while others contain predefined text codes, predefined numeric codes, or numeric values. The complexity of the database can make analysis of the accident data challenging.

TABLE 1 NTSB Aviation Accident Database Tables

Table name	Description
events	Factual information about the accident or incident
aircraft	Information concerning aircraft involved in the event
cabin_crew	Information on individual members of the cabin crew involved in an event
engines	Information on the engines of the aircraft involved in an event
Flight_Crew	Information on individual members of the flight crew involved in an event
flight_time	Flight time of flight crew member
injury	Injury and fatality information for the event
narratives	Narratives about the event
Occurrences	Data on what happened prior to the event that led to the accident or incident
seq_of_events	Information on the sequence of events
ct_iaids	Codes for detail tables
ct_seqevt	Codes for sequence of events table
dt_aircraft	Detail table for aircraft containing multiple responses
dt_events	Detail table for events containing multiple responses
dt_Flight_Crew	Detail table for flight crew containing multiple responses

SOURCE: *NTSB, Accident Database & Synopses (http://www.ntsb.gov/ntsb/query.asp).*

Where coded fields can contain multiple values – for example, the field for runway surface condition could have several different codes assigned to it describing different aspects of the surface condition – this is handled through the detail tables that can have multiple records for the same event. One of the fields (columns) in the detail table is the field name (col_name), allowing multiple entries for a given field for a given event. This also allows the database to be easily searched for events in which a specific field has a given code assigned, for example searching for events for which the runway condition was recorded as icy.

The NTSB website provides an interactive search capability of the data in the Aviation Accident Database and detailed information about the database, at http://www.ntsb.gov/ntsb/query.asp. The database can also be downloaded from the website in Microsoft Access format, together with database documentation.

The NTSB Aviation Accident Database is also available on the FAA Aviation Safety Information Analysis and Sharing (ASIAS) website (http://www.asias.faa.gov). This version is updated regularly. The ASIAS website includes a database description, a data dictionary, and a query tool. The FAA query tool has a few fields that the NTSB database query form does not have (airport name and flight phase) as well as pull down menus for aircraft make, model and series. This may make the ASIAS version of the database somewhat easier to query for some applications.

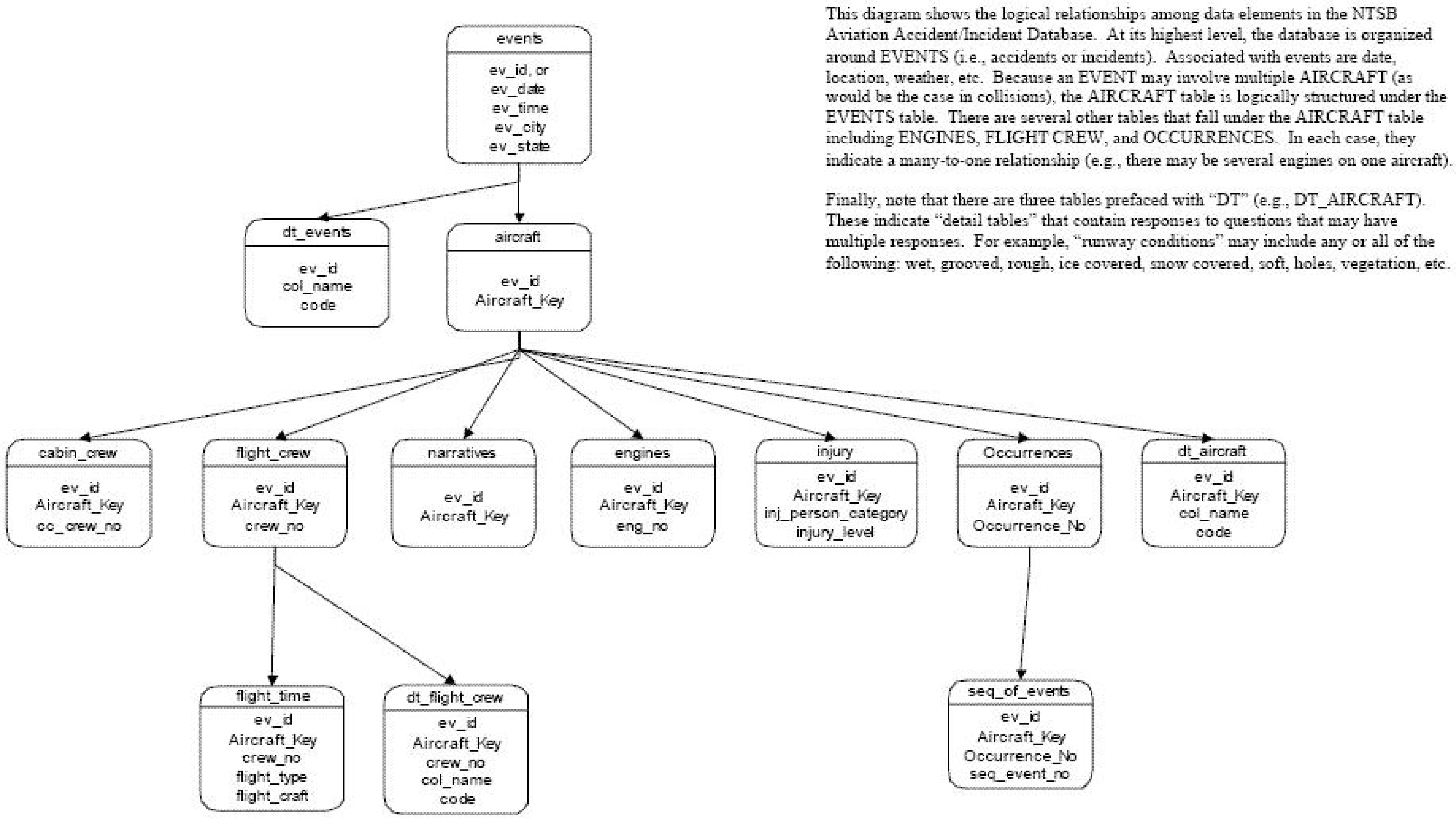

FIGURE 1. NTSB Aviation Accident Database Architecture.
SOURCE: *NTSB, Accident Database & Synopses (http://www.ntsb.gov/ntsb/query.asp).*

The data fields in each of the AAD data tables are listed in Attachment 1 *NTSB Aviation Accident Database Structure*, of this document. Within the database structure the "***events***" table contains data fields for the latitude and longitude of the accident, as well as the nearest airport and direction and distance to the accident from the nearest airport. The latitude and longitude are derived from the direction and distance information. Thus the accuracy of the latitude and longitude depends on the accuracy with which the direction and distance information is recorded. If no direction and distance information is recorded, the latitude and longitude are based on the location of the nearest airport or the zip code of the event site. It is also unclear from the coded or numerical information in the database what the investigator considered "the location" of the accident or the accuracy with which this location was estimated, particularly in cases where there was a significant wreckage swath or the accident involved a collision between two aircraft that subsequently crashed. It would generally be necessary to review the accident narratives and the accident investigation docket, which contains the detailed investigator's notes and related information, to determine the location and extent of any wreckage or ground damage.

International Civil Aviation Organization

The International Civil Aviation Organization maintains an Accident/Incident Data Reporting System (ADREP) database of accident and incident reports submitted by states as required by Annex 13 to the International Convention on Civil Aviation *Aircraft Accident and Incident Investigation* (ICAO, 2001). In principle, this provides a comprehensive database on aircraft accidents worldwide. However, since the source data depends on reports from states, the quality of the information depends in turn on the level of the investigation performed and whether a report is submitted for every accident. It can be expected that the data on accidents occurring in North America, Western Europe, Australia, Japan, and similar countries with a well-developed aircraft accident investigation infrastructure will be comprehensive and of high quality.

The ADREP database uses a standard taxonomy defined by an international working group chaired by ICAO and referred to as ADREP 2000. This defines a standard set of numeric codes for reporting accident data. The ADREP database is used by ICAO to develop statistics on worldwide aviation accidents and is also made available to the states for their own analysis. It is not publicly accessible.

Since the ADREP data derives from accident investigations by individual states, it cannot have information that is not also available in the national aviation accident databases developed by each state, and may well not have some information available in those databases. The main advantage of ADREP is that the data from different countries is reported in a standard format using consistent reporting codes.

World Aircraft Accident Summary

The World Aircraft Accident Summary (WAAS) is a commercial database on aircraft accidents worldwide that is maintained by a United Kingdom (UK) firm, Ascend Worldwide Limited, formerly part of Airclaims Limited and now an independent firm. The database was developed on behalf of the UK Civil Aviation Authority and covers all known major operational accidents to jet and turboprop aircraft, helicopters, and larger piston-engine aircraft. The accident details have been drawn from multiple sources, both official and unofficial, including press reports.

The FAA ASIAS system has acquired a subset of the WAAS data that covers all known fatal airline accidents with passenger fatalities since 1990. The most recent update of the dataset included data entered in the WAAS database through October 8, 2007 and includes records on 395 accidents. The ASIAS system includes a data dictionary and a database query tool. However, the database query tool has very limited functionality and can only search the database by airline or through a text search of the event narrative in the dataset. In each case, a list of accident records is displayed and the user can select a specific accident and display a brief report that contains selected information from the record.

Other Sources

As noted above, there are a large number of national aviation and transportation safety agencies that assemble data on aircraft accidents within their jurisdiction. Many of these agencies share their data with the ICAO ADREP database, although their own databases may have more information than is provided to ICAO. These agencies also serve as the source for some of the accident data in the WAAS.

The FAA maintains an Accident/Incident Data System (AIDS) that provides information on accidents and incidents occurring in the U.S. or involving U.S. registered aircraft. There is a significant overlap between the AIDS and the NTSB AAD, although the fields and structure of the two databases are different.

The Aviation Safety Reporting System (ASRS) is a voluntary, confidential, and non-punitive incident reporting system operated by the U.S. National Aeronautics and Space Administration (NASA) on behalf of the FAA. It differs from the FAA and NTSB accident and incident databases in that the information on an incident is submitted voluntarily by aircraft flight crew, air traffic controllers, or others involved in the incident, rather than being the result of an investigation or a mandatory report. It can thus shed valuable light on the causal factors involved in an incident and includes many incidents that would not be formally reported to the FAA or result in an FAA or NTSB investigation. However, the confidential, de-identified nature of the database requires the elimination of information that could allow those submitting the reports to be identified. In particular, there is no way to link an ASRS report to an accident or incident report in the FAA AIDS or NTSB AAID.

In general, the type of incident reported to the ASRS would not qualify as an accident in the sense that it involved fatalities, injuries, or significant property damage. It would thus not typically be considered an event that would be included in the analysis of third-party risk. However, by providing information on "near-miss" events or insights into the causal factors leading up to a specific type of incident, ASRS reports could be a useful supplement to data from accident and incident investigations.

Prior Studies of Aircraft Accident Location

A number of recent studies have specifically investigated the location of aircraft accidents in the vicinity of airports. Some of these have been primarily concerned with accidents occurring on the airport itself or in the vicinity of the runway ends in order to help establish criteria for the various airfield and runway safety areas. However, each of these studies has assembled data on the location of aircraft accidents relative to runway ends that may be of use in assessing third-party risk.

FAA Study of Commercial Aircraft Accidents

As discussed in Chapter 7 of the final report, in 1990 the Federal Aviation Administration (FAA) published the results of a study into the location of commercial aircraft accidents and incidents relative to runways (David, 1990). This was based on a detailed examination of accident and incident data from investigations undertaken by the National Transportation Safety Board (NTSB) and FAA of accidents or incidents involving commercial air transportation aircraft in the United States from 1978 to 1987. Since the information on the exact location at which the aircraft came to rest was not always given in the computerized data files, the study investigators reviewed the individual investigation notes in the accident or incident docket, and in some cases contacted the investigators or others familiar with the event or reviewed media accounts from the time. The study then classified each accident or incidents into one of five types: undershoots, landings off the runway, veeroffs, overruns, and other events in the vicinity of the airport. Veeroffs, overruns or other events distinguished between those occurring during landing and those during takeoff. Other events were defined as landings where the aircraft came to rest more than 2,000 feet short of the runway threshold or takeoffs where the event occurred after the aircraft had become airborne but before the first airborne power reduction or reaching the pattern altitude. They are thus the category of most interest from the perspective of third-party risk, although in some cases occurrences closer to the runway threshold could create a hazard to those on the ground in the vicinity of the airport. The analysis of each event attempted to determine both the longitudinal distance from the departure threshold in the case of takeoffs or the landing threshold in the case of landings and the lateral distance from the runway centerline or extended centerline.

Over 500 accidents or incidents were reviewed, of which 246 were identified as relevant to the study. A detailed database was assembled with key information for each event, including the airport, the aircraft type, the operator, the type of operation, the runway length, width and surface condition, and the lateral and longitudinal distance from the threshold where the aircraft came to rest. In cases of excursions from a runway, the database also noted the distance from the threshold where the aircraft first left the runway, the maximum distance from the runway that it traveled, and the distance from the threshold where it re-entered the runway, if it did. In addition, a Remarks field includes relevant notes providing more detail on the event, such as whether the aircraft was operating under instrument meteorological conditions or a missed approach had been initiated.

The database fields are listed in **TABLE 2**. Efforts to locate an electronic copy of the database have been unsuccessful but a printout of the database contents is included in the study report, so it would be possible to recreate the database with a modest amount of effort.

TABLE 2 FAA Database of Commercial Aircraft Accidents/Incidents Relative to Runways

Field	Description
Date	Date of accident or incident
City	Nearest city to airport where accident/incident occurred
State	State where airport is located
Arpt Name	Airport name
Rwy ID	Runway used by accident/incident aircraft
Lgth	Runway length (feet)
Wid	Runway width (feet)
Surface Type	Runway surface type
Rwy Surface Character	Runway surface characteristics
Rwy Status	Runway surface condition
Category	Accident or incident category
Phase	Phase of flight when accident/incident occurred
Owner Name	Name of aircraft owner
Operator Name/DBA	Name of aircraft operator
Acft Mfr	Aircraft make and model
FAR Part	FAR part number under which aircraft was being operated
XDistance	Distance to accident location from runway end along centerline
YDistance	Distance to accident location perpendicular to runway centerline
Remarks	Additional description of accident or incident

SOURCE: *FAA, Location of Commercial Aircraft Accidents/Incidents Relative to Runways (David, 1990).*

University of California Study of General Aviation Accidents

As part of research for the development of the California Airport Land Use Planning Handbook, the Institute of Transportation Studies (ITS) at the University of California at Berkeley (UCB) developed a database of the location of accidents in the vicinity of airports involving general aviation aircraft (Cooper & Gillen, 1993; Cooper & Chira-Chavala, 1998).

The initial study examined NTSB accident data for eleven states for the years 1983 to 1989 and the remaining states for the years 1983 to 1985 and identified those accidents that occurred within five miles of the departure or arrival airport. A search of NTSB computer data was used to identify accidents that appeared to fit the criteria and then microfiche copies of the detailed Factual Accident Report for the selected accidents were obtained from the NTSB and reviewed to identify the location of the accident, which was defined as the point of initial impact or touchdown and measured with respect to the landing threshold or runway end at the start of the takeoff roll. A large number of accidents had to be rejected because the accident reports did not provide sufficient information to identify the location with sufficient accuracy. This resulted in a database of 396 accidents. The accidents were classified as arrivals or departures, as well as those involving in-flight collisions and those in which the pilot had no control over the accident location. A subsequent study (Cooper & Chira-Chavala, 1998) followed the same procedure to expand the database to cover accidents in all fifty states for the period from 1983 to 1992. This gave a total of 873 accidents.

In addition to the accident location relative to the runway end, the database included a range of information from the NTSB Factual Report, including the airport where the accident occurred, the aircraft make and model, the date and time that the accident occurred, prevailing weather conditions, the extent of pilot control, the accident swath length and direction, whether the accident involved an in-flight collision with an obstruction, and the number of fatalities and serious injuries onboard the aircraft and on the ground. Of the 873 accidents, only six involved fatalities on the ground. The database fields are listed in **TABLE 3**.

An electronic copy of the database has been obtained in Microsoft Excel format.

TABLE 3 UCB/ITS Database of General Aircraft Accidents in the Vicinity of Airports

Field	Description
DATE	Date of Accident
NTSB FILE #	NTSB File Number
AIRPORT	Airport Name
AIRPORT ID	Airport Code
A/P CITY	Nearest City to Airport
A/P STATE	State in which Airport Located
A/C MFG	Aircraft Manufacturer
A/C MODEL	Aircraft Model
A/C WEIGHT	Aircraft Certificated Gross Wt (lb)
# OF ENGINES	Number of Engines
ENG TYPE	Engine Type
REG #	Aircraft Registration Number
ARR/DEP	Arrival or Departure (ARR/DEP)
ARR/DEP NOTES	Notes on Arrival/Departure
T/O ROLL BEG PT	Start of Takeoff Roll from RWE (ft)
TYPE OF APPROACH	Type of Approach
TIME	Time of Accident
WEATHER	Weather Conditions
VMC/IMC	VMC or IMC
DAY/NIGHT	Day or Night
DUTY RWY	Duty Runway
RWY TYPE	Runway Surface Type
RWY HEADING	Runway Heading (deg M)
RWY LENGTH	Runway Length (ft)
RWY WIDTH	Runway Width (ft)
AVAIL ILS	Available Navaids or Landing Aids
RWY PATTERN	Runway pattern direction (L/R)
FAA TOWER	FAA Tower? (Y/N)
ACC BEARING	Bearing to Acc Location (deg M)
ACC REL BEARING	Relative Bearing to Acc Loc (deg)
ACC DISTANCE	Distance to Accident Location (ft)
X COORDINATE	X Coordinate of Acc Location (ft)
Y COORDINATE	Y Coordinate of Acc Location (ft)
PILOT CONTROL	Degree of Pilot Control
SWATH LENGTH	Length of Wreckage Swath (ft)
SWATH BEARING	Bearing of Wreckage Swath (deg M)
INFLIGHT COLLISION	Inflight Collision? (Y/N) With What?
FACTOR	Collision a Factor in Accident? (Y/N)
A/C FATAL	No of Aircraft Occupants Killed
A/C SERIOUS	No of A/C Occ w/ Serious Injuries
A/C MINOR	No of A/C Occ w/ Minor Injuries
GROUND FATAL	Number on Ground Killed
GROUND SERIOUS	Number on Grnd w/ Serious Injuries
GROUND MINOR	Number on Ground w/ Minor Injuries
A/C DAMAGE	Extent of Aircraft Damage
GROUND DAMAGE	Extent of Ground Damage
NOTES	Notes

SOURCE: *UCB/ITS General Aviation Accident Database.*

ALPA Study of Commercial Aircraft Runway Accidents

The Safety Engineering staff of the Air Line Pilots Association (ALPA) International maintains a database of information on commercial aircraft overrun, undershoot, and veeroff accidents. The data are assembled from multiple sources, including accident investigation reports from the NTSB and aviation safety authorities in other countries, news reports, and industry sources. The database is updated and the resulting distribution of accident locations is revised from time to time as other activities permit.

As of June 2008, the database contained 3,575 records, of which 1,070 had information on the accident location relative to the runway threshold. Overruns are measured relative to the departure end threshold while undershoots and veeroffs are measured relative to the approach end threshold. The database fields are documented in **TABLE 4**.

TABLE 4 ALPA Overrun/Undershoot/Veeroff Database Fields

Field Name	Description
ID	Unique record identifier
A/CTYPE	Aircraft Code as listed in Key Aircraft Code Table
DATE	Date of overrun
NNUM	National Registration Number of aircraft involved
LOCATION	Airport, city, state, country
PHASE	Flight Phase as listed in Key Flight Phase Table
OPERATOR	Airline or carrier operating flight
O/U/V	Overrun, Undershoot or Veeroff
SUMM	Brief summary
SOURCE	Information source, varied and possible more than one
DAMAGE	Severity of damage, as defined in Key Damage Table
X	Distance (ft) parallel to runway centerline to reference point
Y	Distance (ft) perpendicular to runway centerline to reference point
RWYCOND	Runway Condition, as defined in Key Runway Condition Table
FATAL	Yes or No, if involving any fatalities
P/J	Prop or Jet
Called airport for Info	Note whether or not ALPA tried to get any missing data

SOURCE: *ALPA Safety Engineering staff, Personal communication.*

The distribution of accident locations in the database as of June 2008 is shown in **FIGURE 2**. It can be seen from the distribution of data points in the figure that the majority of accident locations lie within 1,000 feet of the runway thresholds or between the runway thresholds. Relatively few accident locations lie more than 500 feet laterally from the runway centerline (about 5.5%) and only about 1.4% lie more than 1,000 feet laterally from the runway centerline. No accident locations in the database lie more than 1,750 feet laterally from the runway centerline. About 2.2% of the accident locations are undershoots with a location more than 5,000 feet from the arrival runway threshold and only about 0.7% of the accident locations are overruns that ended up further than 5,000 feet from the departure runway threshold. Thus, it would appear that the principal area of concern from the perspective of third-party risk is the area within 10,000 feet of the runway threshold and 1,750 feet either side of the extended runway centerline. However, it is clear from the distribution of accident locations shown in **FIGURE 2** that the risk declines with increasing distance from the runway end and laterally from the extended runway centerline.

ACRP Study of Aircraft Overruns and Undershoots

A recently completed ACRP project, Project 04-01 *Analysis of Aircraft Overruns and Undershoots for Runway Safety Areas* (Hall, Ayers, *et al.*, 2008), included the development of a detailed database of aircraft overrun, undershoot, and veeroff accidents, although only the overrun and undershoot accidents were used in the analysis for the study. This database is essentially a subset of the accident and incident database developed by Loughborough University described in more detail below. These data covered accidents and incidents occurring in the United States, Canada, Western Europe, Oceania (Australia and New Zealand), and a few selected countries in Asia.

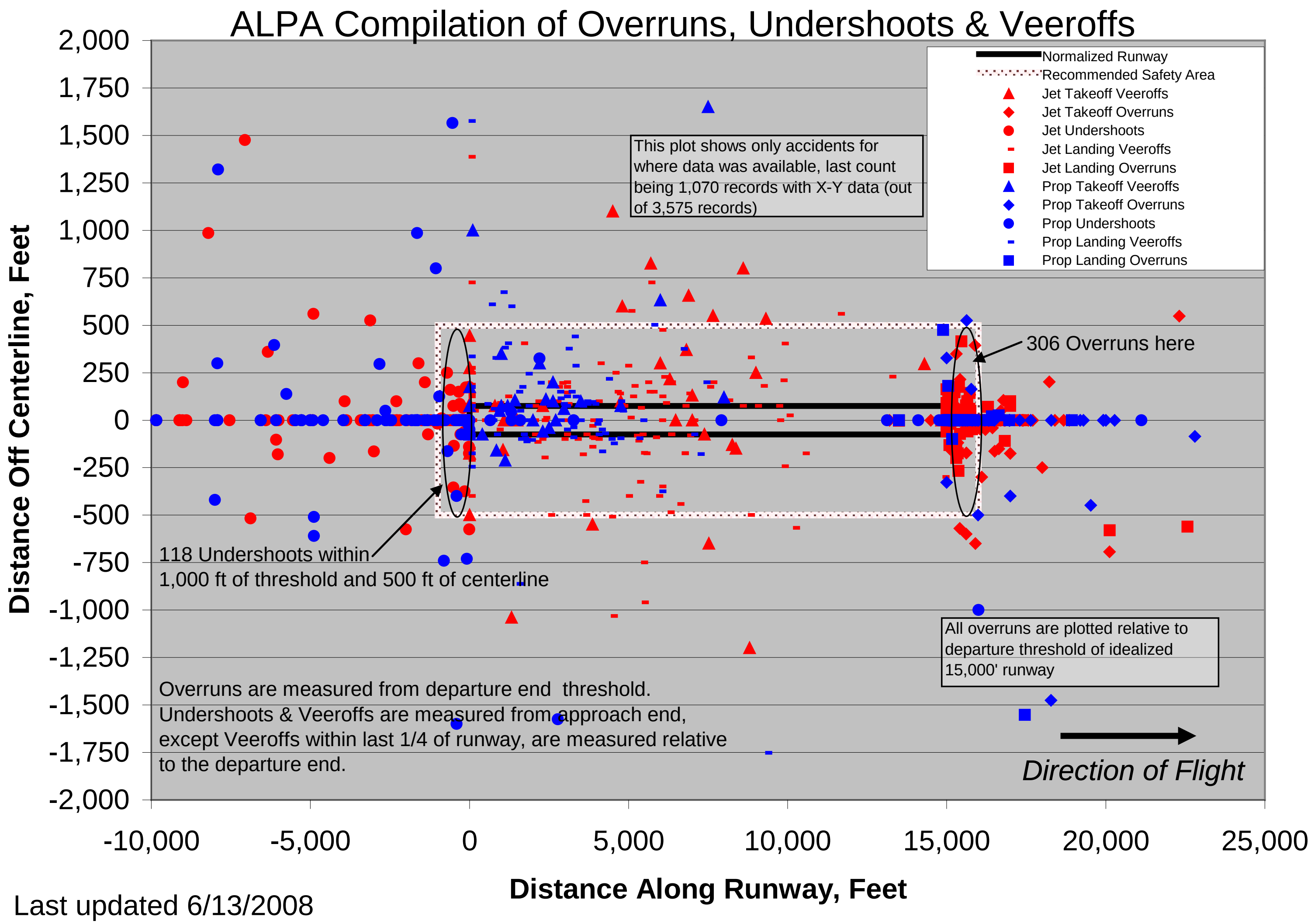

FIGURE 2. ALPA Analysis of Runway Accident Locations

SOURCE: *ALPA Safety Engineering staff, Personal communication.*

The ACRP applied a set of filtering criteria to extract relevant accidents and incidents from the Loughborough University database. Details of the filtering criteria are described in Table 1 of the project final report (Hall, Ayers, *et al.*, 2008). In summary these were:

- Include only operations under FAR Parts 121, 125, 129, 135, and selected Part 91 (general aviation) operations
- Include only events involving fixed wing aircraft with certificated maximum gross weight of 6,000 lbs. or more (12,500 lbs. for Part 91 operations)
- Exclude events involving single engine or piston engine aircraft
- Include only events involving an undershoot, excursion beyond the departure end of the runway (overrun), or veeroff for which either the point of first impact or the wreckage final location is within 2,000 feet of the runway threshold.

This resulted in 459 overrun and undershoot accidents and incidents that were used in the analysis (as noted above, some veeroff accidents or incidents are also included in the database but not utilized in the study), of which 274 were landing overruns, 92 were take-off overruns, and 93 were landing undershoots. The majority of these events (78%) occurred in the U.S.

The database contains a large amount of detailed information on each event, including:

- Aircraft data
- Airport and runway data
- Consequences, including extent of aircraft damage, injuries and fatalities
- Flight operational data
- Prevailing weather conditions
- Details of any obstacles or terrain impacted
- Wreckage information
- Operating anomalies, including aircraft system faults, abnormal weather conditions, human errors, and runway surface condition
- Estimated costs of the event

The details of the database structure are documented in the project final report and summarized in Attachment 2 to this working paper. The database is implemented using Microsoft Access.

While the database contains an extensive amount of information on each accident or incident, the limitation to events in which the point of first impact or wreckage final location lie within 2,000 feet of the runway threshold in turn limits the use of the data for assessing third-party risk, since much of the area for which a third-party risk analysis would be required is beyond 2,000 feet from the runway threshold. This limitation is a result of the focus of the ACRP study on developing risk models to analyze the safety implications of changing runway safety area dimensions.

In spite of this limitation, the database could be used to explore how third-party risk varies within 2,000 feet of the runway end, which may be of interest in some situations. However, care would be needed in interpreting the results of any such analysis due to the exclusion of certain types of aircraft operation from the database.

Accident Databases Developed for Third-Party Risk and Other Studies

Databases with information on aircraft accidents on or in the vicinity of airports have been developed by several organizations in support of studies addressing third-party risk or other safety issues. This section documents four such databases.

UK National Air Traffic Services

The United Kingdom (UK) National Air Traffic Services, Limited (NATS) initially developed a database of aircraft accidents in the vicinity of airports to support a 1997 NATS study of third-party risk near airports and public safety zone policy for the UK Department of Transport (Evans, Foot, *et al.*, 1997). Since that time NATS has continued to update the database with information on more recent accidents and uses it to maintain and enhance the third-party risk models developed in the 1997 study.

In particular, NATS obtained an expanded database of general aviation (GA) accidents, primarily in the U.S., and developed a revised GA crash location model. The commercial aircraft accident database is based on data from Ascend Worldwide Limited. For each relevant accident, an attempt is made to obtain the accident investigation reports to derive specific crash location data (personal communication with Raymond Lim, NATS).

A more recent NATS report (Cowell, Foot, *et al.*, 2000) includes a chronological listing of aircraft crashes in the aircraft accident database as of the date of the report together with a summary table of the number of entries in the database classified by crash site terrain. This comprised 559 accidents, for which 245 entries had a value for debris area and 82 had a value for the destroyed area (as shown in **TABLE 5**).

TABLE 5 Entries in the NATS Crash Location Database as of January 2000

Terrain	Whole Database	Entries with a Value for	
		Debris Area	Destroyed Area
Airport	260	92	14
Built up	42	22	13
Open	115	59	19
Unknown	16	8	0
Water	34	12	1
Wooded	92	52	35
Total	559	245	82

SOURCE: *Cowell, Foot, et al., 2000, Table E.1.*

A little under half of the accidents in the database occurred on the airport, and only about 8% of those for which the crash site terrain was known occurred in a built-up area. Obviously, for many accidents the nature of the crash site terrain depends on the type of terrain that happened to exist at the crash site, and a similar accident at another airport in the future would not necessarily encounter the same type of terrain. However, this brings up the issue of the extent to which the flight crew of aircraft involved in accidents had some discretion on avoiding built-up areas or structures within built-up areas. Because of the commercial nature of NATS work in this area, the NATS database is not publicly available, nor is detailed documentation of the database or models released.

Netherlands National Aerospace Laboratory

Since the early 1990s the Netherlands National Aerospace Laboratory (NLR) has undertaken a series of studies to develop a method for calculating third-party risk around airports (Ale, Smith & Pitblado, 1999; Pikaar, Piers & Ale, 2000). These studies have utilized a database of aircraft accidents that has evolved over the years and now forms the Air Safety Database of the recently established NLR Air Transport Safety Institute (NLR-ATSI) (http://www.nlr-atsi.nl).

The NLR-ATSI Air Safety Database comprises a set of separate databases containing different types of data that can be related to each other. In addition to data on accidents and incidents, these databases include airport data, flight exposure data, weather data and aircraft fleet data. The Air Safety Database is updated frequently using such sources as official reporting systems, insurance claims, accident investigation boards, aircraft manufacturers and civil aviation authorities. The Air Safety Database contains detailed information on accidents and incidents worldwide involving fixed-wing aircraft from 1960 onward. As of July 2008, the Air Safety Database contained information on more than 34,000 accidents and serious incidents (NLR Air Transport Safety Institute, 2008).

The Air Safety Database and its role in third-party risk models has been described by the Air Safety Database manager as follows (personal communication with Yuk Shan Cheung, NLR):

> **Data Used in the Development of the NLR Third-Party Risk Models** The NLR-ATSI Air Safety Database has been used extensively in the development of the NLR third-party risk models. From the NLR-ATSI Air Safety Database different third-party risk related accident rates were derived (*e.g.* by aircraft generation, by type of operation, by type of approach, *etc.*). Furthermore, data for the development of the accident location model were obtained from the NLR-ATSI Air Safety Database. The third-party accident consequence models were mainly developed from detailed accident reports. However, some data were also obtained from the NLR-ATSI Air Safety Database in this development.

> **NLR-ATSI Air Safety Database** The NLR-ATSI Air Safety Database contains detailed information on accidents and incidents of fixed wing aircraft and helicopters from 1960 and onwards. The database contains information on more than 35,000 accidents and serious incidents that occurred worldwide. The data are obtained from a variety of sources including official reporting systems, insurance claims data, accident investigation boards, aircraft manufacturers, civil aviation authorities and more. The database is updated frequently using reliable sources as indicated. For each occurrence a wide variety of factual information can be captured ranging from information on the aircraft, operator/owner, type of operation, aerodrome, weather, ATC, causes, events, narrative, and so forth. There is sometimes also more detailed information recorded such as the location of the aircraft relative to the runway, impact dynamics, survivability aspects, and so forth. The availability of this detailed type of information depends on the type of occurrence (*e.g.* for an accident during the en route phase the location of the wreckage relative to the runway is not recorded).
>
> In addition to data on accidents and serious incidents, the database also contains a large collection of commercial airline safety reports (over 310,000 incident records) for both fixed wing aircraft as well as helicopters. For each occurrence information regarding associated causes, aircraft type, location, and events is recorded as well as a narrative.
>
> Besides data on accidents/incidents, the NLR-ATSI Air Safety Database also [contains] non-accident related data. These data include the following (worldwide): airport databases, flight exposure data (flights/hours at the level of airlines, aircraft type, and departures/arrivals at airports), airport weather data (both climatologically and hourly measurements), aircraft fleet data, and more. These data can be queried separately or in a relational way (*e.g.* combined with the factors present in accidents/incidents or other combination *e.g.* airport weather with number of landings).

Since the NLR-ATSI engages in commercial research and consultancy, access to the information in the Air Safety Database would require a contractual arrangement with the Institute.

Loughborough University

As part of a study for the UK Engineering & Physical Sciences Research Council titled the *Aviation Risk Assessment Project*, a research team at Loughborough University developed an aircraft accident database from a range of industry sources to support improved assessment of risk to aircraft occupants and communities due to aircraft operations on and near airports.

The content of the database is documented in a Ph.D. dissertation by Wong (2007). The accident data were obtained from the NTSB and filtered to include accidents at airports in the U.S. between 1982 and 2002 involving landing overruns, landing undershoots, takeoff overruns and crashes after takeoff within 10 kilometers of the airport reference point. Other filters were applied to include only multi-engine, fixed-wing, jet or turboprop aircraft with a certificated maximum gross weight of 6,000 pounds or more (12,500 pounds or more for general aviation aircraft) operating under FAR Parts 91, 121, 125, 129, and 135. This resulted in 440 accidents, comprising 199 landing overruns, 122 landing undershoots, 52 takeoff overruns, and 67 crashes after takeoff.

The database is not publicly available and access would require payment to Loughborough University.

FAA Runway Excursion Database

The MITRE Corporation Center for Advanced Aviation System Development (CAASD) has recently assembled a database of information on runway excursion events for the Airport Engineering Division of the FAA Office of Airport Safety & Standards. The information in the database was derived from NTSB and FAA accident and incident data sources and covers overruns and veeroffs (termed side excursions or off-side events). The data was assembled to support safety analysis studies for end-around taxiway (EAT) and Runway Safety Area (RSA) design criteria. The database also includes events involving aircraft that were airborne at the departure end of the runway but crashed beyond the runway. The database structure allows for land-short events, but the database contains no such events.

The source data was reviewed by CAASD staff and corrected or standardized as necessary. In addition, estimates were made of the most likely (best estimate) and lower and upper bound 95% confidence intervals for the excursion distance to the side of the runway centerline or stopping distance beyond the departure end of the runway for overrun events.

The database structure is documented in Attachment 3 and the units of measurement used in the database are shown in **TABLE 6**.

TABLE 6 Units of Measurement in FAA Runway Excursion Database

Measurement	Unit
Distance	Feet (ft)
Ceiling	Feet (ft)
Weight	Pounds (lbs)
Speed	Knots (kts)
Visibility	Statute miles (mi)

SOURCE: *FAA Airport Engineering Division (personal communication).*

An electronic version of the database was obtained from the FAA Airport Engineering Division in Microsoft Access format. The database contains a total of 1,708 events from the period 1982 to 2005, including 618 overrun events, 811 veeroff events and 279 crashes beyond the runway end. The breakdown of events by category of event and type of operation (relevant Part of FARs) is shown in **TABLE 7**.

TABLE 7 Distribution of Events in FAA Runway Excursion Database

	Operation under Federal Aviation Regulation				
Event Type	Part 91	Part 121	Part 129	Part 135	Other*
Overrun - arrival	277	76	5	43	2
Overrun - departure	160	19	1	34	1
Veeroff	741	27		34	5
Veeroff / overrun - arrival	2			2	
Crash beyond runway - arrival	30			2	
Crash beyond runway - departure	222	6	1	18	
Total	1,432	128	7	133	8

NOTE: * *"Other" category includes unknown (one event).*
SOURCE: *Author analysis of FAA Runway Incursion database.*

The database includes the worst level of injury (none, minor, serious, fatal) as a result of the event, but does not give either the number of those injured or killed, or distinguish between injuries and fatalities to people on board the aircraft from those on the ground.

Development of an Integrated ACRP Aircraft Accident Database

The current project has obtained copies of several of the aircraft accident databases developed as part of prior studies of aircraft accidents on or in the vicinity of airports. It would be useful to make these data available in a compatible format to support future analysis of aircraft accidents in the vicinity of airports. The development of an integrated database would facilitate the use of the existing data, avoid duplication of effort in assembling additional data, and focus attention on rectifying deficiencies and limitations of the existing datasets. As additional data become available, or efforts are undertaken to fill in missing data in the existing databases, the integrated database could be updated and expanded.

Three key features of the proposed Integrated ACRP Aircraft Accident Database (IAAAD) are:

- Make maximum use of existing data, avoiding unnecessary duplication of effort,
- Allow information from different data sources to be easily combined for analysis,
- Facilitate the identification of missing data and data gaps, and provide a framework to support future efforts to resolve these data deficiencies.

In many cases, data in existing aircraft accident databases relate to the same accident or incident and are typically derived from the same primary source data although the data may be organized in different ways and be enhanced through the addition of supplementary or related information, such as the inclusion of information on accident location derived from investigator's notes or other sources. By identifying the relationships between the data in the different datasets, the information can be leveraged by utilizing different data on the same accident or incident from multiple sources.

It is envisaged that an initial version of the proposed Integrated ACRP Aircraft Accident Database would contain data from the following sources:

- FAA Study of Commercial Aircraft Accidents/Incidents Related to Runways
- UCB/ITS Database of General Aviation Accidents in the Vicinity of Airports
- FAA Database on Runway Excursion Accidents and Incidents
- ACRP Study of Aircraft Overruns and Undershoots

Database Structure and Contents

The different architecture of each of the source datasets to be included in the IAAAD suggest that this will best be organized as a relational database, with separate tables for each of the source datasets. In some cases, a source dataset may well consist of several related tables. A master table would identify each accident or incident included in the IAAAD with a field indicating whether that event is represented in each of the component datasets. To the extent that the component datasets contain information that is common across more than one dataset, for example the aircraft registration number, it would make sense to include this in the master table, or sub-tables, rather than in each of the component datasets. While this will involve a certain amount of work in restructuring the component datasets, this effort will more than pay off in the resulting ease of use of the integrated database.

Data Dictionary

It will be necessary to develop a detailed data dictionary to document the structure and content of the IAAAD. The data dictionary will contain descriptions of the fields (columns) in each table and definitions of numeric or text codes used in specific fields. By organizing the data dictionary as a set of related tables, this can form part of the relational database and facilitate the analysis of the database content.

Database Implementation and Maintenance

In order to make the IAAAD readily available to potential users, it would be desirable to maintain it on an appropriate web server. The website would need to contain some basic descriptive material on the database and allow users to download the current version of the database. It would also be desirable to provide an online data query capability so users could perform fairly simple data queries or analysis without having to download the entire database. The NTSB Aviation Accident Database website (http://www.ntsb.gov/ntsb/query.asp), the FAA ASIAS website (http://www.asias.faa.gov), and the U.S. Department of Transportation Bureau of Transportation Statistics *Transtats* website (http://transtats.bts.gov) all provide good models for how this could work.

While the IAAAD website could be hosted on a TRB web server, this may not be the best solution since there would be a significant amount of work establishing the website and some amount of work maintaining it and providing user support. It is not clear that TRB website staff have the resources to do this or enough familiarity with the data to respond to user questions. A better solution would be to make the IAAAD one of the FAA ASIAS databases. The ASIAS office already has the website infrastructure to support Internet access to multiple databases and staff who are knowledgeable about both database maintenance and aviation safety issues. Since the FAA has already providing the funding to the ACRP to develop the IAAAD in the first place, it would seem reasonable for aviation safety databases developed through the ACRP to be supported by ASIAS. However, ACRP staff would need to discuss the budgetary and organizational implications of this with ASIAS management.

Analysis of Aircraft Accident Trends

Chapter 7 *Aircraft Accidents and Safety Considerations* noted that the continuing efforts to improve aviation safety appear to be resulting in a downward trend in the occurrence of aircraft accidents. The fatal accident rate for commercial aviation in the U.S. for the 10-year period from 1997 to 2006 was significantly lower than for the previous 10-year period, although the rate appears to have been fairly stable for the past 10 years. The average fatal accident rate for 1987-1996 was 0.054 fatal accidents per 100,000 departures while that for 1997-2006 was 0.019, a decline of about 65%. The fatal accident rate for general aviation shows a much smaller reduction, although after showing a fairly steady decline through the 1990s, it appears to be showing an increasing trend in recent years. The average fatal accident rate for 1987 to 1996 was 1.6 fatal accidents per 100,000 flight hours, while that for 1997 to 2006 was 1.3, a decline of only about 20%.

Starting in Fiscal Year 2008, the FAA changed its safety metric for commercial air carrier accidents from fatal accidents per 100,000 operations to fatalities per 100 million people on board. While this new metric may give a better measure of the risk to an individual air traveler, it is not a particularly relevant measure from the standpoint of third-party risk, which is primarily concerned with the risk that an aircraft accident will occur at a particular location, not the risk to the people on board the aircraft. There is also the practical difficulty of obtaining a time-series of past accident rates using the new metric. For these reasons, the discussion of commercial aircraft accident rates in this working paper uses the established NTSB metric of fatal accidents per 100,000 departures.

If this overall reduction in accident rates is also true for those accidents that contribute to third-party risk around airports, namely those accidents occurring within about two miles of the airport, primarily under the arrival and departure flight paths, then this will result in a reduction of the level of third-party risk for any given level of airport operations compared to the level of third-party risk calculated from past accident data. Thus in addition to the trend in the overall aircraft accident rate, it is desirable to determine whether there appear to be any trends in the composition of the accidents that have occurred.

This section examines the NTSB aircraft accident data to determine whether there appears to be any indication of a trend in the composition of aircraft accidents, in other words whether the reduction in fatal accident rate appears uniform across different categories and locations of accidents. However, the ability to analyze different categories of commercial aircraft accident is limited by the small number of such accidents in any year. Examining the rate of occurrence of any particular category of such accidents reduces the number of such events that have occurred in any particular period and hence makes identification of any trend difficult. Therefore the analysis compares the proportion of accidents in any particular category during the past ten years compared to the previous ten years. Even so, there were only 43 fatal accidents involving aircraft operated by large air carriers from 1987 to 1996 and just 21 fatal accidents from 1997 to 2006, excluding events involving suicide or terrorism.

Identifying trends in general aviation accidents is somewhat easier, since the number of fatal accidents each year is significantly greater. From 1987 to 1996, there were an average of 425 fatal accidents per year, while from 1997 to 2006 this reduced to an average of 336 fatal accidents per year.

Commercial Aircraft Accidents

The fatal accident rate for U.S. large commercial air carriers operating under FAR Part 121 for all types of accidents apart from suicide or terrorism is shown in **FIGURE 3**. This shows that the accident rate varied widely from year to year, particularly for the years prior to 1997, as would be expected with what are essentially infrequent random occurrences. Although there were also changes in the number of departures from year to year, these were much less variable and increased fairly steadily from about 7.6 million in 1987 to 11.4 million in 2006, as shown in **FIGURE 4**. Thus the variability in the accident rate reflects the variability in the number of accidents from year to year. It can be expected therefore that this variability in the number of accidents in any year is the result of any even greater variability in the occurrence of any particular category of accident.

Although aircraft accidents can be classified in a number of different ways, from the perspective of third-party risk it is useful to classify the accidents by phase of flight. Accidents occurring during those phases of flight that take place on the airport (standing, taxi, takeoff, and landing) generally pose no risk to third parties, while accidents occurring during the en route phase of flight pose no greater risk to those in the vicinity of airports than those anywhere else. Indeed, the risk to anyone on the ground from an accident occurring during en route flight is infinitesimally small, due to the vast area over which the accident could potentially occur.

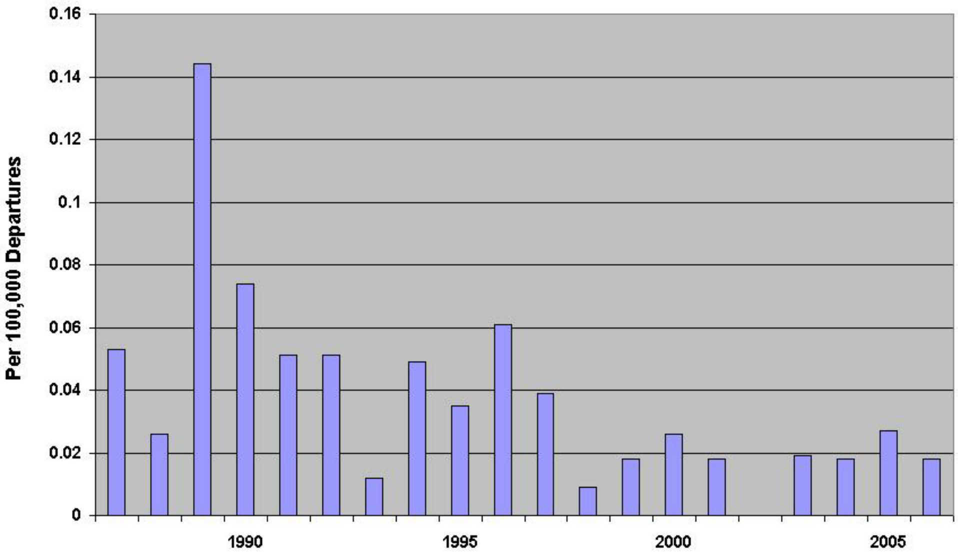

FIGURE 3. Fatal Accident Rate – Large Commercial Air Carriers
SOURCE: *Data from National Transportation Safety Board, Aviation Accident Statistics (NTSB, 2007). Scheduled and Nonscheduled Operations under FAR Part 121.*

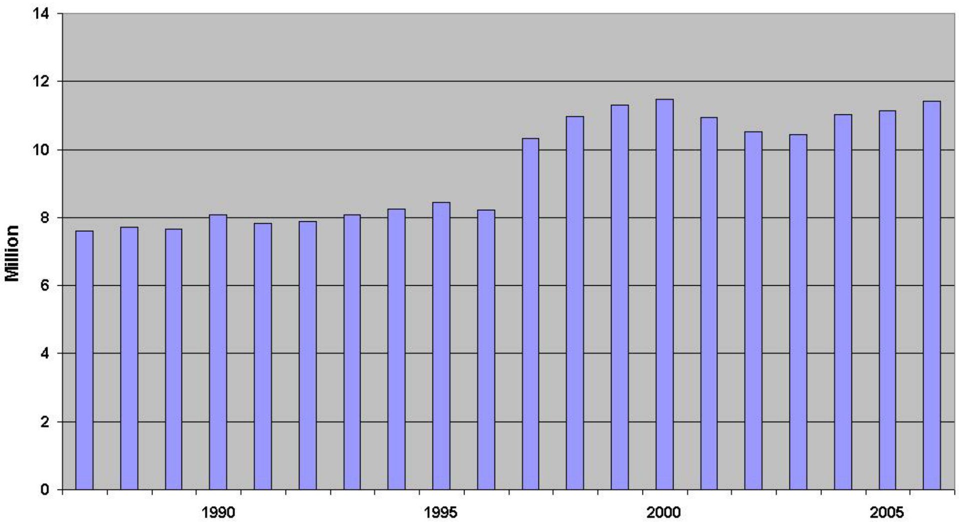

FIGURE 4. Annual Departures – Large Commercial Air Carriers
SOURCE: *Data from National Transportation Safety Board, Aviation Accident Statistics (NTSB, 2007). Scheduled and Nonscheduled Operations under FAR Part 121.*

TABLE 8 shows the number of fatal accidents within the U.S. and the associated accident rate by phase of flight for aircraft performing scheduled or nonscheduled operations under FAR Part 121 for the two 10-year periods 1987 to 1996 and 1997 to 2006. Only accidents that occurred within the U.S. are considered, since accidents that occurred in other countries may have experienced a different operating environment and resulting risk exposure. It can be seen that the reduction in fatal accident rates was greater for some phases of flight than others. However, particular care is needed in interpreting the data for two reasons. The first is that the NTSB began using a number of additional phase of flight codes in its accident investigations from 2000. Accidents that were coded to those phases of flight after 2000 would have been coded to another phase of flight in prior years. The second factor that could affect the accident rates is that from March 20, 1997 regional airlines that had been operating aircraft with 10 or more seats in scheduled passenger service under FAR Part 135 were required to operate under FAR Part 121. To the extent that regional airlines tend to operate shorter stage lengths, often with turboprop equipment, this could change the composition of the risk exposure and affect the pattern of accidents by phase of flight.

TABLE 8 Fatal Accidents to Large Commercial Air Carrier Aircraft by Phase of Flight

	1987-1996		1997-2006	
Phase of Flight	Fatal accidents	Rate per 100,000 dep	Fatal accidents	Rate per 100,000 dep
Standing	5	0.007	6	0.006
Taxi	3	0.004	2	0.002
Takeoff	10	0.013	4	0.004
Initial climb	-		1	0.001
Climb	4	0.005	1	0.001
En route	4	0.005	1	0.001
Descent	-		-	
Approach	7	0.009	2	0.002
Landing	3	0.004	2	0.002
Maneuvering	1	0.001	-	
Unspecified	1	0.001	-	
Total	38	0.049	19	0.020

NOTES: *Data for Scheduled and Nonscheduled Operations under FAR Part 121 within the U.S. Excluding events involving suicide or terrorism.*
SOURCE: *Author analysis of NTSB Aviation Accident Database.*

It can be seen from the fatal accident rates in **TABLE 8** that the reduction in overall accident rate was due to improvements in all phases of flight (combining initial climb and climb, since there was no phase of flight code for initial climb during the period 1987 to 1996), although some phases of flight appear to show greater improvement than others. The largest reduction in accident rate occurred in the takeoff, climb (including initial climb), en route, and approach phases of flight. This suggests that reductions in third-party risk between the two periods are at least as great as the reduction in overall accident rate.

However, these results should be interpreted with caution, due to the low numbers of accidents in total, and particularly in any phase of flight. Consideration should also be given to the relative severity of accidents that occur on the airport surface, compared to those that occur to aircraft that are airborne. In particular, the relatively high number of fatal accidents that occurred while aircraft were standing was largely due to ramp crew walking or being drawn into aircraft propellers or engines. Although tragic for those involved, the number of fatalities caused by such accidents is generally very low (typically one per accident).

Given the relatively low number of accidents to large commercial aircraft that occur in any year, as well as the downward trend in the accident rate, it would be desirable to base any analysis of trends in different categories of accident on a larger population of aircraft operations that includes data from accidents occurring in other countries. Due to the wide variability of accident rates in different parts of the world, it would be desirable to restrict any such analysis to accidents involving aircraft operated by airlines with a similar safety record to the U.S. and that occur in countries with a similar aviation regulatory environment to the U.S.

General Aviation Aircraft Accidents

The fatal accident rate for general aviation aircraft operating under FAR Part 91 for all types of accidents apart from suicide, sabotage and the use of stolen or unauthorized aircraft is shown in **FIGURE 5**. The variation in accident rate from year to year is much less pronounced than for commercial aircraft accidents, as would be expected with the larger number of accidents. The accident rate shows an increasing trend from 1987 to 1994, then declined significantly from 1994 to 1999, since when it has been tending to increase again.

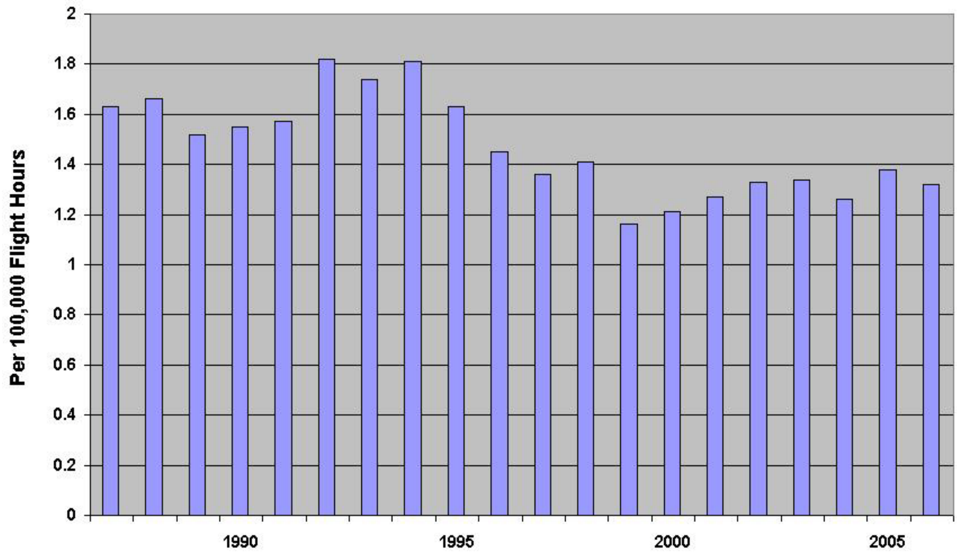

FIGURE 5. *Fatal Accident Rate – General Aviation Operations*
SOURCE: *Data from National Transportation Safety Board, Aviation Accident Statistics (NTSB, 2007). Operations under FAR Part 91.*

The number of fatal accidents occurring in the U.S. and the associated fatal accident rate for fixed wing aircraft by phase of flight for the two periods 1987 to 1996 and 1997 to 2006 is shown in **TABLE 9**. Rotorcraft accidents are excluded from the table, since they do not typically follow the same phases of flight as fixed wing aircraft. However events involving suicide or the use of stolen or unauthorized aircraft (there were no fatal accidents involving sabotage during the two periods) are included in the accident counts and rates, since such accidents also contribute to third-party risk.

TABLE 9 Fatal Accidents to Fixed Wing General Aviation Aircraft by Phase of Flight

	1987-1996		1997-2006	
Phase of Flight	Fatal accidents	Rate per 100,000 flt hrs	Fatal accidents	Rate per 100,000 flt hrs
Standing	19	0.008	11	0.005
Taxi	10	0.004	4	0.002
Takeoff	414	0.174	232	0.099
Initial climb	10	0.004	186	0.079
Climb	124	0.052	132	0.056
En route	498	0.209	470	0.200
Descent	893	0.375	175	0.075
VFR Pattern	-		45	0.019
Approach	510	0.214	364	0.155
Landing	157	0.066	77	0.033
Go-around/Missed approach	13	0.005	68	0.029
Emergency landing after t/o	-		30	0.013
Emergency landing	40	0.017	94	0.040
Maneuvering	898	0.377	625	0.266
Other	13	0.005	7	0.003
Unspecified	127	0.054	358	0.152
Total	3,726	1.56	2,879	1.23

NOTES: *Data for fixed wing operations under FAR Part 91 within the U.S.*
SOURCE: *Author analysis of NTSB Aviation Accident Database.*

It is clear from the fatal accident rates by phase of flight shown in **TABLE 9** that the main contribution to the reduction in the overall fatal accident rate between the two periods came from a reduction in accidents during descent and maneuvering. The latter is mainly associated with accidents occurring during agricultural operations and aerial work. Other significant gains occurred from a reduction in accidents during approach and landing.

The apparent increase in accident rate for initial climb is due to a very limited use of that flight phase code prior to 2001. It would appear from the accident rates for takeoff and climb phases of flight for the two time periods that accidents classified as occurring during initial climb from 2001 would most likely have been classified as occurring during takeoff in earlier years. This eliminates the apparent improvement in accident rate for the takeoff phase of flight. The apparent increase in accident rates for go-arounds, missed approaches, and emergency landings appears to be due to a greater use of those phase of flight codes during the second of the two time periods. Presumably, such accidents would have been assigned other phase of flight codes during earlier years. Likewise, accidents that were assigned a phase of flight code for Visual Flight Rules (VFR) traffic pattern in the second time period would presumably have been assigned to another phase of flight in earlier years.

Some caution is warranted in interpreting the accident rates shown in **TABLE 9** due to the relatively large number of accidents that were not assigned a specific phase of flight. If these accidents did not occur across the various phases of flight in proportion to those accidents that were assigned to a phase of flight, this would distort the apparent change in accident rates.

The inconsistent use of phase of flight codes over time makes analysis of changes in the composition of accidents over time difficult. Although it would be a substantial amount of work, it would enhance the value of the phase of flight information for use in analysis of trends in the composition of aircraft accidents if the detailed data for each accident could be reviewed and the phase of flight codes revised as appropriate. Data mining and text mining tools could be used to perform an initial automated screening and then data for accidents with questionable phase of flight codes examined in more detail.

The changes in accident rates shown in **TABLE 9** suggest that there may have been a slightly greater reduction in third-party risk under approach flight paths than the overall reduction in fatal accident rates between the two time periods, but there does not appear to have been a corresponding reduction in the third-party risk under departure flight paths. However, a more detailed analysis of the accident data would be necessary to confirm this, since both the approach and climb phases of flight can extend a considerable distance from the airport.

Summary and Conclusions

This working paper has documented a wide range of sources of information on aircraft accidents in the vicinity of airports. These sources include primary data collected by the national civil aviation authorities and transportation safety agencies responsible for investigating aircraft accidents, as well as derivative data sources that integrate information from different countries or combine information from multiple sources. The latter include the ICAO Accident Data Reporting System (ADREP) database as well as a number of proprietary or commercially marketed data sources.

Each of these data sources has its strengths and weaknesses, and generally includes only certain categories of accident or partial coverage of all accidents in a given category. In the case of commercial or proprietary databases, it is often not clear how comprehensive they are. There is a need for better documentation of the contents of these databases so that potential users can assess whether the database will satisfy their analysis requirements. At a minimum, this documentation would include a list of the accidents included in the database with the date, location and aircraft type involved, and a list of the fields in the database with a short description of each. It would also be helpful to include for each field the percent of those records for which the field is applicable which have missing data.

From the perspective of the analysis of third-party risk in the vicinity of airports, a key consideration is the quality of the information on the location of aircraft crashes near airports and the extent of any wreckage or damage to property. Since the damage or wreckage swath can cover a significant area, it is desirable to indicate the extent of this area and not just the point of first impact with the ground or the final resting place of the aircraft. Following the common practice of expressing the crash location in terms of X and Y coordinates relative to the runway end, it would be desirable to provide the coordinates of the first point of impact with the ground as well as the direction, width and length of the damage swath. In the case of an aircraft runway overrun or veeroff where the aircraft does not leave the ground, the coordinates of the start of any damage swath should be noted, as well as the point where the aircraft left the airport property if it did.

Much of this information is missing from past accident reports, or can only be derived by careful review of investigators notes, news reports, or other related sources of information. This can require a significant amount of work to assemble. Where data on accident locations has been inferred from related information, it would be helpful to provide an estimate of the likely accuracy of the data. The approach adopted in a recent study for the FAA by MITRE/CAASD of providing a 95% confidence interval for estimates of the locations involved in runway excursion accidents relative to the runway represents a good model.

Because data on aircraft accidents that occur in the vicinity of airports but off the airport property is relatively sparse, since such accidents are fortunately fairly infrequent, it is important to ensure that all relevant data is utilized in accident analysis. Unfortunately, this is complicated by the proprietary nature of some of the more comprehensive safety databases, which prevents the pooling and validation of the information in the various databases.

The current project has identified and assembled a number of datasets of information on aircraft accidents on or in the vicinity of airports. With one exception, the principal focus of these datasets has been accidents on or near the runway (undershoots, overruns, and veeroffs). The exception is a somewhat dated study for the California Department of Transportation that assembled a database of general aviation accidents for use in airport land use planning around airports. While these datasets have their limitations, the data contained in them could be made more readily available for safety analysts by implementing an integrated database, such as proposed in this working paper. The ACRP would need to identify a suitable server to host the database. The FAA Aviation Safety Information Analysis and Sharing (ASIAS) system would appear to be the most logical solution.

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CONTACT INFORMATION

The following contact information for key individuals responsible for the various databases documented in this working paper has been provided to facilitate follow-on activities involving either requesting additional information about the databases or exploring access to the data contained in the databases.

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California Division of Aeronautics General Aviation Accident Database

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Attachment 1
NTSB Aviation Accident Database Structure
Source: NTSB, Aviation Accident Database, Data Dictionary

Data Table: events

Column Name	Description
ev_id	*Event ID Number*
ev_date	Event Date
ev_time	Time of Event
ev_city	Event Location Nearest City
ev_state	Event Location State
ev_type	Type of Event
ev_dow	Event Day of the Week
ev_tmzn	Event Time Zone
ev_country	Event Country
ev_site_zipcode	Zipcode of the event site.
ev_year	Event Date Year
ev_month	Event Date Month
mid_air	MidAir Collision Indicator
on_ground_collision	On Ground Collision occurred
latitude	Event Location Latitude
longitude	Event Location Longitude
biohazard_area	Biohazard Area
apt_name	Event Location Airport
airport_type	Airport type
airport_involvement	Airport involvement
ev_nr_apt_id	Event Location Nearest Airport ID
ev_nr_apt_loc	Event Location, Nearest Airport
apt_dist	Event Location Distance
apt_dir	Event Location Direction
apt_elev	Airport Elevation
rwy_brake_cond	Runway Braking Condition
wx_brief_comp	Weather Briefing Completeness
wx_src_iic	Investigator's weather source.
wx_cond_basic	Basic weather conditions
wx_obs_time	Time of the weather observation.
wx_obs_dir	Weather Observation Direction
wx_obs_fac_id	Weather Observation Facility ID
wx_obs_elev	Elevation of Weather Observ.
wx_obs_dist	Weather Observation Distance
wx_obs_tmzn	Time Zone of the weather observation.
light_cond	Lighting Conditions
sky_cond_nonceil	Sky Condition Lowest Non-ceiling
sky_nonceil_ht	Lowest Non-Ceiling Height
sky_ceil_ht	Lowest Ceiling Height
sky_cond_ceil	Sky Condition for Lowest Ceiling
vis_rvr	Visibility RVR (Feet)
vis_rvv	Visibility RVV (Statute Miles)
vis_sm	Visibility (Statute Miles)
wx_temp	Air Temperature at event time (deg. F).
wx_dew_pt	Dew Point at event time (deg. F).

Data Table: events (continued)

Column Name	Description
wind_dir_deg	Wind Direction (degrees magnetic)
wind_dir_ind	Variable Wind Indicator
wind_vel_kts	Wind Speed (knots)
wind_vel_ind	Wind Velocity Indicator
gust_ind	Wind Gust Indicator
gust_kts	Wind Gust (knots)
altimeter	Altimeter Setting at event time (in. Hg)
wx_dens_alt	Density Altitude (feet).
wx_int_precip	Intensity of Precipitation
wx_obs_tmzn	Time Zone of the weather observation.
metar	METAR weather report
ev_highest_injury	Event Highest Injury
inj_f_grnd	On Ground, Fatal Injuries
inj_m_grnd	On Ground, Minor Injuries
inj_n_grnd	Injury None Ground
inj_s_grnd	On Ground, Serious Injuries
inj_tot_f	Injury Total Fatal
inj_tot_m	Injury Total Minor
inj_tot_n	Injury Total None
inj_tot_s	Injury Total Serious
inj_tot_t	Injury Total All (F+S+M+N)
invest_agy	Investigating Agency
metar	METAR weather report
faa_region	Event Location FAA Region
faa_dist_office	FAA District Office
iicf_fname	FAA IIC's First Name
iicf_init	FAA IIC's Middle Initial
iicf_lname	FAA IIC's Last Name
notf	Notification
ntsb_docket	NTSB Docket Number
ntsb_notf_from	NTSB Notification Source
ntsb_notf_date	NTSB Notification Date
ntsb_notf_tm	NTSB Notification Time
iicn_fname	NTSB IIC's First Name
iicn_init	NTSB IIC's Middle Initial
iicn_lname	NTSB IIC's Last Name
report_status	NTSB Report Status
fiche_number	Fiche Number
approval_date	Approval Date
status_flag	Status Flag
delete_flag	Internal delete flag
latest_src	Latest Data Source (Form #)
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: dt_events

Column Name	Description
ev_id	*Event ID Number*
col_name	Events multiple-entry field, Column Name
code	Events multiple-entry field, Code
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: aircraft

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
regis_no	Aircraft Registration Number
ntsb_no	NTSB Number
acft_missing	Missing Aircraft Indicator
ntsb_19a_date	Form 6120.19A entry date
ntsb_4_date	Form 6120.4 entry date
faa_form_date	FAA Form Date
far_part	FAR Part
flt_plan_filed	Type of Flight Plan filed
flight_plan_activated	Flight plan was activated
damage	Damage
acft_fire	Aircraft Fire
acft_expl	Aircraft Explosion
tc_sheet	Aircraft Type Certification Number
cert_region	Aircraft Certification Region
dt_cur_cert	Aircraft Date of Current Certification.
faa_cert_region	Operator's Cert. FAA Region
oper_cert_fsdo	Operator's Certifying FSDO.
aic_acft_id	AIC code for Aircraft Make,Model,Series
acft_make	Aircraft Manufacturer's Full Name
acft_model	Aircraft Model
acft_series	Aircraft Series Identifier
acft_serial_no	Aircraft Serial Number
year_mfg	Aircraft Year of Manufacture
cert_max_gr_wt	Certified Max Gross Weight
acft_category	Aircraft Category
acft_class	Aircraft Class
acft_reg_cls	Aircraft Registration Class
homebuilt	Aircraft is a homebuilt (Y/N).
total_seats	Total number of seats on the aircraft.
num_eng	Number of Engines
fixed_retractable	Fixed gear or retractable gear.
type_last_insp	Aircraft, Type of Last Inspection
date_last_insp	Date of Last Inspection
afm_hrs_last_insp	Airframe hours since last inspection
afm_hrs_since	Since inspection or accident
afm_hrs	Airframe Hours
afm_cycles	Airframe Cycles
elt_install	ELT Installed.
elt_oper	ELT Operational.
elt_aided_loc_ev	ELT Aided Location of Event Site.
flight_number	Flight Number
owner_acft	Aircraft Owner Name
owner_street	Aircraft Owner Street Address
owner_city	Aircraft Owner City
owner_state	Aircraft Owner State
owner_country	Owner Country
owner_zip	Aircraft Owner Zipcode

Data Table: aircraft (continued)

Column Name	Description
operated_by	Operated By (Name)
oper_individual_name	Operator is an individual (Yes/No)
oper_name	Operator Name
oper_same	Operator Same as Owner
oper_dba	Operator Is Doing Business As
oper_addr_same	Operator Address Same as Owner
oper_street	Operator Street Address
oper_city	Operator City
oper_state	Operator State
oper_country	Operator Country
oper_zip	Operator Zipcode
oper_code	Operator Code
certs_held	Owner has at least one certificate
oprtng_cert	Other Operator of large aircraft.
oper_cert	Certified for Part 133 or 137 Operation.
oper_cert_num	Operator Certificate Number
oper_sched	Flight was Scheduled
oper_dom_int	Indicates Domestic or International Flt.
oper_pax_cargo	Operator carrying Pax/Cargo/Mail
type_fly	Type of Flying (Per_Bus / Primary)
second_pilot	Second Pilot on Board
dprt_pt_same_ev	Departure Point Same as Event.
dprt_apt_id	Departure Airport Code.
dprt_city	Departure City.
dprt_state	Departure State.
dprt_country	Departure Country.
dprt_time	Departure Time.
dprt_timezn	Departure Time Zone.
dest_same_local	Destination Same as Local Flt
dest_apt_id	Destination Airport Code
dest_city	Destination City
dest_state	Destination State
dest_country	Destination Country
inj_idx	Highest Degree of Injury.
injfcrew_fatal	Total Fatal Injuries to Flight Crew
injfcrew_inj	Total Non-Fatal Injuries to Flight Crew
injfcrew_onbd	Total Flight Crew On Board
injccrew_fatal	Total Fatal Injuries to Cabin Crew
injccrew_inj	Total Non-Fatal Injuries to Cabin Crew
injccrew_onbd	Total Cabin Crew On Board
injpax_fatal	Total Fatal Injuries to Passengers
injpax_inj	Total Non-Fatal Injuries to Passengers
injpax_onbd	Total Passengers On Board
injgcrew_fatal	Total Fatal Injuries to Ground Crew
injgcrew_inj	Total Non-Fatal Injuries to Ground Crew
injpub_fatal	Total Non-Fatal Injuries to the Public
injpub_inj	Total Non-Fatal Injuries to the Public
phase_flt_spec	Specific Phase of Flight
report_to_icao	Report sent to ICAO (Yes/No)
pov_desc	Point-of-view description
evacuation	Evacuation occurred.
evac_injuries	Evacuation Injuries.

Data Table: aircraft (continued)

Column Name	Description
rwy_num	Event Location Runway Number and Location
rwy_len	Runway Length
rwy_width	Runway Width
site_seeing	Site Seeing flight Y/N
air_medical	Air Medical Flight Y/N
med_type_flight	Medical Flight
faa_comments	FAA Comments
c5	FAA Incident Identifier.
delete_flag	Delete Flag
ntsb_dtchg	NTSB Last date of change for the current event.
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: dt_aircraft

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
col_name	Aircraft multiple-entry field, Aircraft column
code	Aircraft multiple-entry field, Code
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: cabin_crew

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
cc_crew_no	Cabin Crew Number
cc_lname	Cabin Crew - Last Name
cc_init	Cabin Crew - Middle Initial
cc_fname	Cabin Crew - First Name
cc_seatbelts_used	Cabin Crew - Seatbelts used
cc_seat_occ	Cabin Crew - Seat occupied
cc_seated	Cabin Crew - Seated (Y/N)
cc_inj_level	Injury Level
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: engines

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
eng_no	Engine Number (system generated)
eng_type	Engine Type
eng_group	Engine Group
eng_mfgr	Engine Manufacturer
eng_make	Engine Make
eng_model	Engine Model and Series
eng_tc_sheet	Engine Type Certification
eng_cert_faa_reg	Engine Certification Region
power_units	Power output
hp_or_lbs	Power units are Horsepower or thrust
carb_fuel_injection	Carburator or Fuel Injection.
propeller_type	Type of propeller
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: Flight_Crew

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
crew_no	Pilot Number (system generated)
crew_category	Crew category code
med_certf	Medical Certificate Class
med_crtf_vldty	Medical Certificate Validity
date_lst_med	Date of last medical
crew_rat_endorse	Pilot Type-Rating Endorsement This Acft
crew_inj_level	Crew injury level
seatbelts_used	Seatbelt was used
shldr_harn_used	Shoulder Harness was used
crew_tox_perf	Toxicology Performed
seat_occ_pic	Seat occupied by pilot-in-command
pc_profession	Profession of pilot-in-command
safety_clinic_l3y	Safety clinic within last 3 years
wings_program_l3y	Wings program within last 3 years
recurrent_train_l1y	Recurrent training within last year
bfr	Pilot Has Current BFR
bfr_date	Date of Biennial Flight Review
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: dt_Flight_Crew

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
crew_no	Relative Crew Number
col_name	Name of flight_crew related data element
code	Multiple-entry code for Flight Crew
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: flight_time

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
crew_no	Internal Flight Crew Number
flight_type	Type of flight
flight_craft	Type of aircraft
flight_hours	Number of flight hours
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: injury

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
inj_person_category	Person Category (Crew, Pax, etc)
injury_level	Injury level (F/S/M/N)
inj_person_count	Injury count for the associated category
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: narratives

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
narr_accp	NTSB Preliminary Narrative (6120.19A)
narr_accf	NTSB Final Narrative (6120.4).
narr_cause	NTSB Probable Cause Narrative.
narr_inc	FAA Incident Narrative (8020-5).
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: Occurrences

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
Occurrence_No	Occurrence Number
Occurrence_Code	Occurrence code
Phase_of_Flight	Phase of Flight (NTSB)
Altitude	Altitude (MSL)
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Data Table: seq_of_events

Column Name	Description
ev_id	*Event ID Number*
Aircraft_Key	Aircraft Key (usually 1 or 2)
Occurrence_No	Internal Occurrence Number
seq_event_no	Internal sequence of events number
group_code	Group Code
Subj_Code	Subject Code
Cause_Factor	Cause (C), Factor (F), or Finding (blank)
Modifier_Code	Modifier Code - enhances Subject code
Person_Code	Person Code - enhances Subject code
lchg_date	*Last Change Date*
lchg_userid	*Last Change User ID*

Attachment 2

ACRP Project 04-01 Database Structure

Source: ACRP Report 3 (Hall, Ayers, *et al.*, 2008)

ACRP Report 3, Table 3. Database structure.

Category	Field Level 1	Field Level 2
Basic Info	Accident ID	
	Event ID	
	Accident Class	
	Event Type	
	Researcher	
	Source	
	Location	Country
		State
		City
	Date	
	Time	
	Basic Notes	
Aircraft Data	Make	
	Model	
	Series	
	Serial Number	
	Age	No. of hours or Years
	No. of Engines	
	Engine Type	Turboprop, Turbofan (Low or High) or Turbojet
	Max Certified Landing	
	Max Certified Takeoff	
	Max Gross Weight	
	Registration Number	
	Regulations Reference	
	ACFT Regulator	
	Owner	
	Operator	
Airport Data	Code	IATA Code
	Latitude	
	Longitude	
	Runway Number	
	Landing Distance Available	
	Takeoff Distance Available	
	Landing Elevation	
	Landing Latitude	
	Landing Longitude	
	Takeoff Elevation	
	Takeoff Latitude	
	Takeoff Longitude	
	Runway condition	
	Runway Grooved	Yes/No
	ARFF Availability	A to F
	Control Tower	Yes/No
	Temporary Construction Works	Yes/No
	Runway Width	
	Runway Slope	
	Surface Material	
	Paved Overrun Length	
	Notes	
Consequences	Aircraft Damage	Destroyed, Substantial, Minor or None
	Change of Terrain	Yes/No
	Consequence Area	
	No. of Passenger Seats	
	Total No. Of Seats	
	Difficulty in Getting to Wreckage	Yes/No
	Detailed Consequence Area	

(continued on next page)

ACRP Report 3, Table 3. (Continued).

Category	Field Level 1	Field Level 2
Detailed Info	Aircraft Collision Status	Active/Passive/NA
	Visibility Min. Violation	Yes/No
	Approach Min. Violation	Yes/No
	Approach Category Required	Visual/Non-Precision/ILS Cat1, 2 or 3
	Approach Category Used	
	Other Aircraft Involved	Yes/No
	Crash Controllability	Fully/Partially/No
	Glide slope Captured	Yes/No
	Go Around	Yes/No
	GPWS	Yes/No
	GPWS type	1st or 2nd Generation
	Localizer Captured	Yes/No
	Runway Change	Yes/No
	Stabilized Approach	Yes/No
	Takeoff Aborted	Yes/No
	Takeoff Aborted Speed	
Flight Data	Actual Weight at Crash	
	Was Weight Estimated	Yes/No
	Max Weight for Operation	
	Destination Country	
	Departure Country	
	Diverted Flight	Yes/No
	ELT Fitted and Operational	Yes/No
	Flight Delayed	Yes/No
	Flight Duration	
	Fuel Load	
	Load Factor	
	Operation Type	
	Scheduled	Yes/No
	Landing Distance Required	
	Takeoff Distance Required	
	Takeoff Weight	
	Takeoff Fuel Load	
	Weight restriction Violated	Yes/No
Hit Obstacles	Obstacle Depth	
	Obstacle Height	
	Obstacle Width	
	Obstacle Location	X, Y and Z
	Notes	
Hit Terrain	Terrain Depth	
	Terrain Height	
	Terrain Width	
	Terrain Location	X, Y and Z
	Notes	
Injuries	No. Passenger Injuries	Fatal, Serious, Minor, None
	No. Flight Crew Injuries	Fatal, Serious, Minor, None
	No. Cabin Crew Injuries	Fatal, Serious, Minor, None
	No. Ground Crew Injuries	Fatal, Serious, Minor
	On Ground Injuries	Fatal, Serious, Minor
	Public Injuries	Fatal, Serious, Minor
	Total Injuries	
	Event Highest Injuries	
	Notes	

ACRP Report 3, Table 3. (Continued).

Category	Field Level 1	Field Level 2
Weather	Ceiling	
	Dew Point	
	Electric Storm	Yes/No
	Fog	Yes/No
	Frozen Precipitation	Yes/No
	Wind Direction	
	Wind Velocity	
	Wind Shear	Yes/No
	Gusts	
	Icing Condition	Yes/No
	Light Level	Dawn/Day/Dusk/Night
	Rain	Heavy/Moderate/Light/None
	Snow	Yes/No
	Temperature	
	Visibility	
	RVR	
	Actual Weather Different than Reported	Yes/No
	Weather General	
	Local Variation	Yes/No
	Tailwind	
	Crosswind	
Wreckage Info	Explosion	
	Fire	
	No. Obstacles Hit	
	Runway Exit Speed	
	Total Wreckage Path Length	
	Pilot Actively Avoided	
	POFI Angle	
	POFI Velocity	
	POFI Location	X,Y and Z
	Wreckage Location	Longitude and Latitude
	Wreckage Location	X,Y and Z
	Runway Exit X	
	Runway Touchdown X	
	Touchdown Speed	
	Wreckage Site Elevation	
	Height Above Threshold	
	Approach Speed	
	Wreckage Path Length on Each Terrain	Up to 4 segments
	Wreckage Slope	Up to 4 segments
	Wreckage Surface	Up to 4 segments
Anomalies	Aircraft System Fault	Power
		Brake (wheel brakes, spoilers or reversers)
		Hydraulic
		Tire
		Other
	Weather Conditions	Low Visibility
		Rain
		Wind Shear
		Tailwind
		Crosswind
		Gusts
		Low Ceiling
		Strong Wind
		Turbulence
		Freezing Rain
		Other

(continued on next page)

ACRP Report 3, Table 3. (Continued).

Category	Field Level 1	Field Level 2
	Human Errors	Incorrect Flight Planning
		Communication/Coordination
		Visual Illusion
		Fatigue
		Pressonitis
		Other
	Runway Surface Conditions	Wet
		Contaminated - Standing water
		Contaminated - Rubber
		Contaminated - Oil
		Contaminated - Ice
		Contaminated - Slush
		Contaminated - Snow
		Contaminated - Paint
		Contaminated - Other
		Construction
		Down Slope
	Wildlife Hazards	
	Approach/Takeoff Procedures	Unstabilized - Low Approach
		Unstabilized - Low Speed
		Long Touchdown
		Unstabilized - High Speed
		High Above Threshold
		Takeoff Rejected
		Other
Cost	Aircraft Body Type	Wide or Narrow
	Aircraft Cost	2007 dollar value
	Human Cost	2007 dollar value
	Total Event Cost	2007 dollar value

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Attachment 3
FAA Runway Excursion Database Structure
Source: FAA Airport Engineering Division

DATABASE COLUMNS

Select Event ID	Permits selection of a specific event for viewing by means of its ID
Event Reference / Ref.:	ID for event (of type AAA##AA### for NTSB)
Event Reference / ID:	For FAA events, same as Event Ref; for NTSB events equals 14-character code (one letter and 13 numbers) of event
Event Type	
Event Type / Arrival Overrun	Event was an overrun that took place during landing operation
Event Type / Offside	Event was a side excursion
Event Type / Departure Overrun	Event was an overrun that took place during a departure operation
Event Type / Low Flight	Key location for EAT analysis based on low altitude of flight -- not location that aircraft was on ground
Event Type / Crash	Not part of RSA study: event crashed beyond runway (underrun or "overrun" that was airborne at DER then crashed)
Event Type / Go Around	Airport operation for event was intended to be an arrival operation
Event Type / Arrival End	Event took place at or involved areas of the arrival end (threshold) of the runway
Event Type / Side of Rwy	Event took place at or involved areas to either side of the runway
Event Type / Departure End	Event took place at or involved areas of the departure end (opposite threshold) of the runway
Airport	
Airport / Name	Name of airport at which event occurred
Airport / ID	3-letter ID code for airport at which event occurred
Airport / Elev.	When notable, elevation of airport
Airport / City	City of airport in which event occurred
Airport / State	State of airport in which event occurred
Airport Remarks	Explanatory remarks provided by event reviewer regarding airport location information
Event Runway	
Event Runway / ID	ID of runway (as corrected as part of review) at which event occurred
Event Runway / Length	Length of runway (as corrected as part of review) at which event occurred
Event Runway / Width	Width of runway (as corrected as part of review) at which event occurred
Event Runway / Condition	Runway condition at time of event (e.g., dry, wet, contaminated)
Runway Remarks	Other issues of note regarding runway
Event Runway / Breaking	If specifically noted in event summaries, quality of breaking conditions of runway

DATABASE COLUMNS (continued)

RSA End Dimensions	
RSA End Dimensions / Length 1	Self-explanatory
RSA End Dimensions / Width 1	Self-explanatory
RSA End Dimensions / Length 2	Self-explanatory
RSA End Dimensions / Width 2	Self-explanatory
Aircraft	
Aircraft / Make	Make of aircraft involved in event (as corrected as part of review)
Aircraft / Model	Model of aircraft involved in event (as corrected as part of review)
Aircraft / Type	Specific type of aircraft involved in event (as corrected as part of review)
Aircraft / Part	Certification of aircraft (e.g, Part 121, 125, 91, or 129)
Aircraft / <6000	Was aircraft's maximum certificated takeoff weight less than 6,000 pounds (YES/NO)?
Aircraft / CAT	Approach Category of aircraft (AB or CD)?
Aircraft / Class	Weight class of aircraft (e.g., S, S+, L, H)
Aircraft / Operation	Type of operation (e.g., Takeoff, Landing, touch-and-go)
Aircraft / Span	Aircraft wing span
Aircraft / Eng.	Number of engines of event aircraft (e.g., 1, 2, 3, 4)
Aircraft / Eng. Type	Type of engine of event aircraft (e.g., P, T, J)
Aircraft / Pilot	Notable characteristic of pilot of event aircraft (e.g., "Student")
Aircraft Remarks	Additional comments regarding type of aircraft

DATABASE COLUMNS (continued)

Weather	
Weather / Wind dir.	Wind direction at time of event
Weather / Speed	Wind velocity at time of event
Weather / Cross	Crosswind component of wind at time of event
Weather / Head	Headwind component of wind at time of event
Weather / Tail	Tailwind component of wind at time of event
Weather / Gust	Velocity of wind gusts at time of event
Weather / Daytime	Lighting condition at time of event (e.g., Daylight, Night)
Weather / Ceiling	Altitude of cloud ceiling at time of event
Weather / Sky	Sky condition at time of event (e.g., Scattered, Broken, Overcast, Clear, Obscured)
Weather / Visibility	Visibility at time of event
Weather / Environment	Weather condition at time of event (e.g., FOG, RAIN, SNOW, HAZE, DRIZ)
Weather / Conditions	Weather condition at time of event (e.g., VMC, IMC)
Weather / Minima	Runway minima values entered if event investigation considered significant
Weather Remarks	Other issues of note regarding weather or wind conditions at time of event
Used for RSA Analysis?	Some overrun and underrun events used only for EAT studies, so answer is NO for them, else YES.
Used for ETA Analysis	Event was used in End-Around-Taxiway analysis (overrun/underrun and not an exclusion event)
SP_TR_CHK	Exclusionary event for EAT studies because involved a student pilot, training flight, or check ride flight
Flt. Type Primary	From original database, primary purpose of flight (see additional information below)
Flt. Type Secondary	From original database, secondary purpose of flight (see additional information below)

DATABASE COLUMNS (continued)

Event Information	
Event Information / Damage	Extent of damage to aircraft as a result of event (e.g., None, Minor, Substantial, Destroyed)
Event Information / Injury	Extent of worst injury as a result of event (e.g., None, Minor, Serious, Fatal)
Event Information / Severity	Severity level as a result of event (based on damage/injury, … e.g., Serious, CATostrophic, Minor)
Event Information / Wind a factor?	Was wind listed as a contributing factor to event? (YES/NO)
Event Information / Obstruction?	Was damage to aircraft the result of colliding with an object (e.g., Sign-Light, Ditch, ROUGH terrain)
Event Information / End Location?	General description of final location of event (e.g., Within RSA, Unknown)
Event Information / RSA Involved?	Was the size or quality of the RSA a contributing factor to the severity of the event? (YES/NO)
Event Information / Source of Info	Specific source(s) where locational information was obtained
Event Information / U Distance / LB	Lower bound estimate (95% confidence) for distance from arrival end of runway for a land-short event
Event Information / U Distance / UB	Upper bound estimate (95% confidence) for distance from arrival end of runway for a land-short event
Event Information / V Distance / LB	Lower bound estimate (95% confidence) for (side) distance from extended runway centerline for a land-short event
Event Information / V Distance / UB	Upper bound estimate (95% confidence) for (side) distance from extended runway centerline for a land-short event
Event Information / W Distance / LB	Lower bound estimate (95% confidence) for (side) distance from runway centerline for a side excursion event
Event Information / W Distance / UB	Upper bound estimate (95% confidence) for (side) distance from runway centerline for a side excursion event
Event Information / X Distance / LB	Lower bound estimate (95% confidence) for distance from departure end of runway for an overrun event
Event Information / X Distance / UB	Upper bound estimate (95% confidence) for distance from departure end of runway for an overrun event
Event Information / Y Distance / LB	Lower bound estimate (95% confidence) for (side) distance from extended runway centerline for an overrun event
Event Information / Y Distance / UB	Upper bound estimate (95% confidence) for (side) distance from extended runway centerline for an overrun event
Event Information / Most Likely / U	Best estimate (mostly likely location) for distance from arrival end of runway for a land-short event
Event Information / Most Likely / V	Best estimate (mostly likely location) for (side) distance from extended runway centerline for a land-short event
Event Information / Most Likely / W	Best estimate (mostly likely location) for (side) distance from runway centerline for a side excursion event
Event Information / Most Likely / X	Best estimate (mostly likely location) for distance from departure end of runway for an overrun event
Event Information / Most Likely / Y	Best estimate (mostly likely location) for (side) distance from extended runway centerline for an overrun event
Event Remarks	Explanatory remarks provided by event reviewer

DATABASE COLUMNS (continued)

Analysis Data	
Overrun Events	Event was an arrival overrun, used for EAT and/or RSA studies
Land Short Events	(BLANK)
Off-Side Events	
200 (%)	Likelihood that aircraft travelled on ground less than or equal to 200 ft to side of runway centerline
225 (%)	Likelihood that aircraft travelled on ground less than or equal to 225 ft to side of runway centerline
250 (%)	Likelihood that aircraft travelled on ground less than or equal to 250 ft to side of runway centerline
275 (%)	Likelihood that aircraft travelled on ground less than or equal to 275 ft to side of runway centerline
300 (%)	Likelihood that aircraft travelled on ground less than or equal to 300 ft to side of runway centerline
325 (%)	Likelihood that aircraft travelled on ground less than or equal to 325 ft to side of runway centerline
Confidence	Level of confidence on the above locations
Overrun Events	
200 (%)	Likelihood that aircraft travelled on ground less than or equal to 200 ft to side of runway centerline
400 (%)	Likelihood that aircraft travelled on ground less than or equal to 400 ft to side of runway centerline
600 (%)	Likelihood that aircraft travelled on ground less than or equal to 600 ft to side of runway centerline
800 (%)	Likelihood that aircraft travelled on ground less than or equal to 800 ft to side of runway centerline
1000 (%)	Likelihood that aircraft travelled on ground less than or equal to 1000 ft to side of runway centerline
1200 (%)	Likelihood that aircraft travelled on ground less than or equal to 1200 ft to side of runway centerline
> = 1000	Did aircraft travel more than 1000 ft from departure end of runway, clearly yes, possibly yes, probably no, clearly no

DATABASE INFORMATION

Data information contained in database column SP_TR_CHK

TO = takeoff
LD = landing
EL = emergency landing
TG = touch-and-go
GO = Attempted go-around
AB = aborted takeoff
SP = student pilot
INS = instructional flight
CHK = check ride
INT = intersection departure
TST = test flight (maintenance, air show)
SP = student pilot
HB = homebuilt (kit) aircraft
EXP = experimental aircraft
SFL = short-field landing
REST = restored historical aircraft
OTH = other special flight/aircraft

Data information contained in database columns:

Flt. Type Primary		Flt. Type Secondary	
1	Personal	B	Pleasure
2	Business	F	Ferry
3	Executive	N	None/Other
4	Instruction	S	Passenger
5	Air Taxi (Non-Sched)	T	Cargo
8	Other	U	Pax & Cargo
A	Air Taxi (Sched, not Comm)	W	Unknown
B	Air Taxi (Commuter)	X	Training
C	Sched Air Carrier		