BY WAYNE ROSENKRANS

COMMON CAUSE

U.S. airline participation in ASIAS triples with the prospect of access to system-level safety intelligence.

As the Aviation Safety Information Analysis and Sharing Program (ASIAS) approaches its second anniversary in October, signatory airlines have come to represent a substantial majority of commercial flights in the United States. The growth from seven to 22 participating airlines — despite the tough economic environment — signifies a long-anticipated advance in voluntary safety information sharing between the Federal Aviation Administration (FAA) and air carriers, several representatives say. Each company has signed a memorandum of understanding (MOU) that in effect enables exchanges of de-identified safety data, and several have furnished subject matter experts to ASIAS analytical working groups and to the development of safety enhancements under the Commercial Aviation Safety Team (CAST).

One attraction for the airlines is exclusive access to compelling ASIAS products. So far they include a directed study of terrain awareness and warning system (TAWS) alerts, a directed study of traffic-alert and collision avoidance system (TCAS II) resolution advisories (RAs); the

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capability to compare airline-level TAWS alerts and TCAS RAs with experiences of the whole group — called *benchmarking* — and the capability to benchmark specific airline versus aggregate experience of unstabilized approaches.

"Two years ago, it was very hard to envision that the program would get to this size and level of participation," says Don Gunther, vice president, safety, Continental Airlines; industry co-chair of CAST; and co-chair of the ASIAS executive board. "Airlines finally see a process that is functioning as designed — not just in the analysis but in the development of safety enhancements that are meaningful for the whole industry. I can't help but think that as ASIAS matures, we will continue to reach out to the international community to determine areas of concern and try to reduce aviation risk around the world, not just within the United States." The airline participants (Table 1) represent a diverse cross-section of U.S. major air carriers, regional air carriers and cargo operators.

The central premise of ASIAS is that the federal government and aviation stakeholders — given a conducive environment and ground rules — stand to benefit by cross-querying de-identified aggregate data distributed across airline network servers and associated data on government servers. This collaborative effort includes airline pilot unions, air traffic controller unions, airframe manufacturers, avionics manufacturers, maintenance and repair organizations, aviation industry associations and the Department of Defense.

The focus has been on known-risk monitoring, directed studies, benchmarking, research and development of analytical tools, and vulnerability discovery, said Jay Pardee, director of the FAA Office of Aviation Safety Analytical Services, and Michael Basehore, ASIAS program manager. The ASIAS Issue Analysis Team — comprising FAA employees, contractors and specialists lent by the industry — typically applies text-mining tools and data-mining tools to manually or automatically discover trends, atypical events, exceedances and aberrations in the large network of databases. "By September, we will have a 360-degree view — from the narrative data — of the controller's perspective, the pilot's or copilot's perspective and, where it is relevant, the maintenance technician's side of a particular issue," Pardee said. The work has produced various fusions of data, often computer-rendered as graphics that reveal safety insights, such as the image on page 34.

"We are developing the ability to see national-level trends either in flight operational quality assurance [FOQA] data or aviation safety action program [ASAP] data," Pardee said. "FOQA databases have grown beyond 5 million flights, and ASAP records exceed 50,000." The sheer volume of flights by current ASIAS participants — about 75 percent of all 2008 flights in the

U.S. Airlines Participating in ASIAS, August 2009

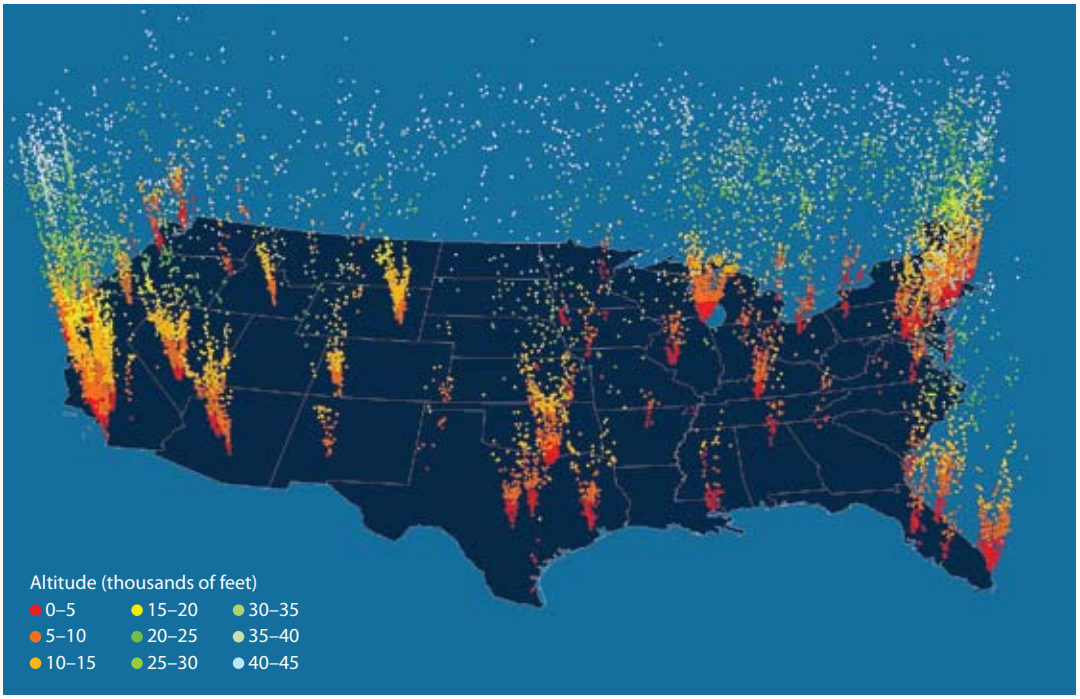
AirTran Airways
Alaska Airlines
American Airlines
American Eagle
Atlantic Southeast Airlines
Chautauqua Airlines
Compass Airlines
Continental Airlines
Delta Air Lines
ExpressJet
Frontier Airlines
Gulfstream International Airlines
JetBlue Airways
Northwest Airlines
Republic Airways
Shuttle America
SkyWest Airlines
Southwest Airlines
Sun Country Airlines
United Airlines
UPS Airlines
US Airways

ASAPs = aviation safety action programs; ASIAS = Aviation Safety Information Analysis and Sharing Program; FOQA = flight operational quality assurance; MOU = memorandum of understanding

Note: Each airline has a FOQA program, or one or more ASAPs, or both, and has signed an MOU with the Center for Advanced Aviation System Development at the MITRE Corp., a federally funded research and development center, to provide network access to its de-identified data and to receive analytical reports from ASIAS.

Source: U.S. Federal Aviation Administration

Table 1



U.S. Federal Aviation Administration; MITRE Corp. Center for Advanced Aviation System Development

ASIAS analysts plotted 38,100 TCAS RAs from all sources in their network of databases, which at the time contained data from approximately 3 million flights, a subset of all U.S. flights in 2006–2008.

National Airspace System — increases the FAA's confidence that issues discovered are likely to be comparable and relevant to all operations.

ASIAS analysts essentially add a new dimension to what airlines learn from their own analysis of data through the FOQA programs of routine flight data monitoring, and the ASAPs designed for voluntary disclosure of safety issues by aviation professionals with non-punitive corrective action.

The Center for Advanced Aviation System Development at the MITRE Corp., a federally funded research and development center, provides the high-level architecture, synthesizes databases and conducts airline data analysis as a trusted intermediary between the participating airlines and the FAA. Twice a year, the FAA hosts FOQA/ASAP Infoshare meetings that enable all interested airlines to share and learn best practices.

ASIAS continues to evaluate advanced text-mining algorithms — such as the open source Mariana software[1] developed by the National Aeronautics and Space Administration (NASA) and other software used by participating airlines — for automatic classification of ASAP reports. "We are putting considerable energy and resources into advancing the science of text mining," Pardee said. "Today we can detect TAWS and TCAS alerts in either digital or narrative data. Being able to quickly pore through millions of records — that's going to be key."

The program's reputation was burnished last year by the directed study of alerts from TAWS equipment, such as the Honeywell enhanced ground proximity warning system (EGPWS). The study (*ASW,* 5/08, p. 25) was initiated "based on ASAP reports — flight crewmembers expressing concern about the numbers of EGPWS alerts, particularly Mode 2A ['Terrain, Terrain'] alerts on approach to mountainous-terrain airports," Pardee said.

The study got the attention of airlines partly because these data-driven processes proved up to the task of identifying issues that only the FAA could address. "Airline-level analyses of TAWS alerts would not have come up with the issue of inaccurate minimum vectoring altitudes [MVAs][2] around our airports … yet several MVAs were not appropriately designed, and a couple of key elements weren't addressed," Gunther said. "So the FAA is reworking those MVAs to make them more appropriate for the surrounding terrain."

FOQA and ASAP programs vary in their maturity, and all airlines should be open to continually improving them, he said. At Continental Airlines, better analytical tools and methods of deriving new data from actual FOQA parameter data — to evaluate unstabilized approaches, for example — are welcome products from ASIAS. "They might mean that we can do a better analysis and maybe refine some of our operational changes based on that analysis," Gunther said. Particularly for air carriers that have launched

FOQA programs in recent years, "these tools are going to be a tremendous boost," he said.

Nothing in the new ASIAS and CAST processes diminishes an airline's responsibility to implement corrective action with due diligence. "If we start to put out changes, change in itself is a threat," Gunther said. "We have to make sure there are no unintended consequences. Every airline has to ensure data integrity and, more importantly, look at proposed safety enhancements, and ensure it has thoroughly analyzed and addressed all the associated issues."

FAA Perspective

ASIAS products in 2008 and 2009 have been used exclusively within the ASIAS executive board and CAST under procedures and operations stipulations in the MOUs signed by the participating airlines and MITRE. Public release of more detailed information might be authorized after CAST completes and officially issues its safety enhancements, Pardee said.

As Gunther noted, one safety enhancement to reduce non-safety-critical TAWS alerts aims to improve the FAA's calculation of MVAs at each location where high numbers of TAWS alerts have been documented. The FAA already has searched all Federal Aviation Regulations Part 139 air carrier airports for the same "data fusion signature" first identified last year near Oakland, California.

"We've identified other locations that have similar issues, mountainous-terrain approaches, that would benefit from the knowledge learned from the initial study," Pardee said. "We will revisit those MVAs with some new tools that we developed in the process, and the FAA Air Traffic Organization will check and revise as necessary the MVAs at facilities with high numbers of TAWS alerts."

The variations in arrival tracks — including vectoring of arriving aircraft by FAA air traffic control (ATC) — noted by ASIAS analysts also have prompted the FAA to introduce airspace improvements based on more precise navigation technology as a second safety enhancement. "One test airport, Oakland, showed the benefits of creating an area navigation [RNAV] approach, which was able to provide more repeatable routing and more accurate approaches around the high-terrain obstacles," Pardee said. "Our evaluations showed that airport equipage there would support RNAV." At other airports, the FAA has pursued required navigation performance (RNP) approaches where supported by the existing airport equipment.

In the third safety enhancement, the FAA has urged air carriers to upgrade their TAWS software — both system logic and terrain database — to a minimum standard and install global positioning system (GPS) receivers. Later this year, CAST plans to publish details of these safety enhancements as a solution set on Revision 14 of CAST's compact disc of resources.

"In the interim, improved MVAs and airspace procedures should serve aircraft that can't be upgraded to new TAWS software and GPS immediately, vastly eliminating the number of non-safety-critical alerts," Pardee said. "With this solution set, we can eliminate more than 98 percent of these alerts."

Two recent additions to ASIAS analysts' data resources have been MITRE's capability to download en route radar track data on a daily basis from the FAA National Offload Program and the capability to receive data from airport surface detection equipment, model X (ASDE-X), the local radar data from the 39 largest air carrier airports. By the end of 2010, ASIAS plans to downlink TCAS RA data from 21 sensors located at terminal areas throughout the United States to meet FAA safety management system requirements related to TCAS II Version 7.1 software implementation (*ASW*, 4/09, p. 34).

TCAS Study Approved

In August, the ASIAS executive board approved the report of the second directed study, focused on TCAS RAs. "We have looked at all the major airports where airline concerns were expressed," Pardee said. "We literally have mapped — for all the arrivals, all the departures and every runway end in the United States — all of the TCAS RAs for a selected period of time, whether from ASAP data, FOQA data, radar data archives or radar tracks. It has been incredibly revealing. We also saw the effects of closely spaced parallel runways and of interactions with general aviation, including helicopter operations and general aviation training bases."

Developing mitigations for non-safety-critical TCAS RAs — especially in densely packed airspace in the Northeast — could prove far more challenging than TAWS alerts. "This one will be hard," Pardee said. "Short of redesigning the airspace, what other techniques or mitigation strategies might we have? Where we had local peaks of TCAS RAs, can we do something locally? Is there a systemic solution? Can we redesign the TCAS [II avionics] box? Can we change things operationally or airspace management-wise?"

The genesis of this study was the concerns expressed during Infoshare meetings. "We knew that several airlines had initiated TCAS RA studies on their own using FOQA data analysis,"

Example of ASIAS Benchmark for U.S. Airlines: Unstabilized Approach Criteria — Below 500 ft

Approach Element	Metric
Landing gear setting	Down and locked
Flap setting	Any movement of flap setting greater than 2 degrees
Low thrust	Less than 35% average N_1 for five seconds or more
Sink rate	Greater than 1,500 fpm for three seconds or more
High-speed approach	Greater than V_{REF} plus 30 kt for three seconds or more
Low-speed approach	Less than V_{REF} for three seconds or more
Above glide slope	Greater than one dot above glide slope centerline for five seconds or more
Below glide slope	Greater than one dot below glide slope centerline for five seconds or more
Localizer deviation	Greater than one dot deviation from localizer centerline for five seconds or more

ASAP = aviation safety action program; ASIAS = Aviation Safety Information Analysis and Sharing Program; FOQA = flight operational quality assurance; N_1 = engine compressor speed; V_{REF} = reference landing speed

Note: This subset of criteria for post-flight analysis was developed by ASIAS analysts and 22 U.S. airlines. The airlines have provided access to their de-identified digital and narrative data from routine flight operations. They, in turn, receive aggregate data from participating airline counterparts as benchmarks for airline-to-aggregate comparisons.

Source: U.S. Federal Aviation Administration

Table 2

Basehore said. "We also found that there were some geographical areas where there were a higher number of TCAS RAs than others, so that warranted another directed study."

To identify TCAS RAs, ASIAS analysts began with ASAP reports, but they lacked the exact locations. Validating and cross-referencing events with FOQA data partially addressed this gap. "It would have been wonderful if we had the ASAP report tied right to the FOQA data for a particular flight, but that's not going to happen with de-identified data, so we have to do it generically," Basehore recalled. The TCAS RA study already has yielded insights into U.S. airline pilot responses. "In the vast majority of the instances of the TCAS RAs, we saw what we considered the appropriate pilot response as derived from avionics measurements," Basehore said.

Unstabilized Approach Benchmark

Concerns about distinguishing stabilized from unstabilized approaches — and the need for national benchmarks — also were raised during Infoshare meetings. ASIAS analysts worked with airline specialists to develop and issue a set of consensus definitions (Table 2) and common research methods as a starting point. "ASIAS tells the airlines what parameters are being analyzed for an unstabilized approach, then enables them to calculate their own unstabilized approach metrics to compare against the aggregate of all participants' values," Basehore said.

ASIAS also has issued the first set of benchmarks, tailored to each participating airline, representing TAWS alerts, TCAS RAs and unstabilized approaches. The airlines have been asked to share with ASIAS, and their counterparts, any safety lessons learned from considering the benchmarks and implementing operational changes.

"We also can look at whether the flight crew actually went around if they did not meet the criteria that we have mutually defined as a stabilized approach," Basehore said. ASIAS is taking a second look at the data to help airlines prepare for such assessments, he said. Criteria actually used in airline flight operations — such as the elements of a stabilized approach recommended by Flight Safety Foundation <www.flightsafety.org/files/alar_bn7-1stablizedappr.pdf> — differ from the post-flight criteria that ASIAS analysts derive from FOQA data, he said.

Southwest Airlines Experience

The chance to study TCAS RAs at the national level emerged as the "perfect example" for most airlines of the possibilities of ASIAS, said Tim Logan, senior director, operational safety, and Don Carter, senior manager, flight safety programs, of Southwest Airlines.

"With ASIAS and the FAA Air Traffic Organization involved, we've had the ability to overlay more detail of the traffic in the area where TCAS RAs occurred and to know the cause — whether general aviation traffic or scheduled airline traffic operating under instrument flight rules [IFR]," Logan said. "We used to look at the Southwest Airlines flight data but we could never know what the conflicts were. Now we are able to pinpoint the location, and look at

designing new approach areas, routes within visual flight rules corridors or IFR corridors, or similar kinds of fixes."

Southwest Airlines was among the ASIAS airline participants that received the first set of benchmarks. "We are still in the process of validating the data to be sure we are measuring the same thing on the same flights to get the same rates," Carter said.

The company has taken more time than expected to sort out validation and practical implications. "We are learning that benchmarks are not as easy as people thought they were going to be," Logan added. "I don't think people understood that if ASIAS publishes a benchmark across the industry, there are, first of all, different operators of different aircraft types, and different environments and quality of data sets coming off aircraft or from ASAP. Even for a simple measurement, such as whether or not there was a GPWS alert, there are difficulties because different systems have different data issues."

Airlines know from experience to discard the data if a GPWS or TAWS terrain alert was not a real alert, and ASIAS analysts who aggregate FOQA data have to take such false alerts into account so that they are not inadvertently included in aggregate data, he said.

Similarly, airline FOQA analysts have learned to assume that the quality of narrative-text information in ASAP reports varies and especially does not accurately represent the quantity of events. "We can only look at the aggregate, long-term trends to see if we've got an increase or a decrease," Logan said.

Another issue that participating airlines keep in mind is the possibility of problems with the validity of data generated by their peers. Such problems would be more likely if the level of FOQA program experience at an airline is below the average. If an airline does not realize that some information in its FOQA database is not valid, it cannot convey that fact to others, Carter said. "This is something that airlines learn over time," he said.

Trend analysis by the Southwest Airlines flight data analysis program already had shown "very encouraging" improvements in rates of stabilized approaches, reduction of non-safety-critical GPWS alerts and correct flight crew responses to GPWS alerts, Carter said. "The thing that we have never known, and until now have had to guess, is 'Does the number that we have now indicate an extremely safe operation — which we think it does — or does it simply indicate safer than it used to be, but there is still significant room for improvement?' Benchmarks allow us to see if we want to focus on previously identified issues or move on to others more critical for us."

The ASIAS airline participants have been careful about managing their own expectations of the program and influencing those of companies that have not signed up. "We have been very deliberate in indicating that this requires a lot of manpower, a lot of good hard analysis because we spend most of our time validating that what we are seeing is the true picture and actually represents a safety issue," Logan said. "Usually, when we get to that point, however, the answer — or at least the direction to go look — is pretty obvious. There has been a lot of angst among others in the industry asking 'Why has this taken so long?' It has taken so long because it is a new process, and we are trying to do it right to make sure that when we come out with a report on something as serious as TCAS RAs, we are definitely accurate and the report is usable."

False alerts and the frequent occurrence of alerts involving the same locations, flight phases or aircraft types must be taken seriously no matter how good an airline's safety record. "In areas where we got alerts, for example, some Southwest crews were just saying, 'Well, it's not a hazard right now, we are just going to continue,'" Logan said. "They didn't respond to the alert. The areas may have been places where ATC needs to route the airplanes around so that when crews get an alert, it is a real alert, and they react. ASIAS gives us the ability to know how often such alerts are happening, and that they are not just affecting one airline or one type of airplane."

The airline industry and the FAA may need periodic reminders to maintain an unwavering system-level focus at ASIAS, however, he added. "We have to stick to our guns to keep a methodical process of detailed analysis," Logan said. "Following every accident, the industry seems to react a little bit, but this program is not going to solve something at the push of a button. We need to keep the discipline and make sure that political pressures don't push us into an area that system-level analysis was really not designed to do."

Notes

1. NASA said, "Mariana is an algorithm that can be applied to the text portion of reports, determining the likely categories that each report falls into, and calculating a confidence for each classification."
2. An MVA on an air traffic controller's display is a predetermined altitude, based only on a required 1,000 ft or 2,000 ft obstruction clearance, shown in an airspace sector.