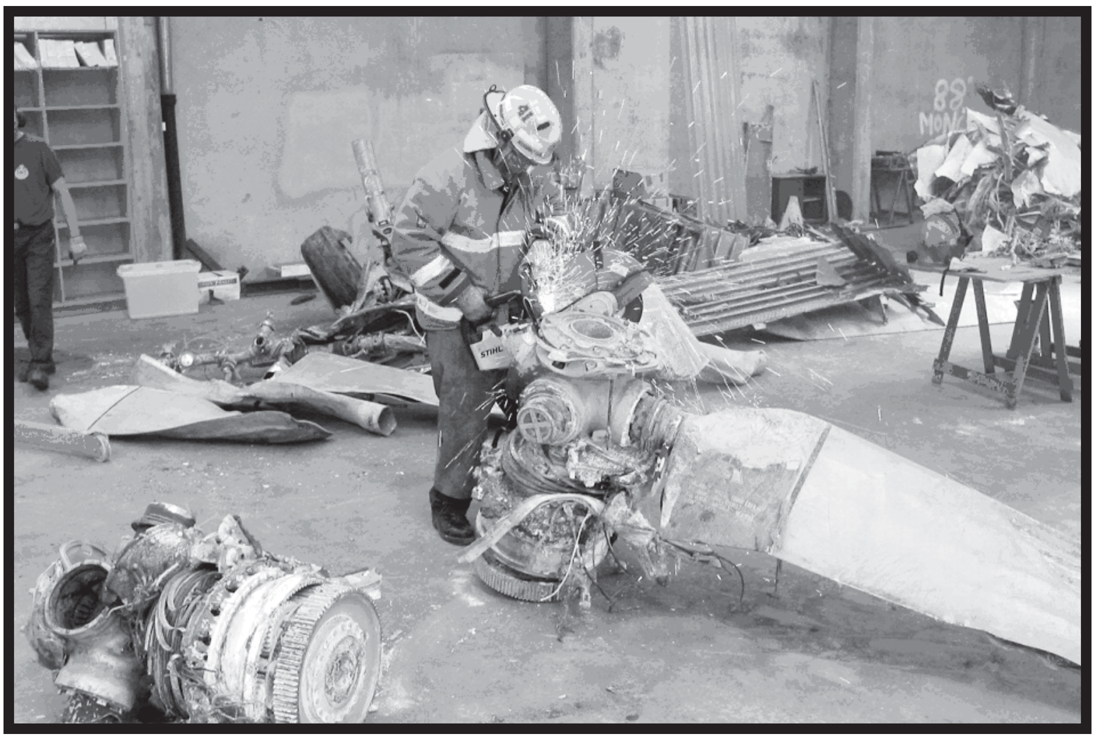
ISASI FORUM

"Air Safety Through Investigation"

JULY–SEPTEMBER 2008



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Personnel from the New Zealand Fire Service cut the prop blades of the Convair 580 ZK-KFU to prepare the hubs for shipment to Pac Prop (see article on page 15). Photo courtesy TAIC.

ISASI FORUM
"Air Safety Through Investigation"

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AIR SAFETY INVESTIGATORS
INCORPORATED AUGUST 31, 1964

A Mid-Year Review of Activity

By Frank Del Gandio, ISASI President

I would like to give you an update on "happenings" in your Society. Our Reachout program has far exceeded expectations. To date (July 1), we have had 29 Reachout workshops that were attended by 1,388 participants. The Reachout program has taken ISASI and accident investigation workshops to the four corners of the earth. These seminars have been well received and very effective in enhancing safety. There were a number of folks working hard on the programs, but the driving force behind Reachout has been Jim Stewart who has served as chairman of the program. However, last month Jim submitted his resignation due to an extremely heavy workload. I accepted it with great reluctance because Jim has been extremely successful in meeting program goals. The Society is deeply indebted to him for a "job well done." After thorough research, I have appointed John Guselli to fill the chairmanship position. I am confident that John will carry the ISASI banner and continue with the same increasing momentum that his predecessor has established.

In the Council's continuing effort to make ISASI membership more beneficial to the air carriers that are corporate members and to enlist new members, Ron Schleede and I met with the Air Transport Association in January. More recently, a Reachout-type program was conducted in Seattle for the airline members of ATA. The workshop focused on accident investigation management and was very well received.

Our annual international seminars on air accident investigation have been technically and financially successful. At each seminar I am the beneficiary of numerous unsolicited accolades from attendees attesting to the quality of the seminars and to the outstanding networking that is available to the attendees. The seminars are successful for all the right reasons and also due to the hard work of many. However, the efforts of Barbara Dunn as Council seminar chairperson and Ron Schleede as Council point person for corporate member fund raising are driving forces to the success of the seminars.

ISASI 2008 is scheduled for September 8-11 in Halifax, Nova Scotia, Canada. And if you have never attended an annual seminar, here is a perfect opportunity to meet the international representatives who make up your Society. Full details of the program are on page 24 of April-June issue of the *ISASI Forum.* On page 26 of this issue, you will find a seminar update that includes how to secure discounted airfare tickets on Air Canada, which has been named the official Canadian airline for ISASI 2008.

Our Society was deeply saddened by the untimely death of Ron Chippindale (see memorial in the previous issue of *Forum*). Ron served the organization in many ways. One of those ways was to oversee and administer the "ISASI Fellow" program. I have appointed Ludi Benner to fill this position. Ludi is both a Life and Fellow member of the Society. I have asked him to rely upon his experience to streamline the membership application procedure without diminishing the quality of the "Fellow" designation. There are only 21 Fellows in our organization. We should have many more. Review the requirements on the ISASI website and then consider applying or recommending another member for this elite level of membership.

Our annual international seminars on air accident investigation have been technically and financially successful. At each seminar I am the beneficiary of numerous unsolicited accolades from attendees attesting to the quality of the seminars and to the outstanding networking that is available to the attendees. The seminars are successful for all the right reasons and also due to the hard work of many. However, the efforts of Barbara Dunn as Council seminar chairperson and Ron Schleede as Council point person for corporate member fund raising are driving forces to the success of the seminars.

Our working groups are working well and are fairly productive. We need a volunteer to chair the Government Air Safety Investigators Group. This position should be occupied by a government safety investigator or regulator. Are you interested? Call me!

I have started the initial laborious tasks of the many needed to have Jerry Lederer's image placed on a United States postage stamp. The requirements are stringent and lengthy, but I hope to be successful in about two years.

Finally, I want you to know that your Society is in great shape. We are financially sound and because of this we have made an early $51,542 full payoff of the mortgage on our office condominium purchased in 2000. Moreover, we now have a membership representing 70 countries: 1,336 current individual members and 122 current corporate members. These marks of success are due to the hard work and dedication of your Executive Council, office manager, and each and every one of you who participates in the issues of your Society.

I hope to see you in Halifax. ◆

Investigative Integrity

By Robert Sumwalt, National Transportation Safety Board Vice-Chairman

(Editor's note: The following are remarks of National Transportation Safety Board Vice-Chairman Robert Sumwalt given to the International Society of Air Safety Investigators Mid-Atlantic Regional Chapter on May 1, 2008, in Washington, D.C.)

It is great to be with a group of air safety investigators and leaders from around the world, and I really appreciate the opportunity to speak this evening. I thought long and hard about what I would like to say. I settled on a topic near and dear to my heart: investigative integrity.

Investigative integrity means doing what is right for the investigation, regardless of personal, political, or other outside influences. I think it applies regardless of the hat you wear or which organization you represent.

Independence

Let me start by offering that one of the most critical elements in achieving investigative integrity is independence of accident investigations. The history of this independence for the Safety Board is important to me.

Some of you may know that I enjoy collecting airmail from the 1920s and early 30s, much of which never made it to its final destination because it was in a plane crash. The "youngest" in my collection is from 1931. That year is significant because in 1931 a Fokker F-10A operated by Transcontinental and Western Air (TWA) crashed in Kansas, killing all on board, including famed Notre Dame football coach Knute Rockne. The nation was stunned. Even more stunning, however, was that the investigation was overshadowed by the public perception of incompetence, secrecy, and conspiracy.

In response, Congress amended the Air Commerce Act to require that reports on probable causes of fatal aircraft crashes be made public. In 1935, a DC-2 crashed in Missouri, claiming five lives, including a U.S. senator. Public debate and criticism over the cause of the crash demonstrated the need for, and led to the formation of, an independent accident investigative body.

And although we have undergone structural and organizational refinements in the intervening years, independence of accident investigations has remained central to the way we conduct business in the United States.

Congress further reinforced the criticality of the Board's independence by passing the Independent Safety Board Act of 1974. The Act noted: "Proper conduct of the responsibilities assigned to this Board requires vigorous investigation of [transportation] accidents… No federal agency can perform such functions unless it is totally separate and independent from any other department, bureau, commission, or agency of the United States."

Not only does the U.S. Congress see wisdom associated with independence, but so does ICAO. According to ICAO Doc. 9756, "The accident investigation authority must be strictly objective and totally impartial and must also be perceived to be so. It should be established in such a way that it can withstand political or other interference or pressure."

Because Congress and ICAO recognize the importance of independence, I firmly believe that we must preserve, protect, and defend our independence.

To be clear, independence does not mean not being accountable for our actions and decisions. We do need accountability, but we also need to appreciate that there is a direct relationship between independence and credibility. When independence is eroded, credibility is diminished.

We must conduct investigations that are free of political and other pressures. Again, investigative integrity means doing what is right for the investigation, regardless of personal, political, or other outside influences.

Investigative integrity

Keeping in mind the independence of the Safety Board, I'd like to share three key components of investigative integrity:

- Making tough decisions, even when they may be unpopular.
- Keeping uppermost in mind the goal of accident investigation, and
- Knowing who you are serving.

Making tough decisions

First, Let's talk about making tough decisions, even when they may be unpopular. If I don't make decisions that sometimes make people uncomfortable, then I'm probably not doing my job well enough. Not that making people uncomfortable is my goal; but if I never did this, it would suggest that I am not pushing the safety envelope in ways that I feel strongly about.

For example, recently the Safety Board voted not to hold a public hearing on a particular investigation. Our professional staff

PHOTOS: E. MARTINEZ

held the opinion that a public hearing would provide no additional information to help us successfully complete the investigation. Even more compelling was that staff felt that if we held a hearing, there was a significant downside that could adversely affect the investigation.

I certainly understand, appreciate, and support the notion that our investigations are to be conducted in a transparent manner. I strongly believe it is critical that we allow the public to see inside our investigative process. I was also keenly aware that some groups and individuals felt strongly that we should hold a hearing. I knew that if we didn't hold a hearing, there would be backlash. I pondered the decision for several months. At the end of the process, I weighed the pros and cons of each decision. Through that analysis, I, along with the Board's majority, voted not to hold a hearing.

Yes, I knew we would receive political and news media backlash. But I understood that the credibility of the agency would be adversely affected if we made a decision based solely on real or perceived outside demands and pressures. I believed that it was more important to allow the traveling public and families of victims the ability to put closure on why this accident occurred.

I knew that, despite the value of transparency, a public hearing is not the only means to achieve transparency.

As everyone in this room knows, all Safety Board investigations have transparency by several methods, including opening of the public docket, utilization of the party system, frequent public updates regarding the investigative process, and finally through the Board's sunshine meeting. I highly value the Board's independence, and I believe that my role is to help preserve it. Investigative integrity means putting the needs of the investigation ahead of personal or political needs. The backbone of investigative integrity and the Board's credibility is exercising the ability to make decisions based on what is best for the investigation--not on the basis of personal or political concerns. This [independence] is one critical component of investigative integrity. I am sure that you, as air safety investigators, face difficult decision like this each and every day.

The second component of investigative integrity is keeping uppermost in mind the purpose of accident investigation. We all know that Annex 13 says the sole purpose of an investigation shall be the prevention of accidents and incidents. This means that as air safety investigators, we're not there to point fingers, to lay blame, to assign fault, to push a personal agenda, or to help the lawyers build their cases. As air safety investigators, our job is to determine what happened so that we can prevent it from happening again.

And to remain true to that notion, we need to dig beneath the obvious human error. I am convinced that most accidents are not simply failures of individuals, but rather are the result of system failures as well.

It is one thing to say a person committed an error. It is quite another to try to understand all of the factors that may have influenced that error. What were the elements of the system that allowed, or perhaps even encouraged, errors to exist? Where was the rest of the system that should have prevented a simple error from being catastrophic?

I'm disappointed to still hear comments such as, "It's just another pilot error accident" or "The stupid workers should have known better." And why does this disappoint me? Because if we focus solely on the errors of front-line operators, we may miss valuable prevention opportunities. Systemic flaws may remain undetected, and thus uncorrected.

Framed outside of my office is the cover of this *ISASI Forum*. It says, "The discovery of the human error should be considered as the starting point of the investigation, not the ending point." It hangs on the wall to serve as an icon to remind us all of the importance of going beyond simply stating that someone committed an error. We need to answer why the error was made. Investigative integrity means keeping in mind that our goal is to improve safety. We do that by looking at the entire system and not just focusing solely on the front-line personnel.

"I agree with Frank Del Gandio in that 'safety has no boundaries.' I challenge you to preserve, protect, and defend the independence of your investigations. I challenge you to continue striving for investigative integrity. Through these efforts, we truly are making our transportation system safer."

Knowing who you serve

Finally, I believe investigative integrity means knowing who you are serving. We are here to serve the traveling public by conducting proper investigations that enhance safety. We are not here to please the manufacturers; we are not here to please the regulatory authorities.

We are here to conduct honest, competent, thorough, and timely investigations that identify systemic or individual weaknesses and then issue recommendations aimed at correcting those deficiencies. That is our job.

We demonstrate investigative integrity by remembering that we are servants of the traveling public. Keeping this focus has helped me make many difficult, and sometimes unpopular, decisions—decisions that I can look back on and feel confident about.

In conclusion, investigative integrity means three things: making tough decisions, even when they may be unpopular; keeping uppermost in mind the goal of accident investigation; and knowing who you are serving. I don't believe investigative integrity is something you either have or you don't. I think it is something that must be constantly striven for.

Today I read the current issue of *ISASI Forum.* The cover article is about Ron Chippendale. I believe the professional life of Ron epitomizes those characteristics associated with investigative integrity. He will be missed, but his spirit lives on.

In closing, I applaud your investigative efforts, and I sincerely enjoy the camaraderie and teamwork that we exhibit in working with one another to maintain and improve the quality of investigations across boundaries. I agree with Frank Del Gandio in that "safety has no boundaries." I challenge you to preserve, protect, and defend the independence of your investigations. I challenge you to continue striving for investigative integrity. Through these efforts, we truly are making our transportation system safer.

Thank you very much for all that you do! Keep up the great work. ◆

Web-Based GIS Eases Investigations

(This article was adapted, with permission, from the authors' paper entitled, Utilization of the Web-Based GIS to Assist Aviation Occurrence Investigation *presented at the ISASI 2007 seminar held in Singapore, Aug. 27-30, 2007, which carried the theme "International Cooperation: From Investigation Site to ICAO." The full presentation including cited references index is on the ISASI website at www.isasi.org.—Editor)*

The authors describe the Geographical Information System (GIS) application and cost-effective processing procedures established for ASC investigator use, including the programs developed to translate commercial GIS data formats into the web-based GIS.

By Tian-Fu Yeh, Michael Wen-Lin Guan, and Hong T. Young (Aviation Safety Council Taiwan)

In the past, the Geographical Information System (GIS) was one of the complicated, expensive, and user unfriendly systems. But in the last decade, the computer's computing and graphic techniques, including relevant commercial software with graphic interface, have rapidly developed so that GIS has become a popular technique that is easy to adopt into routine transportations. The computer platforms include PDA, mobile phone, and home-use computer, rather than the high-end computer.

"Digital Earth" has developed extremely fast. There are many resources available on the Internet, i.e., World Wind, Google Map, Google Earth, Virtual Earth, and so on. To date, Google Earth collects worldwide precise satellite imageries, with great computing capability. Anyone with a free browser can access the world via the Internet, and the wonderful searching function is based on place name, street, landmark, lat/long position, and specific keywords. In addition, Google Earth provides the interactive functions for users to build-up the place marks, add the transportation paths, and create 3-D models that enhance the GIS applications into a stage of more extensiveness and reality.

The Aviation Safety Council (ASC) was officially established on May 25, 1998, and has investigated more than 30 aviation occurrences. From an early stage, GIS had become the on-scene investigative tool, but the massive geo-spatial data meant investigators could only process them on a high-cost computer workstation that was locked by a single license, which prohibited its widespread use at ASC. To solve this problem, the web-based GIS became the solution. Google Earth is the platform for ASC investigators to browse the geo-spatial data.

GIS applications at ASC

ASC is not only applying GIS to aviation occurrences investigation, but also to validate the investigative authority.

Justify the investigative authority

According to the Aviation Occurrence Investigation Act, Article 6, "When an aircraft occurrence of an aircraft of any nationality arises in the territory of the Republic of China (hereinafter referred to as ROC), the ASC shall undertake the investigation. When an aviation occurrence of an aircraft registered in the ROC or operated by an airline incorporated in the ROC arises on the high seas or in the territory not subject to any state's jurisdiction, the ASC shall undertake the investigation."

On March 28, 2005, 1803 local time (0903 UTC), EVA Air Flight BR2196, an Airbus A330-203, carried 251 passengers and 16 crewmembers from Chiang Kai-Shek International Airport, Taipei, ROC, to Narita International Airport, Tokyo, Japan. The aircraft encountered severe turbulence during its initial descent at an altitude of 34,500 ft. The cabin ceiling of this airplane was damaged; also 46 passengers and 10 crewmembers were injured, including one with a broken neck.

After the occurrence notification, ASC obtained the flight data recorder and basic weather forecast information. Using the flight path shown on the FDR recording, GIS was used to superpose the waypoints, flight routes, and flight path. Based on those data, and superposing the relevant Flight Information Regions (FIRs) and the range of the country's territorial sea (i.e., 12 nm), the program determined the investigative authority. For example, Figure 1 illustrates the GIS analysis result; the result indicates that BR2196 occurred in high seas out of Japan's

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Dr. Michael Wen-Lin Guan *is the director of Investigation Laboratory with the Aviation Safety Council.*

Dr. Hong-Tsu Young *is the managing director of the Aviation Safety Council. He was the coordinator of the National Taiwan University Commercial Pilot Training Program by the Civil Aviation Authority (CAA) and deputy chairman of the Department of Mechanical Engineering of the National Taiwan University.*

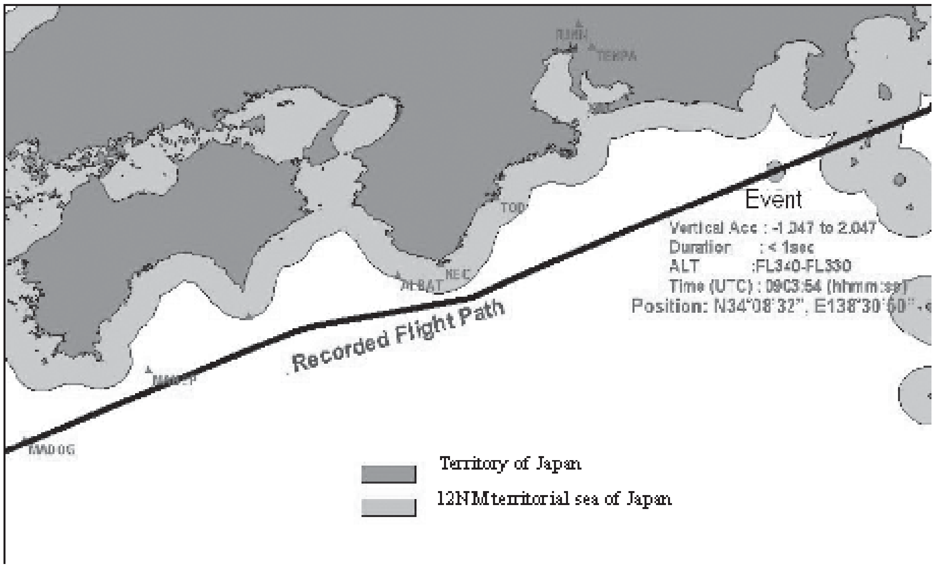

Figure 1. Illustrates the occurrence site in high seas—the investigation authority thus belongs to ASC.

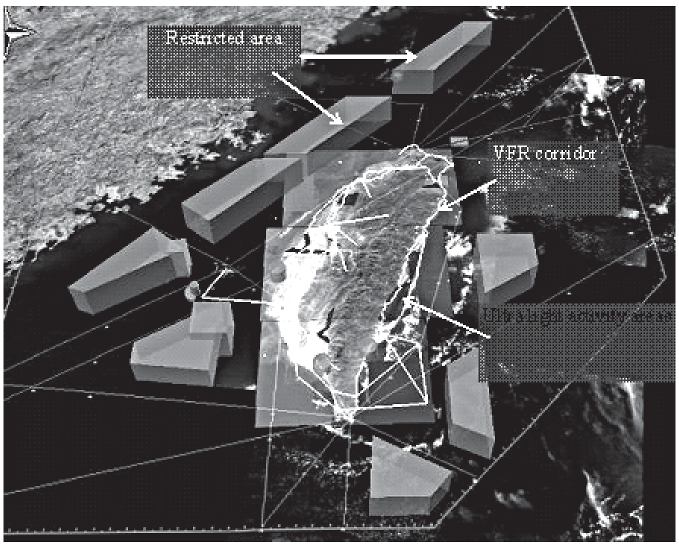

Figure 2. Demonstrates the result of superposing the geo-spatial data (terminal control area, restricted areas, VFR corridors, ultralight activity areas, and radio frequencies).

territorial sea, which means the occurrence investigation authority belongs to ASC.

Reconstructing the temporal and spatial relationships of occurrence

The individual clues on the occurrence site will furnish the initial directions for investigation; preserving the evidence at the occurrence site is a key action for further analysis and validation. But the major occurrence site is very difficult to fully preserve, i.e., the airport operator expects to re-open airport operation as soon as possible; the aircraft crash site is located in the seas or lake with adverse effects, including current and wind. "Digitizing the whole occurrence site" is the perfect dream for the forensic investigators!

The use of computer graphics to reconstruct the events sequence of occurrence (called flight animation) is well known and is driven by flight data (FDR, QAR), GPS data, and ground-based surveillance radar data. In general, three charts are frequently used by investigators to illustrate the aircraft occurrence site with different scales—occurrence site chart (OSC), occurrence perspective chart (OPC), and wreckage distribution chart (WDC). The "OSC" displays the symbol of north, relative positions of site and nearby airport, access ways, ground navigation facilities, and scale bar. The "OPC" presents the flight path, ground obstacles, terrain profiles, and relevant impact marks or ground scars. The "WDC" shows the locations of major components of the aircraft, with the attribute of damage conditions (failure modes, fire and explosive evidence, and so on.). So hand sketches are time consuming and inaccurate. GIS is a systemic and sensible tool to record and present the geo-spatial evidence for the forensic investigators.

In 2004, ASC developed the three-dimensional GIS (3-D GIS) for occurrence investigation to present the geo-spatial data and assist the visual simulation. Those commercial GIS-system-assisted programs developed by ASC investigators could handle different formats of the terrain data, 3-D display of massive satellite images, superposing the occurrence survey data—treetops, ground scars, flight path (based on FDR, GPS, or radar data) and interactive to visualizing the occurrence geo-data together. 3-D GIS became the powerful tool to present the sequence of occurrence events.

Relationship of flight path and LLWAS data

The ground-based Low Level Windshear Alert System (LLWAS) is based upon a network of anemometers placed near runways throughout the geographic area covered by an airport to detect low-level windshear and microbursts. Typically, LLWAS consist of 12 to 16 anemometers placed near runway areas and extended to cover about 3 nm. To date, there are two LLWAS installed in Taiwan's civil airports—Taipei SongShan Airport and Taiwan Taoyuan International Airport.

In past occurrence investigations, weather-related occurrences were complicated to analyze, such as the relationships of surface winds, flight path drift, and an aircraft's lateral operation. ASC has been using a module called "tracking analyst" under the ArcGIS platform to dynamically present the multiple anemometers data of LLWAS and 3-D flight path.

The 3-D flight path is then reconstructed from FDR recorded parameters (ground speed, magnetic heading, drift angle, altitude). All of the FDR recorded parameters are selectable to dynamic link with geo-spatial data (satellite images, terrain, ILS beams, weather charts, Jeppesen charts). Figure 3 (page 8) illustrates the LLWAS data of SongShan Airport. The data will update every 10 seconds, and the 3-D flight path will update every 1 second. The entire superposing of GIS data is programmable to display or change the levels of transparency.

Therefore, integrating the 3-D flight path

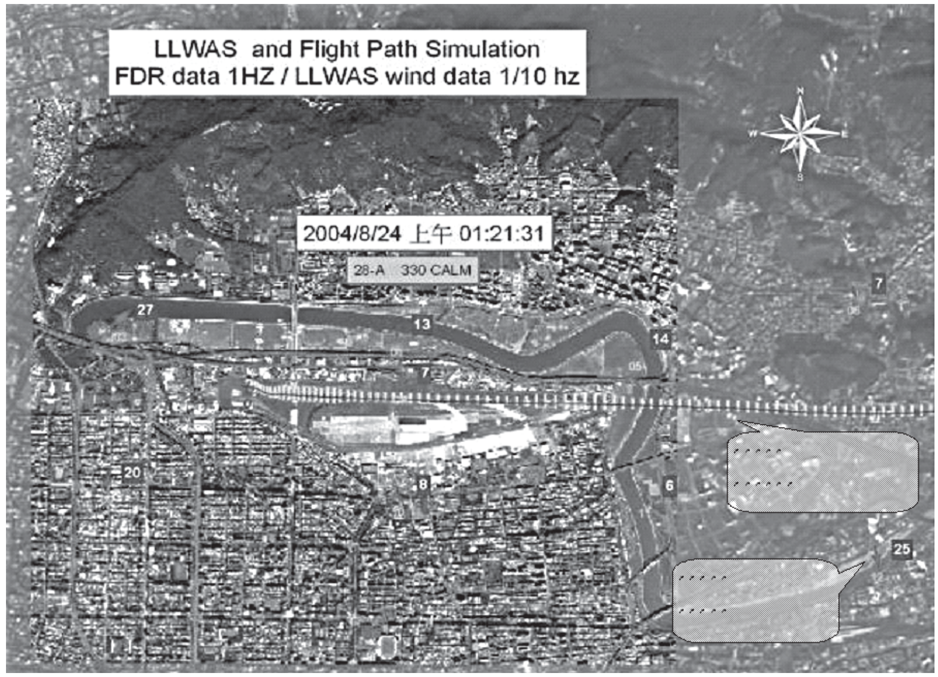

Figure 3. Superposition of LLWAS data and flight path (an MD-82 encountered severe windshear at 120 ft AGL).

and LLWAS data is useful to evaluate the aircraft's maneuvers dynamically, especially for conditions the FDR does not record—the wind, windshear, or gust exist on the final approach routes and those the flightcrew and onboard Doppler radar can not detect.

Digitizing AIP charts

An aeronautical information publication (AIP) is issued by or with the authority of a state and contains aeronautical information essential to air navigation. An AIP is designed to be a manual containing thorough details of regulations, procedures, and other information pertinent to flying aircraft in the particular country to which it relates. The structure and contents of AIPs normally have three parts—GEN (general), ENR (enroute), and AD (aerodromes). The document contains many charts; most of these are in the AD section where details and charts of all public aerodromes are published.

For occurrence investigation, those charts related to enroutes and aerodromes are difficult to analyze because they are without the standardized tools to superpose with weather data and flight data. Figure 2 (page 7) demonstrates the ASC-developed tool, to superposing the geo-spatial data (terminal areas, VFR corridors, ultralight activity areas, and restricted areas).

In 2002, ASC contracted a project to translate Taipei FIR AIP into GIS layers, which were accessed by enroutes, airport codes, or pre-selected attributes. Those Taipei FIR AIP data are compatible with commercial GIS platforms (Mapinfo, ArcGIS, Global Mapper, etc.). In 2006, most of Taipei FIR AIP data were translated into KML format, which is a new standard format of the web-based GIS.

Figure 4 shows the 3-D GIS results of ArcGIS and Google Earth. The geo-spatial data of Taipei FIR includes waypoints, airways, VFR corridors of helicopters, restricted areas, and ultralight activity areas. In Figure 3, the basic satellite maps consist of LandSat downloaded images (ground resolution about 15 meters) and precise SPOT-5 images (ground resolution 2.5 meters). All of those layers are independent to access and modification. The relevant attributes of Taipei FIR are available at the click of a mouse.

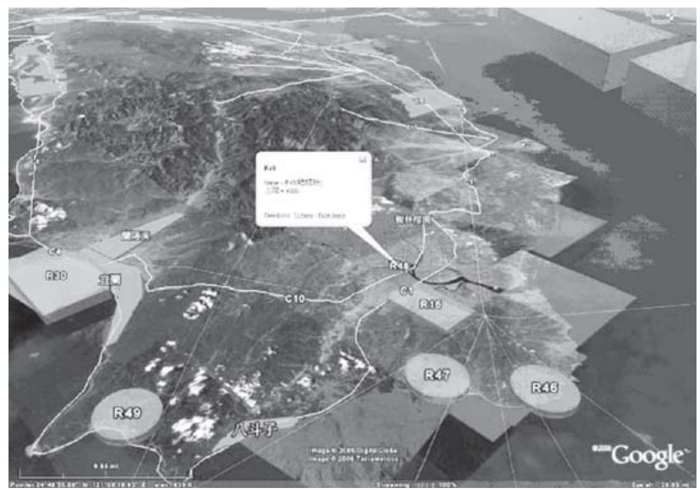

Figure 4. Demonstrates the web-based GIS result of superposing the geo-spatial data (satellite imageries, terrain, waypoints, air-ways, restricted areas, VFR corridors, and ultralight activity areas).

Advanced applications of Google Earth

Google Earth combines the power of Google Search with satellite imageries, maps, terrain, and 3-D buildings to integrate the worldwide GIS data at your fingertips so that the forensic investigators can import interesting place marks, site images, and 3-D models into Google Earth using self-developed programs to batch import the geo-spatial data with KML or KMZ formats. The practical problems and solutions are described as follows.

Coordinate systems conversion

In Taiwan, most of GIS data are based on geodetic coordinate systems of TWD 67, TWD 97, and WGS84; but Google Earth only accepts WGS84. Therefore, any users of Google Earth need to find or develop the multiple coordinates conversion program to overcome this problem. To date, ASC has developed a program to convert the coordinate systems among TWD67, TWD97, UTM, and WGS84.

KML/KMZ format and translation

KML (Keyhole Markup Language) is an XML-based language for managing 3-D geo-spatial data in Google Earth. The word Keyhole is an earlier name for the software that became Google Earth; the software was produced in turn by Keyhole, Inc., which was acquired by Google in 2004. The KML file specifies a set of features (place

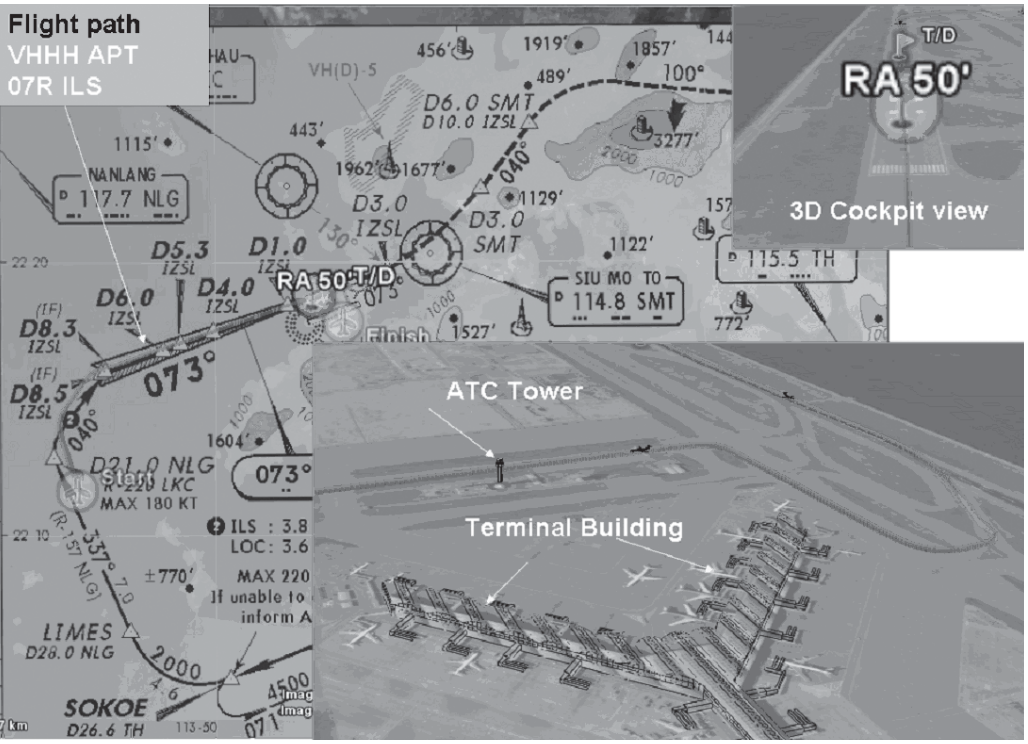

Figure 5. **Superposition of flight path on the Jeppesen chart with 50 ft and T/D place marks and 3-D building models.**

marks, images, polygons, 3-D models, textual descriptions, etc.) for display in Google Earth. Each place always has a position (longitude and latitude). Other data can make the view more specific, such as tilt, heading, and altitude—which together define a "camera view." KML files are very often distributed as KMZ files, which are zipped KML files with a .kmz extension.

Google Earth provides major features to align with imported flight paths, (a) add several place marks, i.e., deviated altitude and airspeed from reference glide path, aircraft relative position when radio altitude is 50 ft, touchdown point and tire marks on the runway; (b) image overlay, i.e., doppler weather radar chart, weather satellite image, and Jeppesen charts.

There are two commercial software programs available to translate the GIS data into KML format. Arc GIS version 9.2 or higher allows users to export GIS data in KML format for viewing in the Google Earth. Any geo-spatial data point, polyline, or polygon dataset, in any defined projection, can be exported. Features of export to KML can be exported as either 2-D features or 3-D features "extruded" upward by an attribute or z-value. The stand-alone program called "GPSBABEL" can convert waypoints, tracks, and routes between popular GPS receivers and mapping programs.

In Taiwan, many general aircraft, national aircraft, and ultralight aircraft have installed the handheld GPS receiver, so "GPSBABEL" is a great tool to download and convert the flight path of GPS data into KML format.

3-D modeling of Google Earth

Recently, there have been many free 3-D models available for Google Earth, such as famous buildings in the world, specific models (aircraft, ground obstacle, airport terminal building, wreckage), and transportation structures (train stations, airports, harbors). All of those 3-D models could be searched and downloaded free from the website of 3D Warehouse (http://sketchup.google.com/3Dwarehouse/). But the latest version, 4.x, of Google Earth has not yet provided the 3-D modeling functions, so it needs another program—"Google SketchUp" to create and translate the 3-D model into Google Earth. Google SketchUp version 6 is a 3-D modeling software tool that allows designers and planners to explore, communicate, and present complex 3-D concepts. Its import and export capability gives you the speed and functionality for use in a professional workflow.

Results and discussion

Airport terminal area application

Most typical aviation occurrences take place in the terminal area of the airport, sometimes accompanied by thunderstorms or slippery runway conditions. From the flight operational point of view to an occurrence investigation, the essential questions include Which approach mode (IFR or VFR) was selected by the flight crew? Which one of the Jeppesen charts was applied? Between the approach path of 1,000 ft AGL and 50 ft, did the aircraft pass though the runway threshold higher than 50 ft? Where was the touchdown point? What methodology should be used to identify the ground scars and tire marks that remained on the runway surface or mud grass? Using reliable and accurate flight path data, investigators could answer these questions, but they need an interactive platform to integrate all of the factual information to validate those answers.

Now, Google Earth provides major features to align with imported flight paths, (a) add several place marks, i.e., deviated altitude and airspeed from reference glide path, aircraft relative position when radio altitude is 50 ft, touchdown point and tire marks on the runway; (b) image overlay, i.e., doppler weather radar chart, weather satellite image, and Jeppesen charts. All the image overlays are determinates of two known positions, but if the original chart lacks the position information of latitude and longitude or is not the WGS84 coordinate system, it could be inaccurate to superpose with Google Earth's build-in image and terrain; (c) create and import the simple 3-D models, i.e., terminal building, tower, ground facilities, FIR models, and relevant aircraft models. Therefore, KML is similar to HTML and allows users to edit the "virtual" occurrence site via available factual data to evaluate the sequence of occurrence events.

Figure 5 shows the flight path of an MD-90 approaching Hong Kong International Airport via Runway 7R, the place marks and the 3-D models that include the place

(continued on page 30)

Going the Ext

The author discusses a "back-to-basics" approach to investigations and then provides some examples of actual "field" investigations to show why such an approach is so important.

By Donald F. Knutson (MO4529)

(This article was adapted, with permission, from the author's paper entitled Going the Extra Mile, *distributed at the ISASI 2007 seminar held in Singapore, Aug. 27-30, 2007, which carried the theme "International Cooperation: From Investigation Site to ICAO." The full presentation including cited references index is on the ISASI website at www.isasi.org.—Editor)*

Working as an air safety field investigator and engineer for Beech Aircraft (1990-1999) and as an accident and wreckage reconstruction consultant (since 1999) has opened my eyes to how inaccurate and/or incomplete investigations can impact the entire aviation industry. One of the areas that has not changed much in the air safety world is the amount of attention dedicated to a high-visibility or "major" investigation versus a typical "field" investigation. Even though airline crashes receive more news media coverage and typically result in a multitude of injuries/fatalities at once, the majority of investigations are related to general aviation.

The limited budgets of manufacturers and government agencies makes the limited efforts devoted to general aviation accidents understandable. But we as investigators still can make substantial improvements to our methodologies without incurring substantial increases in cost. Inaccurate and/or incomplete probable causes litter the "field" investigation databases. This situation affects our ability to assist the aviation industry in making effective judgments to resolve immediate and long-term problems. This article will briefly discuss a "back-to-basics" approach to investigations. Then, some examples of actual "field" investigations are presented to show why this is so important.

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Proper investigation foundations

Does a relatively simple accident change our approach to the investigation when compared to a complex accident? Theoretical answer: It shouldn't. Practical answer: It usually does. High visibility and liability typically drive the depth of an investigation, and it is human nature to "relax" when nobody gets hurt. We need to keep in mind that minor incidents can turn into major accidents; therefore, we should thoroughly document all events when possible. One way to achieve this is to maintain a consistent and comprehensive methodology for documenting both "accidents" and "incidents" (as defined by the NTSB).

Empirical knowledge is one of our best friends. Obviously, engineers intend for aircraft system or component designs to be safe. Also, certification and regulations consider many possible failure scenarios that engineers attempt to design out of the equation. This usually, and fortunately, results in limited accidents; but this also means investigators end up with limited empirical data to compare with an aircraft accident. Inconsistent data and limited data result in lost opportunities to take advantage of empirical knowledge.

Complex investigations require a team with the appropriate expertise. But as noted, general aviation may be neglected due to lack of resources. When comparing a Boeing 747 mid-air explosion with 500 fatalities versus a Cessna 152 stall/spin resulting in 2 fatalities, it doesn't take much thought to see which accident should get the most attention. Or does it?

The money spent to conduct the investigation will differ, but the experts required to find the cause may not—pilot and mechanic experts, radar/flight data experts, structural and system engineers, meteorologists, metallurgists, etc., could all be needed for both accidents. Investigators sometimes wear several hats such as being the reconstructionist, metallurgist, and human factors expert. This can be a problem because it is rare for an "expert" to have enough background to properly cover all these areas. For example, in the consulting world it is common for a metallurgist to also be the accident reconstructionist. This approach may be successful in some cases, but we must remember that the accident reconstructionist is usually a generalist, compared with a metallurgist who is usually a specialist.

Generalists, who include most field investigators, require a broad-based knowledge of the industry along with the ability to recognize what types of specialists are needed to support the investigation. It is not unusual to find specialists, who are not pilots or mechanics, analyze details involving flight and maintenance operations without actually having this experience. Likewise, it is typical for field investigators, who are not metallurgists or human factors experts, to analyze fatigue failures or cockpit resource management.

We normally have limited time and money to conduct our investigation. For instance, if aircraft wreckage is scattered along a major metropolitan highway and the

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investigation team is getting serious pressure by the local authorities to recover the wreckage ASAP, the investigation team needs to prioritize the most important parts to document and preserve. Another example is setting up a relatively inexpensive test to prove or disprove a theory, prior to deciding on a full-blown test program. This means an investigator must know how to think creatively and "outside the box" to solve problems practically. Typically, we become better at this concept as we gain investigation experience and work with experienced investigators on our team.

Even though investigators become savvier and more confident based upon their experience, we must guard against becoming overconfident or complacent. A fireman with 30 years' experience might investigate a house that burned down and determine that the fire started at the furnace. If his findings are based upon the fact that he has seen this happen 100 times during his career but no evidence exists to determine the origin of this particular fire, then he has used flawed analysis. Investigators must base their conclusions on facts and scientific principles, not just experience. Remember this adage: "*Evidence is king.*" We need to maintain the investigation's integrity by staying away from putting our "gut feelings" ahead of actual physical evidence. Investigators should be disciplined and patient about gathering all possible evidence and look past the perceived obvious, i.e., use in-depth analysis. Do not start forming any conclusions until the facts are completely documented and evaluated. Examples in this article will show how inaccurate or incomplete investigation findings result from selective gathering of evidence.

No matter how many investigations you conduct, there is always something new to experience. This means that there is always room for improvement when it comes to both our communication and learning process. The previously mentioned empirical knowledge can be enhanced when we share our investigation experiences and use them as lessons to be learned. Effective ways to do this include attending and presenting at seminars organized by the International Society of Air Safety Investigators and General Aviation Air Safety Investigators.

Who's on the team?

Imagine a mechanic trying to fix an airplane without using the proper tools, or a pilot flying in unfamiliar airspace without using the proper aeronautical maps. This is similar to an investigator not being aware of all the expertise that is available and may be necessary for the investigation. We should develop a strong awareness of the following areas of expertise (I'm probably missing something):

- Air traffic control and radar
- Airport operation and design
- Biomechanics
- Certification and airworthiness
- Engineering (aerodynamics, safety, structural, systems, etc.)
- Fire and explosion
- Flight data and cockpit voice recording
- Human factors (machine-person-environment interface issues)
- Maintenance
- Materials (metal, composite, and plastic)
- Meteorology
- Pathology and toxicology
- Piloting (test, instruction, or general operation)
- Simulator and animation
- Sound spectrum analysis (tower recordings and CVR)
- Test and system modeling
- Tribology (lubrication, friction, and wear)
- Wreckage and accident reconstruction

As indicated before, we may possess knowledge in areas beyond our primary expertise, but we need to understand our limitations and know when to involve the appropriate generalists or specialists. Build a network of experts and learn as much as possible about what/how they can add to your investigation.

Concentrate on small pieces of evidence until understanding the big picture

When have you heard someone ask, "How do you take all those broken pieces and understand what happened?" The answer is, "One piece at a time." This seems so simple; yet our experience, knowledge, and ego can prompt us to cut corners or jump to conclusions. Sometimes we get away with this, but we are not exercising quality control no matter how we would like to justify it.

Solve the following sentence: **KFDE W CWMDCWZZ XDZUDPDX FWM YZL MGVBNTVM, TED OTLZA MWG FD NFXTKM WN W YDPDX BUNOF.** First clue is **Z** = ***L***.

Tools needed to solve this puzzle are knowledge of the English language (reading, writing, and spelling), similar to understanding engineering and sciences. Also, knowledge of the American culture is required (e.g., sports, slangs, and humor), similar to understanding the various facets of aviation. We should logically start by replacing all the **Z**s with ***L***. Next, evaluate the small words to determine their vowels, knowing that one-letter words are either ***A*** or ***I***. Another helpful clue is that two words have the same suffix. Note that during this process we start by concentrating on the words in the sentence and not the entire sentence. Likewise, when we are documenting pieces of wreckage, our focus starts on each piece and not the entire wreckage. After we make some educated guesses about which letters can work, we start to string two or more words together. Then, we iterate the process until we see that the sentence makes sense. Likewise, as we accumulate our wreckage findings piece by piece, we theorize realistic possibilities based on the available evidence. Then, we compare relationships between two or more findings and iterate through logic and tests to find out whether we can connect the dots. Our goal is to eventually "visualize" the accident; in other words, establish the sequence of events leading to and including the accident.

An effective investigation tool is the "nine-box matrix" depicted in Figure 1. This tool helps us derive a comprehensive checklist in addition to the basic established report format. The nine-box matrix also prompts us to account for the small pieces of evidence before looking at the big picture and helps establish a game plan for further investigation needs. For example, questions involving the "Machine" should include radar and ground support equipment along with the aircraft. "Environment" involves the airport operations and company policies as well as the weather. Each box eventually evolves into a multitude of specific questions.

Scientific method

We want to minimize the influence of any bias or prejudice of the investigation team by evaluating a hypothesis or theory through accurate, reliable, consistent, and non-arbitrary representation of the investigative findings. The flow chart depicted in Figure 2 concisely shows the basic process. Integrating the nine-box matrix with this process will provide investigators with a comprehensive approach along with quality control of the investigative findings.

Figure 1: Nine-box matrix.

	Person *(owner, operator, passengers, witnesses, etc.)*	**Machine** *(aircraft, radar site, maintenance equipment, etc.)*	**Environment** *(weather, accident scene, work culture, etc.)*
Before			
During			
After			

Art versus science

The old adage that "physics doesn't change" is alive and well. Mechanisms and structures have physical properties that "talk" to us. (No, I'm not eccentric!) Also, miniature pieces obey the physical laws of nature the same as big pieces, e.g., for every action there is an equal and opposite reaction. Physical properties of materials can be verified and quantified in many ways. We measure and describe the amount of damage or change in parts regarding their geometry, volume, direction, and orientation. One common method to visualize damage is by piecing wreckage together on a frame or during a wreckage layout. We try to distinguish impact versus pre-impact damage (or normal wear). This is typically the *scientific* part of wreckage reconstruction.

Specific details or *scientific* findings usually are what they are: Part A fracture profile fits together with part B fracture, radar data showed the aircraft flying at X ft and descending at Y ft per minute, autopsy revealed cause of death from blunt force trauma, metallurgical findings showed fatigue cracks and dissimilar metal corrosion, human factors studies show a person can optimally react to a specific emergency in Z seconds, etc.

To be creative and imaginative, we need to recognize our inherent biases such as preconceived notions based on our experience (or lack thereof) and have a willingness to consider the "absurd."

Our *artistic* side (skill acquired by a combination of experience, creativity, and imagination) comes into play when we need to globally consider evidence, then mix and match it with logical perception. This becomes even more necessary when conveniently related test or engineering data, proven empirical knowledge, or crash-recording devices (CVR, FDR, etc.) are unavailable.

To be creative and imaginative, we need to recognize our inherent biases such as preconceived notions based on our experience (or lack thereof) and have a willingness to consider the "absurd." For example, visualize a propeller-driven airplane flying level at cruise speed while crashing into gradually rising and densely forested terrain. The main wreckage comes to rest ~500 feet from the initial tree impact and sustains a post-impact fire. The propeller had separated from the engine and was found just downstream of the main wreckage. Study the three-bladed aluminum propeller damage depicted in Figure 3. Notice the pronounced aft curling of only one blade tip, with the other two blades exhibiting relatively simple bending. Also notice that two blades appear to be in a feathered position (~90° pitch angles from the plane of rotation), and the two non-curled blades are bent in opposite directions. Physics tells us that the curled blade tip did *not* impact a tree and wrap around a branch. In order for the blade curling to take place, the propeller needed to have been rotating under power (2,000-2,700 RPM) through a dense medium (cutting through trees), while systematically striking the trees with only one blade. Each strike of the blade tip incrementally twisted it toward low pitch until finally curling about 1½ times. Think about the odds of this happening. Now, think about what an investigator would possibly consider if the post-impact fire had consumed just the curled blade tip. This could easily create a false perception that the engine was not producing power during the impact sequence. The moral of this example is keeping an open mind along with being thorough during the wreckage examination.

"Proof is in the pudding"

Now let's look at a few examples of how failing to apply the aforementioned investigation principles can result in incomplete or inaccurate analysis. Please note that I've briefly summarized two Cessna models *not* with the intention of picking on Cessna aircraft. Correspondingly, I've chosen two NTSB investigations not to single out the NTSB. These case studies just happen to demonstrate investigative concepts that are easy to follow in a concise format.

Case study #1—Cessna 525A (CJ2) runway overrun, NTSB Report No. NYC03FA002

The pilot landed the airplane too fast down the runway and failed to properly abort and execute a go-around. The airplane rolled off the end of the runway and impacted upward-sloping terrain while trying to become airborne. Both front-seat (cockpit) occupants sustained serious facial injuries, and both rear-cabin occupants were uninjured. The NTSB probable cause was "the pilot's improper decision to land with excessive speed, and his delayed decision to perform an aborted landing, both of which resulted in a runway overrun. A factor was the tail wind." This case study discusses the implications of the field investigation falling short of looking into what caused the cockpit injuries.

Both front-seat occupants sustained serious head impact injuries, which rendered the pilot unconscious as well as required the right front-seat passenger to have facial reconstruction. NTSB investigative findings showed that the left front-seat inertia reel passed its acceptance test, and the right front-seat inertia reel did not. Both acceptance tests resulted in the reels locking at 1.5 g, yet both shoulder harness assemblies did not appear to adequately restrain the occupants.

Examination/comparison of the subject Cessna CJ2 wreckage and an exemplar CJ2 have revealed that significant crushing of the fuselage nose section absorbed most of the impact energy and prevented the occupants from sustaining fatal deceleration/g-loads. Per the wreckage recovery crew, both front-seat assemblies had remained attached to the cockpit floor structure, i.e., relative displacement of the floor and seat assemblies were similar. Both control column assemblies remained intact and were displaced aft and upward in concert with both front seat-tracks, i.e., relative displacement of the front-seat occupants in relation with their control wheels. The right side of fuselage nose section exhibited a 44-45° crush line, and the left side exhibited a 35-36° crush line, which are consistent with the occupants flailing primarily forward and slightly to the right during the ground impact. Biomechanics analysis and evaluation of the overall cockpit deformation revealed that the facial injuries sustained by both front-seat occupants were caused from striking their respective control wheel. Vertical g-loads sustained during the terrain impact did not result in serious back injuries.

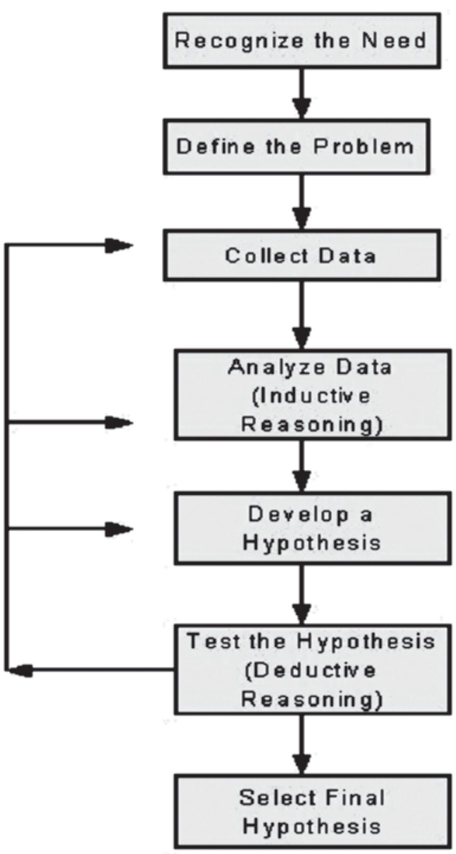


Figure 2: Basic scientific method flow chart.

Figure 3: Propeller blade curl.

During the exemplar CJ2 inspection, the accident pilot (6′3″ and 170 lbs) was positioned in the left front seat with the five-point restraint system properly adjusted against his body. The pilot positioned his seat the same as when he is flying—adjusted to its most aft-locked position on the seat tracks, with the seat back at its most upright setting. The pilot adjusted his seat height via the sight gage mounted above the center of the glare shield. The shoulder harness belts were jerked forward and locked at the least possible inertia reel payout length. Shoulder harness belt tension was maintained. The pilot's left hand held the control column full aft with the control wheel rotated approximately 45° from a neutral setting, and the pilot's right hand was on the engine controls in the full power position (normal positions when a pilot is trying to lift off and avoid impact with terrain). The pilot was then able to droop his shoulders and thorax downward (simulating vertical g-loads), without exerting any excessive pull force on the seat back, and lean forward enough to make facial contact with the control wheel. Two other persons (5′11″ and 175 lbs, and 6′0″, 230 lbs) duplicated the seated test without changing the seat and control positions—both were able to droop their shoulders and thorax downward, and lean forward enough to make facial contact with the control wheel.

In addition, static pull tests on the ends of both shoulder harness belts were conducted. The shoulder harness belts were jerked forward and held to the least possible inertia reel payout length. The straps were then pulled forward at 20, 40, 60, 80, and 100 lbs. During each pull force, the elastic displacement of the upper portion of the seat back was measured. The forward seat back deflections (i.e., roughly corresponding to the forward motion of the pilot's upper torso) were $1/8$, $5/8$, $7/8$, $1\,1/8$, and $1\,5/16$ inches, respectively; therefore, the pilot's cheek would translate forward at least another one inch into the control wheel with a shoulder harness tension force of 100 lbs.

Per FAR 23.561, the pilot should be given "every reasonable chance of escaping serious injury" during emergency landing conditions, with static inertia loads of 9.0 g forward. Also, FAR 23.562 requires the seat assembly to withstand peak dynamic loads of about 26 g forward (with 10° yaw) and 19 g downward (with 30° pitch up). This means that the pilot's upper torso would easily exert more than 100 lbs of forward pull force on the shoulder harness and more than $1\,5/8$ inches of seat back deflection during a dynamic crash condition.

While researching cockpit seat certification, it's interesting to note that crash sled tests were conducted with the seat and restraint assembly, an instrumented crash dummy, and a mock instrument panel and glare shield. A control column and wheel assembly was not included because head impact with the glare shield, not the control wheel, was assumed. The occupant's chest is expected to impact the control wheel, and the crash dummy is not designed to simulate the drooping of the shoulders and thorax during the impact tests. Airplanes have to deal with both the horizontal and vertical components during an emergency landing. The normal response for a pilot preparing to contact terrain would be to pull the nose up to minimize a direct head-on collision; therefore, facial impact with the control wheel should be a practical consideration during the crash sled tests.

The normal response for a pilot preparing to contact terrain would be to pull the nose up to minimize a direct head-on collision; therefore, facial impact with the control wheel should be a practical consideration during the crash sled tests.

Case study #2—Cessna 152 stall/spin, NTSB Report No. NYC05FA069

An instructor and student took off in good weather with full fuel. They apparently were practicing a stall/spin from approximately 3,000 feet AGL. Available radar data and witness statements indicated that the airplane maintained its descent until ground impact. Witnesses saw the airplane "spiraling" in a nose-down attitude but could not determine its direction of rotation. Both occupants sustained fatal injuries during terrain impact. Wreckage remained together and was resting upright, with no debris path or horizontal ground scars.

Pertinent NTSB wreckage inspection findings included the following:

- No evidence of fire or smoke in cockpit
- Cockpit instrumentation and flight controls destroyed
- Engine mixture control (vernier type) pulled out and bent downward (?)
- Engine throttle control full in/forward (?)
- Propeller blades did not exhibit twisting or chordwise scratches, i.e., no evidence of engine torque during ground impact
- Flaps up/retracted
- Rudder exhibited full left deflection with its rudder horn stop plate over-traveled and snagged under the stop bolt head (refer to Figures on page 154 of the *2007 ISASI Proceedings* and the below-noted NTSB safety recommendation).
- Rudder stop plates (riveted on rudder horn) were installed backwards
- Flight control continuity was established
- No structural anomalies were found (e.g., fatigue failures)

Maintenance records indicated that the airframe had at least 10,700 hours total time, and no major repairs or alterations were performed on the rudder control system. Cessna Service Bulletin SEB01-01 was issued about 3½ years prior to this accident, which provided an enhanced rudder stop installation designed to assist in preventing the possibility of the rudder overriding the stop bolt during a full left or right deflection. This service bulletin was not complied with. Records also indicate that the rudder stop plates were not replaced or repaired.

Research of other Cessna 150/152 stall/spin accidents revealed what appeared to be a closely related accident in Lac Saint-Francois, Quebec, Canada, on July 18, 1998 (Transportation Safety Board of Canada Report No. A98Q0114). The NTSB probable cause was an "improperly installed rudder bumper, which resulted in a rudder jam during spin training and subsequent uncontrolled descent into terrain. A factor was the operator did not comply with the service bulletin." Furthermore, the NTSB issued a safety recommendation (A-07-33) to the FAA on March 21, 2007, requiring an airworthiness directive to comply with Cessna Service Bulletin SEB01-01.

Beyond the NTSB investigation, further findings came to light that do not support the NTSB probable cause, nor the safety recommendation:

- Contact areas between the rudder stop plates and their respective bolt heads exhibited wear patterns consistent with properly rigged rudder travel (unlike reported findings from the Lac Saint-Francois accident).
- Elastic properties of rudder assembly only allowed a forced over-travel condition in aft direction (i.e., cannot be pulled via cables/pilot input).
- Extreme rudder pedal push tests (just short of damaging pedals) on exemplar/serviceable Cessna 150/152 models would not create a rudder over-travel condition, regardless of how the rudder stop plate was installed (tab forward versus aft).
- Rudder cable pull tests (>350 lbs tension on either right or left control cable) on both an exemplar tail section assembly mock-up/test fixture as well as the subject damaged tail section assembly would not create a rudder over-travel condition.

In essence, a "cut-and-paste" analysis from the Lac Saint-Francois accident was applied to the subject accident without being substantiated. The information noted above clearly shows that the rudder over-travel occurred during terrain impact and that something else was involved with the pilots not regaining control of the airplane, e.g., improper engine control inputs and performing the stall/spin with inadequate altitude over terrain.

Summary

So practically speaking, what can we do to reduce inaccurate and incomplete investigation findings?

1. Establish the criteria that everyone needs to buy into a sound philosophy.
2. Base the facts on scientific principles, not just experience.
3. Always look past the perceived obvious, and even the "absurd."
4. Completely document and evaluate facts before forming any conclusions.
5. No "cut-and-paste" analyses allowed—confirm other investigation findings.
6. Break investigators into generalists and specialists, and provide appropriate training where it's needed to help them understand *how* to support each other.
7. Foster teamwork and require generalists to work with specialists.
8. Share knowledge and work closely with *all* parties to the investigation.
9. Maintain a comprehensive database and thoroughly document *both* major and minor events when possible ◆

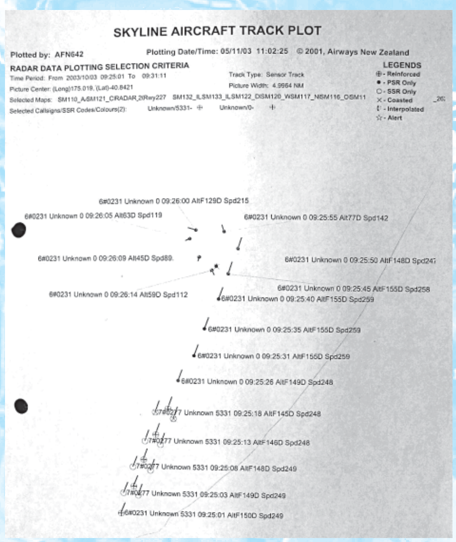
CONVAIR 580 ACCIDENT INVESTIGATION:

A Study in Synergy

Only by working in conjunction with other organizations was identification of all the contributory factors and determination of the probable cause of the accident possible. Such cooperation is especially crucial for smaller agencies that rely heavily on fellow organizations to help provide those additional pieces of the jigsaw.

By Ian McClelland, New Zealand Transport Accident Investigation Commission (TAIC)

(This article was adapted, with permission, from the author's paper entitled Convair 580 Accident Investigation: A Study in Synergy, *presented at the ISASI 2007 seminar held in Singapore, Aug. 27-30, 2007, which carried the theme "International Cooperation: From Investigation Site to ICAO." The full presentation including cited references index is on the ISASI website at www.isasi.org.—Editor)*



Skyline Aircraft Track Plot.

On Friday, Oct. 3, 2003, Convair 580 ZK-KFU was on a scheduled freight flight from Christchurch to Palmerston North. At 2126 hours, shortly after passing Paraparaumu (north of Wellington) in descent, the aircraft was observed on radar to enter a left turn and disappear. No radio calls were made, and attempts to contact the aircraft were unsuccessful. A search for the aircraft and its two pilots was commenced immediately. The Transport Accident Investigation Commission (TAIC) was notified soon after, and at 2305 I was appointed the investigator-in-charge. ZK-KFU was a dedicated freighter that primarily carried mail and courier packs. The aircraft was powered by two Allison 501 turboprop engines and had a maximum all-up weight of 26,450 kg. The aircraft departed Christchurch at 2032 and proceeded uneventfully north at Flight Level 210. At 2113, ATC cleared the aircraft to descend initially to 13,000 ft. At 2125, after a further descent clearance, ZK-KFU was instructed to change frequency to Ohakea Control.

Ohakea cleared ZK-KFU to descend to 7,000 ft and passed on the ATIS information and joining instructing for Palmerston North. The copilot correctly repeated back the clearance but omitted the amended QNH. The controller asked for confirmation of the QNH, but there was no response.

Shortly after, the controller observed ZK-KFU on radar enter a tightening left turn and disappear from the screen. About an hour later, debris identified as coming from the aircraft was found washed up along the shoreline. An aerial search by Air Force helicopter using night-vision devices located further

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ABOVE: Wreckage recovery.
RIGHT: Fireman cuts blades to prepare hubs for shipment.

wreckage offshore but no survivors.

This was an experienced crew, with the captain having flown nearly 17,000 hours, including 3,300 hours on type. The copilot was less experienced on type with 194 hours but had more than 20,000 hours total experience. Both were in good health.

More than 1,000 Convairs in a range of variants were produced. Some 170 of these were later converted to 580 status; and with more than 80 still in service around the world, including 10 in New Zealand, it was important that we recover the aircraft and determine the cause of the sudden departure from controlled flight.

The investigation

The first challenge was to locate and recover the aircraft. A marine salvage company and the Navy were given the task, and using side-scanning sonar located a possible wreckage field in 110 ft of water about 4 km offshore. The area was subject to strong tides with divers often working in visibility of less than a meter. However, after 12 days both pilots were located and the recovery of wreckage commenced.

A plot of the wreckage identified that the aircraft had likely broken up in flight, but the close proximity of the engines, propellers, and undercarriage raised questions about the height of the break-up. To add to the conundrum, light paper articles littered the beach areas, and four pieces of aircraft paneling were found spread in a line up to 3 km inland. With the assistance of the NTSB, the characteristics of the paneling, location found, and known wind were analyzed and a possible trajectory determined. This was combined with the radar track and mode C information to identify a break-up point.

In all, about 70% of the aircraft by weight and 15% of the cargo was recovered for examination. No dangerous goods were reported being carried or found. The Commission received assistance from Rolls-Royce (Allison), which sent out an investigator to review the inspection of the two engines. Both engines were found to be producing power at the time of impacting the water.

The propeller hubs were sent to Pac Prop in the States and under NTSB supervision were examined. They were found to be operating normally at time of impact. With the assistance of TSB Canada, aircraft and performance information was sourced from the type certificate holder, Kelowna Flightcraft; Transport Canada; and the National Research Council. The FAA also provided valuable supporting information.

Across the ditch, the Australian Transport Safety Bureau (ATSB) worked on the DFDR and CVR. Unfortunately the CVR, although testing satisfactorily, only recorded VHF radio transmissions and no cockpit voice. This was a huge setback to the investigation, but we were able to extract engine noise, indicating that at the time of the last transmission both engines were operating normally.

Fortunately the DFDR provided good quality data and held a record of the full flight until descending rapidly through

As Genghis Khan once said, "There comes a time when numbers count." So we pressed into service our marine and rail investigators where suitable—especially in the early days.

6,800 ft. This matched the trajectory of those pieces of paneling found over land. The ATSB and NTSB together were able to determine that after leveling at 14,400 ft, the aircraft rapidly went to a 60° to 70° nose-down attitude, with a descent angle of about -70° increasing to -86° approaching 6,800 ft—at which stage the aircraft was doing 392 kts and pulling about 3.25 g.

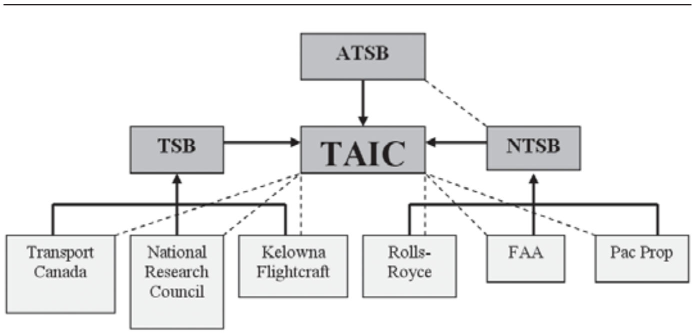
Back in New Zealand, the MetService provided the weather information surrounding the event. Given the timing and routing of the flight, the meteorologists were able to determine that ZK-KFU descended through the trailing edge of a very active front. The conditions were conducive to turbulence and severe icing. For unknown reasons, possibly turbulence, the aircraft was leveled and slowed in this band of icing before suddenly departing controlled flight.

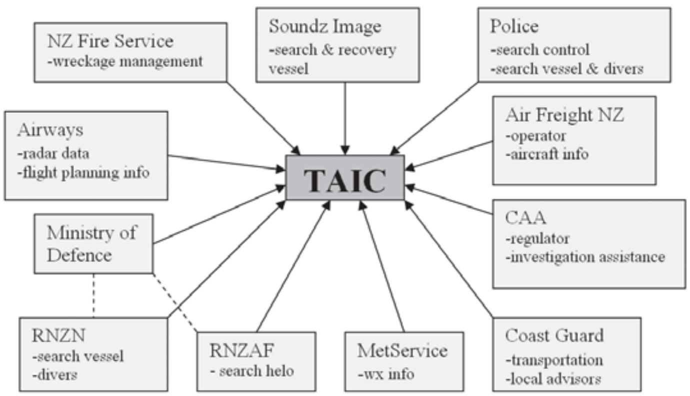
Finding

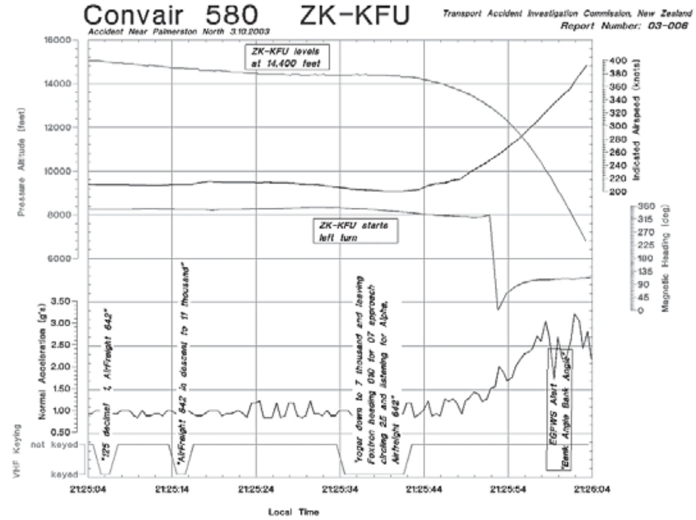
The investigation determined that ZK-KFU had descended through an area of severe icing and stalled after flying level for a short time. The crew was unable to recover from the ensuing spiral dive and the aircraft broke up as it descended through about 7,000 ft.

Coordination

In all, 19 agencies provided direct support for the investigation, including 9 overseas







DFDR data.

organizations. In each of these cases, the relevant independent investigation agency (the ATSB, NTSB, and TSB) provided a central point of contact and joined the investigation as interested parties under ICAO Annex 13. The utility of this document can not be understated. For as the saying goes, we were all dancing to the same tune.

Where expert advice was required, either from within another investigative organization, for example the DFDR analysis in ATSB, or from an external agency, for example icing research data collected by the NRC, the national point of contact would facilitate direct access to these people. This was important, for while the IPs were kept informed of investigation progress, I needed to be able to talk directly to the experts to ensure that I got the required information and that the investigation remained focused. This way energy and resources were not wasted. In nearly all cases, this took the form of an exchange of e-mails providing contact details and smoothing the path.

Memorandums of understanding

For the ATSB, the prior setting up of an MoU ensured full cooperation. It also provided comfort knowing that the CVR and DFDR would be afforded the same level of protection as under New Zealand legislation. On the national front, an MoU with the police ensured a smooth transition from police control of the initial search, where we supported, to taking over after the recovery of the two pilots. A similar agreement with the CAA allowed a CAA safety investigator to be seconded to the investigation, providing a valuable interface and good training. A participants' agreement ensured that sensitive information remained confidential and avoided any potential conflicts of interest.

Organizational structure

Flexibility is a requirement for any organization. TAIC policy is for the IIC to manage the investigation through, to and including the public release of the report. This allows for continuity of command and communications. However, with only three air investigators and the need to manage other investigations, we also need to be flexible in releasing staff during a protracted investigation. For ZK-KFU, the report was released to the public within 11 months—an easily manageable timeframe.

Another challenge for a small organization is the expertise of the staff available. We had only just recruited a new investigator when this accident occurred. A very steep learning curve ensued. However, the retiring investigator was at the opposite end of the scale, with nearly 25 years on the job, including investigating a previous Convair 580 accident in July 1989. Nevertheless, as Genghis Khan once said, "There comes a time when numbers count." So we pressed into service our marine and rail investigators where suitable—especially in the early days. For example, the marine investigators were used on the search and recovery vessels—a tummy-rumbling experience for these big-ship captains. We also had a CAA safety investigator with engineering and large aircraft experience attached to the team for the duration of the investigation. However, to ensure credibility, interviews and the handling of the recorders remained solely our domain.

The accident and subsequent investigation, although not large by aviation standards, did pose some significant challenges—primarily wreckage location and recovery, combined with the lack of CVR information. This lead to a typical two-pronged approach for the investigation—what caused the accident and what didn't. TAIC's small size, with its limited manpower and material resources, dictates that we are adaptable and ardent in our investigations.

We must also be able to have access to the wider safety community, to use the wealth of expertise available. For ZK-KFU, only through the cooperation of the agencies mentioned were we able to determine the probable cause of the accident—a finding that the investigating coroner was able to accept without further inquiries. In short, the investigation and unchallenged report were made possible by

- an established investigation framework (ICAO Annex 13),
- direct and unhindered communications,
- flexibility,
- good team work,
- networking, both pre- and post-accident (e.g., seminars, regional workshops), and
- established working relationships and agreements (e.g., MoUs). ◆

There is a real need for investigators to be able to identify systems that can be useful for the investigation. This underlines the need for close cooperation with manufacturers.

Finding Nuggets in Buried

By Christophe Menez and Jérôme Projetti, BEA—Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation civile

(This article was adapted, with permission, from the authors' paper entitled Finding Nuggets: Cooperation Vital in Efforts to Recover Buried Data, *presented at the ISASI 2007 seminar held in Singapore, Aug. 27-30, 2007, which carried the theme "International Cooperation: From Investigation Site to ICAO." The full presentation including cited references index is on the ISASI website at www.isasi.org.—Editor)*

By December 1993, the Global Positioning System (GPS) had achieved initial operational capability, and the U.S. Federal Aviation Administration (FAA) approved its use by civil operators. This was followed in 1995 by full operational system capability, and the industry then started to produce commercial GPS devices.

As the use of GPS devices has rapidly expanded in general aviation, and since manufacturers have equipped them with recording capabilities, they are now systematically collected by investigators after an accident. Because of the absence of flight recorders in general aviation, these small data storage devices have been viewed as a new and valuable source of information for investigations.

However, as these devices are not primarily designed for investigations, they offer no protection against the severe conditions encountered during an accident. For this reason, investigators have often found themselves in a position where the retrieval of data could not be performed using the standard direct readout procedure. Faced with this, investigators in many parts of the world have started to look for ways of accessing the data buried in damaged data storage devices.

At the BEA, GPS examinations started in 1998; initial work consisted of direct readouts when the GPS was in good enough condition, which sometimes meant carrying out repairs prior to the readout.

Data recovery from early-production GPSs was all the more difficult since data saving was then performed through volatile memories. These electronic chips erase information when the power is turned off. For this reason, early systems were equipped with an additional capacitor or battery in order to preserve the data contained in the memory. After an accident, the connection to the capacitor or battery is sometimes broken, resulting in total data loss.

Later-model GPSs use a non-volatile memory (NVM) for data storage, thanks to the generalization of flash memories in the 1990s. In contrast to volatile memories, NVMs keep data stored even without power. From 2003 on, BEA investigators started to access GPS data by reading out the raw data contained in NVMs and, a year later, a similar operation was made possible on volatile memories. But volatile memories remain problematic because data can be lost at any moment if the power source is not maintained constantly throughout the examination.

The BEA's interest in carrying out examinations of electronic memories from onboard data storage devices—other than GPSs—came from issues encountered during investigations of accidents involving Eurocopter helicopters equipped with VEMDs (Vehicle and Engine Multifunction Displays). The VEMD is an onboard computer used for flight and ground operations. It displays data and limitations related to the engine as well as the vehicle and records failure reports, flight reports, and over-limits. These recording capabilities, as well as the absence in most cases of onboard flight recorders, can make the VEMD an important source of data during an investigation.

The initial procedure used for extracting data from a VEMD after an accident was to send it to the manufacturer, Thales. However, though the procedure used to read out the contents was satisfactory for product testing, it was not suitable for investigations. The readout was made by connecting the VEMD processor card to a readout bench, sometimes coupled with a direct readout onto the VEMD screen when the VEMD was in apparently good condition.

The following weaknesses were found in this procedure:

- Such a readout is not possible if the processor card is damaged.
- There is no guarantee that the contents will not be altered, or even lost.
- A direct readout from the VEMD screen

Christophe Menez *is a graduate engineer from the Ecole Polytechnique and did an internship at California Institute of Technology (U.S.). He holds a master's degree in aeronautics from the French National Civil Aviation School (ENAC). Following 3 years at the French Civil Aviation Directorate (DGAC), he joined the BEA in 2003, where he serves as head of the Engineering Department. International investigations in which he has participated include the Flash Airlines B-737 (January 2004, Sharm el Sheikh, Egypt) and the Armavia Airbus A320 (May 2006, Sochi, Russia) accidents.*

Jérôme Projetti *also holds a master's degree in aeronautics from ENAC. He joined the BEA Engineering Department in 2003 as a safety investigator. He then joined the flight recorder group and began developing tools for solving data-recovery issues. He also undertook the development of a laboratory dedicated to onboard computer examinations. He also participated in the Armavia Airbus A320 (May 2006, Sochi, Russia) investigation and the MHS Eurocopter AS332 (January 2007, off the Sarawak coast, Malaysia) investigation, among others.*

Data

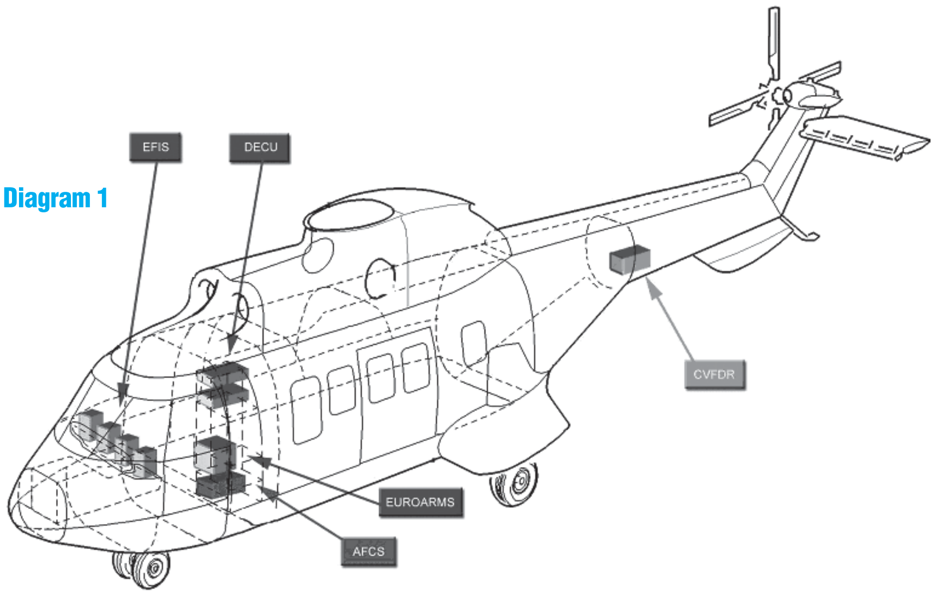
does not show data recorded during a flight that did not terminate as per manufacturer's definition (an accident flight might therefore not be displayed).

- When power is applied to a VEMD, new data are written and there is a consequent potential loss of data useful to an investigation.
- In case of data loss or direct readout failure, it is difficult to know how the loss or failure occurred.
- The application of such a method depends on the manufacturer's interest in maintaining its readout equipment.

This way of reading out VEMDs also proved to be unsatisfactory in cases where no data could be extracted. In addition, the cost to the BEA of each examination performed by the manufacturer increased our desire to find an alternative solution.

With the experience gained from reading out the contents of GPS memories, it was decided to apply the same approach to reading out the contents of NVMs contained in VEMD electronic cards.

Diagram 1



Data storage device variety

Along with GPSs and VEMDs, plenty of other onboard data storage devices contain data that could be used for investigations. The appended table shows the wide variety of types of data storage devices examined at the BEA in recent years and illustrates the diversity of the systems that should be considered as potential information sources when conducting an investigation.

These devices have ranged from health and usage monitoring systems, collision and obstacle avoidance systems, and flight management guidance computers to PDAs and digital cameras.

Even for similar aircraft types, there is often significant variation in the type of onboard data storage devices from one aircraft to another. There is thus a real need for investigators to be able to identify systems that can be useful for the investigation. This underlines the need for close cooperation with manufacturers.

The diagram (above) shows a Eurocopter AS332 and illustrates the complexity of identifying potential sources of information on an aircraft. New integrated avionics systems bring new challenges to investigators. Primary flight and navigation displays can also record data for maintenance purposes. They not only record screen failures but also failures transmitted by the AFCS (Automatic Flight Control System). Although a CVFDR (cockpit voice and flight data recorder) is installed, health data collected by approximately 15 magnetic and vibration sensors can be recovered using EUROARMS.

Methodology

As mentioned in our introduction, reading out the contents of an onboard data storage device with a direct "plug-in-and-power-up" method is not advisable after an accident. Experience shows that such an approach endangers the data. Moreover, direct readouts sometimes show only part of the recorded information. BEA investigators and advisers from Eurocopter encountered an interesting example of this during the analysis of data extracted from a VEMD. The T4 temperature was displayed by the VEMD screen as a three-digit number, though it is recorded with greater

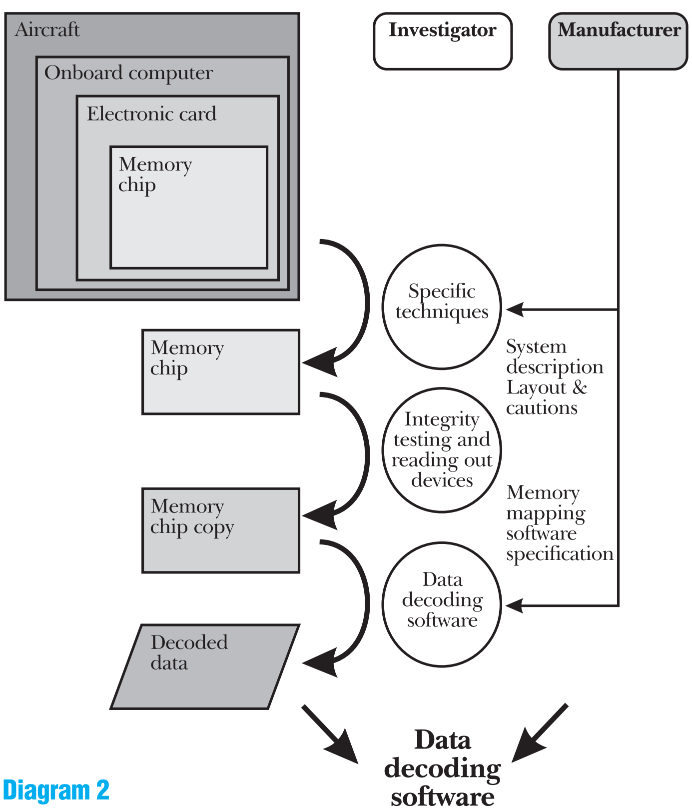


Diagram 2

accuracy, resulting in any recorded temperature above 1,000°C being displayed as 999°C.

The general outline methodology is therefore

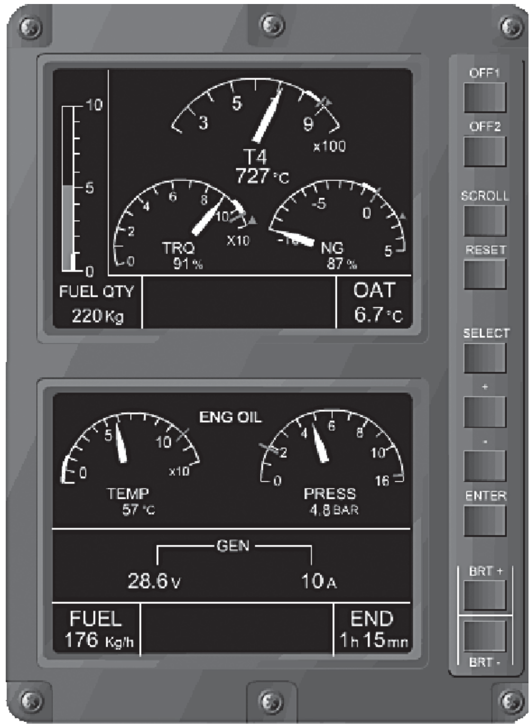
- to identify the potential source of information,
- to remove the corresponding systems from the wreckage,
- to identify and extract the electronic cards and memories associated with data recording,
- to read out the contents of the memory chips,
- to decode the raw data, and
- to validate the results.

The decision to perform the physical examination and the memory readout at the BEA laboratory instead of using the manufacturer's equipment changed the role of the manufacturer in the investigation process. Nevertheless, this approach—rather than excluding the manufacturer—increased the necessity for close cooperation.

The diagram on page 19 shows the various steps in an onboard computer examination, as well as the role of the investigator and the manufacturer.

During the first phase, the manufacturer's knowledge of the systems is essential to know which memory chips store the recorded data. With growing experience, investigators have been developing specific techniques to extract electronic memories without jeopardizing the data. However, when a new system is examined, the manufacturer possesses essential information about the specific characteristics of the system's electronic cards, their position, and the detailed precautions to take. Manufacturers can, for example, point out the presence of a volatile memory and its power source, as well as provide information on the physical composition of the protective layer on an electronic card that investigators will have to remove to access connections to the chips.

The second phase of the work consists of reading out and making a copy of the contents of the memories. By doing so, investigators ensure that raw data are preserved before any further work is carried out. Before reading out a memory, its condition must be assessed in order to ensure that the readout process won't destroy its contents. This phase includes both visual observation of its physical state (microscope, X-ray) and measurement of its electrical properties (voltmeter, oscilloscope). At the



Example of VEMD display on takeoff.

BEA, investigators have developed readout equipment to download the contents of memory chips that can be configured in accordance with the memory type. However, during this phase the manufacturer can also help by providing datasheets for obsolete memory chips or ASICs (application specific integrated circuits).

During the third phase, investigators have to convert the raw data into a comprehensible format. In order to do this efficiently, BEA investigators have developed software with a core algorithm capable of handling several types of formats corresponding to very different types of onboard data storage devices. This software can thus supply a readable format from a raw data input. The number of algorithm decoding features grows when new systems are encountered, so they are added to the software based on the description provided by the manufacturer.

Finally, when the data have been read out and, where necessary, converted into engineering units (or at least to an understandable format), investigators and the manufacturer's specialists work in parallel to validate the values obtained. This parallel work also ensures that the whole process is well understood by both parties before starting the analysis phase.

As a general rule, before examining a new system, investigators work with the manufacturer on defining a readout and decoding procedure. The procedure should then be tested on a similar data storage device before being used on the device from the accident being investigated. Throughout the examination process, an important part of the investigators' work is to identify the risk of damaging the potentially available data and to establish technical solutions to preserve it.

Accident to a Eurocopter EC120 Colibri in India in 2005

During a flight to Delhi, the engine, a Turbomeca Arrius 2F, shut down and the helicopter landed with heavy vertical impact, killing the pilot and two of the passengers. The other two passengers were seriously injured.

As per ICAO Annex 13, the BEA participated in the investigation as a state of manufacture, accompanied by advisers from Eurocopter and Turbomeca. The context of the investigation was particularly difficult as the two fatally injured passengers were Indian ministers and some suspicions of sabotage arose.

The engine examination showed that one blade in the gas generator turbine had separated from the disc, resulting in engine failure. Later, a non-standard ferrule was identified in the secondary air cooling system, and it was suspected that this had been the cause of the temperature over-limit in the engine, resulting in the blade separation, leading to the engine failure. The engine manufacturer issued an all-operator alert for all non-standard ferrules in 39 engines worldwide.

However, the VEMD data, retrieved and decoded at the BEA, threw new light on the accident scenario. Analysis of the recorded data showed that the T4 temperature (free turbine input temperature/EGT) reached 998.5°C during the start-up phase of the flight, which is far beyond the acceptable limit of 870°C. During flight, the T4 overlimit was again recorded. Such an excessive temperature is displayed to the pilot and should result in his aborting the flight and an engine tear-down. However, the pilot decided to continue the flight—the presence of ministers on board perhaps contributing to the decision-making process.

After analysis of the VEMD data, the presence of a non-standard ferrule was defined as a possible contributory factor to the accident, whereas it would probably have

Type	Manufacturer	Country	Examples of model	Examples of aircraft on which it was encountered	Type of content
DECU (Digital Engine Control Unit)	Sextant / Thales	France	70BMA01080 70BMA01090 70BMC01030 70BMC01031	S-76 Sikorsky SA365 Dauphin 2 EC155 B1 AS350 B3	*Calibrations* *Dated failure blocks* *Number of starts and cycles*
	Turbomeca	France	70CMB01050	AS332 Super Puma	*Failure blocks* *Last flight duration* *Number of starts and cycles*
HUMS (Health and Usage Monitoring System)	Eurocopter / Sodielec	France	EuroArms	AS332 Super Puma	**Health and usage data** *BITE*
	Smith Aerospace	UK	EuroHums	AS332 Super Puma	*Health and usage data*
BAP (Engine failure prediction computer)	Sinters	France	N/A	SA365 Dauphin 2	*Failures without time stamp* *Engine health data*
VEMD (Vehicle and Engine Multifunction Display)	Sextant/Thales	France	B19030FC03 B19030FB02 B19030SA02 B19030MC02 B316M30S1001	EC120 Colibri EC130 EC 145 EC 155 B1 AS350 B3 Squirrel	*Calibrations* *Failure reports* *Flight reports* *Over limits* *Engine check*
CAD (Caution and Advisory Display)	Thalès	France	C19243EB04	EC 145	*Failure reports* *Last flight number*
AP (Auto-Pilot)	Sfim	France	416-00297-201	EC 145	*Failure reports*
FLARM (Collision and obstacle avoidance)	Flarm Technology	Swiss	231018-13000	Gliders	*IGC (International Gliding Commission) file*
EFIS (Electronic Flight Information System)	Thales	France	SMD66H C19435BA01 C19435BA02 C19252PC08 39982973	AS332 Super Puma	*Failure reports (AFCS, FDC, HSU, PSU, NMD, PFD, VOR)*
FMGEC (Flight Management Guidance Envelope Computer)	Thales	France	B398BAM0209	A320	*BITE*
GPS	GARMIN	USA	Family VI GNS 150XL GNS 250XI GNS 430 GNS 530	Various aircraft	**Waypoints** **Routes** **GPS configuration** (No trackpoint)
			Family V GPSMAP296	Various aircraft	*Flight reports* *Trackpoints* *Waypoints* *Routes*
			Family IV GPSMAP 295 GPSMAP 196	Various aircraft	*Flight reports (GPSMAP 196)* *Trackpoints* *Waypoints* *Routes*
			Family III GPSMAP 195 GPS III Pilot GPS 12, 12XL	Various aircraft	**Trackpoints** **Waypoints** **Routes**
			Family II GPS II+,III+ GPS 45XL GPS 55 GPS 90 GPS 95XL GPS100	Various aircraft	**Trackpoints** **Waypoints** **Routes**
			Family I GPS38 GPS40 GPS45	Various aircraft	**Trackpoints** **Waypoints** **Routes**
	MLR	France	SP24XC / FX312	Various aircraft	**Trackpoints**/*Trackpoints* **Waypoints**/*Waypoints* **Routes**/*Routes*
	GARRECHT AVIONIC	Germany	Volkslogger 1.0	Gliders	*IGC file*
	Filser	Germany	LX20 LX4000 LX 5000	Gliders	**IGC file**
	ZANDER	France	SR940	Gliders	IGC file
	BENDIX KING	USA	KLN 90B	Beech 90 King Air	Waypoints Routes
	Cambridge	USA	GPS-NAV 301/302 S-NAV	Gliders	*IGC file* **Waypoints & routes (S-NAV)**
	GEONAV	Italy	GEONAV 7C	Microlights	*Trackpoints* *Waypoints* *Routes*
	MAGELLAN	USA	SKY STAR GPS 2000 PIONNEER GPS 315 SPORTRACK	Various aircraft	**Trackpoints** **(Except SKY STAR)** **Waypoints** **Routes** *Trackpoints* *Waypoints* *Routes* *(SPORTRACK)*
PDA (Personal Digital Assistant)	ASUS HP	N/A	A632 iPAQ	Gliders	Trackpoints Waypoints Various files
VHF	Becker	Germany	AR2009/25	DR-400	Last selected frequency
	BENDIX KING	USA	KX155 KA134	DR-400 F-172 Reims	*Last selected frequency*
ACCELERO	MEV	France	PGM 1212	CAP 10 B	*Number date of flight* *Flying time* *Maximal accelerations* *Over limits* *Thresholds*
VARIO	Peschges	Germany	VP6	Gliders	**Flight report**
Digital Cameras	N/A	N/A	N/A	Various aircraft	*Photographs (JPEG)* *Movies (MPEG)* *Date and time*

Data storage devices examined at BEA since 1998. In the content column, italic text indicates a non-volatile memory and bold text indicates a volatile memory.

been identified as the probable cause of the accident without such an examination. The VEMD data showed that the decision to continue the flight after start-up was the probable cause of the accident.

Challenges, limits, and objectives

Working in this way requires the manufacturer to provide information on software specifications, and this is sometimes proprietary information or has not been stored because of system obsolescence. With some manufacturers, collaboration has so far not proved fruitful. For such reasons, and also because the data structure is less complex than for big onboard computers, GPS examinations can often be performed by either a direct readout or a simplified version of the general methodology.

In addition to this first limitation, some difficulties have been encountered where the manufacturer has worked with a large number of component suppliers. Onboard systems and corresponding software are sometimes produced by two distinct suppliers. In some cases, investigators have to talk to several interlocutors before eventually being able to obtain a proper system description.

Work on onboard data storage devices and GPSs has proven to be very challenging. Investigators have tried to find a common way of retrieving and preserving data from a wide variety of systems, but when new systems are encountered, adaptation is necessary and requires some procedural flexibility. For example, decoding a raw file extracted from a memory chip can be performed by the manufacturer if it does not wish to share the product software description with investigators. On the other hand, if a manufacturer does not want to devote time to the investigation process, providing the necessary documents to investigators can greatly help them to get useful data.

The decision to find as much possible data at the memory chip level enabled investigators to strengthen their links with manufacturers. Working protocols that follow this approach have been established between the BEA and Eurocopter, Turbomeca, and Thales.

Manufacturers have expressed great interest in this type of work, which is also beneficial for them as they can obtain more data from the tools and methods developed by investigators. Manufacturers may thus be interested in taking into account knowledge gained during onboard data storage device examinations when developing future systems. Investigators have been invited to give their opinions on data preservation for the development of a new maintenance system called SMMART (System for Mobil Maintenance Accessible in Real Time).

Investigators have also learned more through close collaboration with manufacturers than in cases where the manufacturer was the only one capable of retrieving data. Investigators are better informed about ongoing developments and are better prepared—in case of a new accident—to exploit the manufacturer's knowledge in order to select the systems to be examined.

BEA investigators have been able to work closely with national manufacturers as well as manufacturers from neighboring countries. Cooperation in this field needs to be constantly widened, and the best way to succeed in this is to work in unison with the investigation boards of different countries around the world, which have themselves developed their own working relationships with national manufacturers. ◆

International Council Spring Meeting Actions

(Compiled from Council meeting minutes prepared by Secretary Chris Baum and Council member written reports.—Editor)

The ISASI International Council meeting in Herndon, Va., USA, on May 2, 2008, received a thorough financial status briefing, increased the ISASI Kapustin Scholarship award, reviewed the ISASI annual seminar schedule, and applauded the payoff of the ISASI home office mortgage. In addition, reports were received from Council executives, working groups, and committees.

President Frank Del Gandio called the meeting to order. Attendees included Dick Stone, executive advisor; Ron Schleede, vice-president; Tom McCarthy, treasurer; Chris Baum, secretary; Curt Lewis, U.S. councillor; Barbara Dunn, Canadian councillor; Anne Evans, European councillor; Caj Frostell, international councillor; Lindsay Naylor, Australian councillor; Peter Williams, New Zealand National Society president; Jeff Edwards, Code of Conduct chair; Darren Gaines, proxy for the ATC chair; Anthony Brickhouse, ERAU; Jayme Nichols, ERAU, and ISASI 2009 seminar chair; Marty Martinez, editor, *ISASI Forum;* and Ann Schull, ISASI office manager.

Council Executives

• **President** Frank Del Gandio reported that he is in the process of having the U.S. government create a postage stamp commemorating Jerry Lederer. Government rules require that 5 years elapse after an individual's death before such a stamp can be issued. Permission is first being sought from Mr. Lederer's family to move forward with the commemorative stamp. He noted that Ron Schleede and John Purvis will represent the Society as one of 13 observers at the ICAO AIG meeting in October. Further, he happily announced the early payoff of the home office condominium's $51,542 mortgage, which was celebrated by a "burning of the mortgage" the evening prior to the Council meeting. Chances for an increase in corporate members received a boost from his meeting with Mont Smith of the Air Transport Association, who expressed interest in ISASI's safety role.

• **Treasurer** Tom McCarthy's written report noted that the 2007 financial data are in the hands of a tax accountant and will be on file in the home office. He considers the Society's financial position as "excellent," which enabled the early payoff of the mortgage. He noted that the office condo has appreciated from the purchase price of $101,000 to a current market value of $330,000. In addition to the $800-per-month mortgage cost savings, the existing tenant space generates more than $8,000 per year.

He led the Council into a discussion of

PHOTOS: E. MARTINEZ

ABOVE: From left, A. Evans, J. Edwards, R. Stone, F. Del Gandio, and R. Schleede listen to a report from the international councillor.
RIGHT: From left, T. McCarthy and B. Dunn prepare for the meeting.

TOP: From left, B. Dunn and C. Baum review a policy point.
ABOVE: From left, L. Naylor, P. Williams, and A. Brickhouse listen to the treasurer's report.
LEFT: C. Frostell, international councillor, makes his report.

fiduciary responsibility to the membership by noting the need for the treasurer to be aware of the status of funds/ finances of individual societies in order to know the overall financial status of the International Society. He soothed individual society's fears of losing autonomy through assurances that there was no intention of sharing confidential information or of attempting to influence the way an individual society does business within the established ISASI by-laws.

Council member Anne Evans noted that some of her members had not received dues notices. Ensuing discussion showed that dues notification and payment methods are varied within the Society: In some cases, the home office notifies and collects, in others the tasks are done locally. The situation was slated for further review.

In closing, Tom noted the rising cost of travel to seminars and how it affects the students awarded the ISASI Kapustin Scholarship. He recommended and motioned an increase in the award from US$1,500 to US$2,000. The motion was unanimously passed.

• **Executive Administrator** Dick Stone reported on the lagging pace of applications for the Society's student scholarship. Discussion showed that the established submission deadline could be having a negative effect. Anthony Brickhouse (ERAU) commented that by the June deadline most students have left campus for the year. He noted that an earlier deadline during the school year might motivate students to apply and also would allow instructor supervision necessary to increase the likelihood of applying. Dick said the Fund administrators will consider a change and urged Council members to encourage any interested student to apply for the scholarship, and if his or her enrollment status is not clear, it will be handled on a case-by-case basis.

National Societies/Councilors

• **Lindsay Naylor**, ASASI, reported a membership of 146 and that the regional Reachouts have been successful. The one in Mumbai drew 146 attendees. ASASI is planning to work with NZSASI on developing a regional commemorative program in Ron Chippindale's honor.

• **Barbara Dunn**, CSASI, noted that CSASI attended the Canadian Aviation

Safety Seminar (CASS) in late April. Most Society activity is geared toward preparation for the Halifax seminar.

- **Anne Evans**, ESASI, reported that the Society's European seminar was very successful and as result ESASI is interested in extending the Air Safety Seminar beyond the U.K. The German BFU has expressed interest.
- **Peter Williams,** NZSASI, gave appreciation for the many expressions of sympathy upon the death of Ron Chippindale. NZSASI is working with ASASI to determine how best to commemorate Ron Chippindale. Ron was also the secretary-treasurer of NZSASI and elections are planned. He noted the Society plans to present a bid for the 2012 seminar.
- **Curt Lewis,** USSASI, reported that he intends to step down as president of the Chapter, which should allow him to become more active as the U.S. Society president. Chapter elections are being planned. He noted that Curt Lewis & Associates has joined ISASI as a corporate member.
- **Caj Frostell**, international councilor, reported that Asia, the Mideast, and Africa are considered international areas of special interest to ISASI regarding the establishment of future societies and Reachout workshops. The Mideast and Asia are "well in hand" making good progress in many areas of safety initiatives, including our ISASI involvement, such as multiple Reachouts, new members, and corporate support to our annual seminars.

ISASI Committees

- **Tom McCarthy,** Membership, reports 1,122 dues-paying members in good standing, and 135 current corporate members. Newly recruited members since October 2007 were 101 individual and 11 corporate. He pointed out that waving fees for seminars and Reachouts as a means of enticing new members has worked well in most regions where it has been tried. Tom, therefore, recommended continuing the waiver program.
- **Ludwig Benner**, Board of Fellows, reported the Board will begin processing current applications. It was also noted that there is a need for Fellows to be on the Board Committee.
- **Tom McCarthy** has resigned as chair of the Nominating Committee and has not yet been replaced. There have been no nominations for the ISASI officer positions other than the sitting officers.
- **Jeff Edwards**, Code of Ethics and Conduct, held a discussion regarding verifying information on membership applications. It will be further discussed during the Halifax seminar meeting of the Committee.
- **Barbara Dunn**, Seminar, reported that the Halifax program is developing well. Jim Stewart is in charge of the technical program, and Nick Stoss is setting up the tutorials. The Organizing Committee received twice as many abstracts as there are spaces for papers to be presented. The selectees have been notified. Discussion ensued regarding the final reporting of the Singapore seminar. Believing that a communications difficulty may exist, President Del Gandio will work to close the issue. In addition, discussion was held on the policy language regarding monetary issues of seminar receipts when a seminar may experience a loss. A review and corrections, if needed, will be undertaken and presented at the September Council meeting.

Regarding ISASI 2009. Jayme Nichols, chair, and Anthony Brickhouse, Committee member, reported that things are running smoothly, largely due to the familiarity of the Disney organization with such events. The Tuesday social event will be a "pirate dinner" followed by a party with a DJ. The Friday optional activity will be a tour of the Kennedy Space Center. That tour is structured so there will be no security requirements. The Sunday before the seminar, there will be a Kaputstin Scholarship golf tournament. The course is reserved, and ISASI expects to raise about US$3,500-4000 for the Scholarship.

- **Jim Stewart**, Reachout, has resigned his position after 8 years as the chairman. No replacement has yet been named, but seminars continued to be scheduled and conducted.

Working Groups

- **Dick Stone**, Human Factors, expressed concern that the Group has reached a stalemate. There is a tendency on the part of some members to want to continue doing research rather than publish the "modules" originally envisioned. Dick is sending reminders to members of the project, trying to reach some consensus on finishing. There is a draft module available on visual illusions and spatial disorientation; it is user-oriented and not too heavily academic. Dick is hopeful that the Group can create 3-4 modules by the fall of this year (near AIG 08). ◆

MARC Members Honor Chippindale Memory

Mid-Atlantic Region Chapter President Ron Schleede opened his group's annual meeting on May 1 with a moment of silence for long-time ISASI advocate Ron Chippindale, who "flew west" in February as a result of an auto-pedestrian accident. MARC's membership responded later in the evening by contributing more than $5,200 in his name to the ISASI Rudolph Kapustin Memorial Scholarship Fund. Ron provided a brief update to the 94 attendees of the Scholarship's progress. He noted that three Scholarship recipients are now working in aviation-safety-related fields.

ISASI President Frank Del Gandio and Robert L. Sumwalt, recently appointed NTSB vice-chairman, were also on the program.

President Del Gandio commented on

PHOTOS: E. MARTINEZ

ABOVE LEFT: President Del Gandio delights in the mortgage burning ritual.
ABOVE: R. Schleede shows progress of Scholarship fund raising.
LEFT: NTSB Vice-Chairman Sumwalt chats with MARC members.
BOTTOM LEFT: This group of MARC members shares a laugh before dinner.
BELOW: R. Sumwalt, C. Baum, and F. Del Gandio look over the prize table.

Ron Chippindale's service to ISASI and to the New Zealand Society membership and upon the many contributions he made to air safety. "Ron may be gone but is not forgotten," said Del Gandio. He then introduced some of the visiting dignitaries, along with Truman "Lucky" Finch, who is a founder of SASI and holds charter member No. 3 credentials. About the meeting, Lucky said: "It was an honor and a pleasure to attend the Mid-Atlantic Chapter meeting in Herndon. I was proud and thrilled with the progress ISASI has made in over 44 years since its birth. The present officers and staff are doing an outstanding job."

Before concluding his remarks, President Del Gandio surprised the group by placing atop the lectern a large flameproof platter and striking a flame to the rolled document, which represented the "paid-in-full" mortgage held against the ISASI home office condominium purchased in 2000. As he performed the "mortgage burning" ritual, he noted that the pay off of the $51,542 debt was due to the excellent financial condition of the Society, made possible by the active support of its members, both individual and corporate. Two persons submitted member applications during the evening: Ronald J. Whipple, BAE, and Lynette Jamison, FAA. The General Aircraft Manufacturers Association (GAMA) was recognized as the newest corporate member.

NTSB Vice-Chairman Robert Sumwalt interacted with many of the Chapter's members early in the evening and through dinner. He appeared very pleased to be involved with a group of his peers. Indeed, he is an ISASI member on the active roster. He is a retired airline captain with more than 14,000 flight hours and earned ratings in five aircraft types before his retirement in 2005. A good amount of his airline service was in safety-related positions either with his airline or the Air Line Pilots Association, which honored him with its 2004 Air Safety Award, the highest honor it bestows in its safety arena.

As a trained accident investigator, he participated in some noted investigations, including USAir Flight 427 in 1994, USAir Flight 861 in 1998, and Swissair Flight 111 in 1998. In addition, he has co-authored a book on aircraft accidents and has had more than 85 articles and papers published in aviation trade publications.

He was sworn in as the 37th member of the NTSB on Aug. 21, 2006, and was later designated vice-chairman by President Bush. His term expires in 2011.

In addressing the MARC group, Sumwalt spoke to "investigative integrity." He said: "Investigative integrity means doing what is right for the investigation, regardless of personal, political, or other outside influences. I think it applies regardless of the hat you wear or which organization you represent."

On occasion he would leave his prepared text and add pertinent remarks, such as "I believe the professional life of Ron Chippindale epitomizes integrity." And "My job is to help preserve transparency," when speaking of the public's right to know. He stressed the need of independence for an investigation to make unbiased judgments. (The vice-chairman's full address is on page 4.) A robust Q-and-A session followed his presentation. ◆

Members Making Contributions in Memory of Ron Chippindale

Chris Baum
Frank Del Gandio
Shelby & William Edwards
Truman "Lucky" & Virlene Finch
Stuart & Kaye Matthews
Tom & Ginger McCarthy
John Purvis
John and Lou Rawson
Alissa Rojas
Ron & Kathie Schleede
Richard & Ruth Stone
Curt Lewis & Associates LLC
Kreindler & Kreindler LLP/ Christine Negroni
RTI Group LLC/Joe Reynolds
Canadian Society of Air Safety Investigators/Barbara Dunn
European Society of Air Safety Investigators/ David King/ Anne Evans
Irish Aviation Authority/ Kevin Humphreys
Dallas-Fort Worth Regional Chapter/ Curt Lewis
Mid-Atlantic Regional Chapter/ Ron Schleede
Pacific Northwest Regional Chapter/ Kevin Darcy ◆

Air Canada Named ISASI 2008 Air Carrier

ISASI 2008 has named Air Canada as the official Canadian airline for the event, said Barbara Dunn, chairperson of the Society's 39th annual international seminar. It is the first time in recent history that seminar leaders have selected an official airline to provide travel to the event's location.

In thanking ISASI for selecting Air Canada, the carrier provided the guiding rules for travel. It noted that to secure a discounted fare, a traveler must book through the carrier's website, www.aircanada.com, and enter the following promotion code in the search panel—**M46R4AJ1**. The booking is to be made to the following city: Halifax, YHZ (NS). The travel period begins Thursday, Sept. 4, 2008, and ends Monday, Sept. 15, 2008, and the traveler must attend ISASI 2008. Any tickets not purchased on aircanada.com for the purposes of travel to ISASI 2008 will not qualify for any benefits provided by the Meetings and Conventions Travel Services Terms and Conditions, which is serving as the applicable governing rules for the travel service. The discounts are applied to the fare at the time that the tickets with Air Canada are purchased. The discounts and the fares are subject to all

2007 Annual Seminar Proceedings Now Available

Active members in good standing and corporate members may acquire, on a no-fee basis, a copy of the *Proceedings of the 38th International Seminar*, held in Singapore Aug. 27-30, 2007, by downloading the information from the appropriate section of the ISASI web page at http://www.isasi.org. The seminar papers can be found in the "Members" section. Alternatively, active members may purchase the *Proceedings* on a CD-ROM for the nominal fee of $15, which covers postage and handling. Non-ISASI members may acquire the CD-ROM for a US$75 fee. A limited number of paper copies of *Proceedings 2007* are available at a cost of US$150. Checks should accompany the request and be made payable to ISASI. Mail to ISASI, 107 E. Holly Ave., Suite 11, Sterling, VA USA 20164-5405.

applicable taxes and surcharges.

The technical program planning is nearing completion. Approximately 20 papers have been selected for presentation. The selected theme of the seminar, "Investigation: The Art and the Science," was sharply kept in mind during the paper selection process.

Registration for the seminar is now in full swing. The Canadian Society has established a detailed and easy-to-manage website accessible through the ISASI website, www.isasi.org. All areas of delegate interest are easily identified and accessed on the site. A seminar registration form is on the website and can be submitted electronically. A copy of the seminar registration form was reprinted on page 25 of the April-June issue of the *Forum*. Either registration form may be downloaded or clipped out and mailed to ISASI Seminar Registration, P.O. Box 16032, Albuquerque, NM, USA 87191 .

The seminar program registration fee (in U.S. dollars) by August 10 is—member $525, student member $200, non-member $570. If registration is made after August 10, the fees are $575, $225, and $625, respectively. Day pass fee for any of the 3 days is $200 by August 10, after that date $225. The member fee for either of the two September 8 tutorials is $125 by August 10 and $150 after that date; student member $75 and $100. Companion fee is $320 by August 10 and $350 after that date. Registration cancellations made before July 10 will incur a $10 fee. Cancellations between July 27 and August 10 will incur a $75 fee. There will be no refund of fees for cancellations after August 10.

The seminar will be held at the Halifax

ISASI ROUNDUP

Continued . . .

Marriott Harbourfront Hotel. The ISASI delegate room rate is $185 Canadian for either a single or double and is subject to taxes. The special rate is valid to August 7 and is available from September 2-16. No provisions exist for special rates on upgrade rooms. The hotel registration form is available through a link accessed through the ISASI 2008 seminar website, www.isasi.org. ◆

2008 Int'l Council Election Voting is Under Way

The 2008 ISASI International Council Election voting period will run from June 23 to August 23, 2008. This year's election will be conducted electronically via the Internet using VoteNet. The goals for implementing the electronic ballot are to make it easier; faster for members to vote; and to significantly reduce postage, labor, and materials costs. The process is easy, and there are readily understandable prompts to take you to the ballot so those eligible members may cast their vote.

Members can log on to www.isasi.org and a link to VoteNet will appear on the home page. Click on the link and follow the easy-to-use instructions. There are three ballots available: one for U.S. members, one for members of national societies, and one for international members. Be sure you select the correct ballot. Voting is strictly confidential and the results will be available only to the Ballot Certification Committee. This is another action taken by your Council to ensure that our resources are spent in a productive manner.

As you vote, please consider how the International Council shapes the programs and direction our society takes. Please participate and take advantage of this opportunity to elect your International Council officers for the next 2 years.

If any eligible member does not have access to the Internet to vote, he/she may contact Ann Schull or Tom McCarthy at the international office and a paper ballot will be made available. Contact may be made by telephone (703) 430-9668; fax (703) 430-4970; and via e-mail at isasi@erols.com.

The following members **are not eligible to vote**: affiliate members, corporate members (status only), honorary members, and student members. ◆

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Fax this form to 1-703-430-4970 or mail to
ISASI, Park Center
107 E. Holly Avenue, Suite 11
Sterling, VA USA 20164-5405

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Address ______________________

City __________________________

State/Prov. ____________________

Zip ___________________________

Country ______________________

New Address*

Name ________________________

Address ______________________

City __________________________

State/Prov. ____________________

Zip ___________________________

Country ______________________

E-mail _______________________

*Do not forget to change employment and e-mail address.

NZSASI Seats New Officers

The New Zealand Society has elected and seated new officers. They are—president, Peter Williams, air accident investigator with the Transport Accident Investigation Commission (TAIC); vice-president, Alan Moselen, air safety investigator with the Civil Aviation Authority of NZ; and secretary/treasurer, Russell Kennedy, flight safety officer with (corporate member) the RNZAF.

President Peter Williams joined the RNZAF in 1972 and after completing a bachelor of science degree in physics; he completed pilot training, graduating with the Sword of Honour as the top student. He flew the Bell 47 and C130 Hercules, and was an instructor pilot on the Airtrainer and Hercules.

Williams

Peter flew the B-747 Classic and B-747-400 with Cathay Pacific Airways and was a senior captain when he left that company.

Since 1997, Peter has been involved full-time as a safety investigator, first with the Civil Aviation Authority, then Ansett New Zealand/Qantas New Zealand, followed by Air New Zealand. He has been an air accident investigator with TAIC since early 2005 and a member of ISASI since 1997. He is married to Gayle, who is a nurse, and they have three children and one grandchild.

Vice-President Alan Moselen trained as an airframe fitter in the RNZAF, working on C130 Hercules and P3 Orion aircraft. He joined Air New Zealand as a LAME and worked on DC-10 and DC-8 aircraft. In 1979 he began flight engineer training and went on to crew DC-10, DC-8, B-727-200, and B-747-200 aircraft for 20 years. In 1999, Al became a safety investigator with Air New Zealand and has been an investigator with the NZCAA since 2001.

Moselen

Al has been an ISASI member since 2000. He holds a current commercial pilot license and has held a single-pilot multiengine instrument rating. He is a member of Rotary and the Royal Aeronautical Society. Al is married with two daughters.

Secretary/Treasurer Russell Kennedy has more than 30 years service in the RNZAF, 15 of those years being in the flight safety role. Russell has been an ISASI member since 1994. He trained as a radar technician before completing a bachelor of engineering degree in electrical and electronics, and then completing pilot training. Russell has flown in both transport and maritime patrol roles and has been an instructor pilot in transport aircraft. He and his wife Vicki have three sons and enjoy farming and sailing. ◆

Kennedy

Reachout Chairman Stewart Leaves Post; Guselli Accepts Chair

Jim Stewart (MO2421) has resigned as chairman of the Reachout workshop program, which he initiated 8 years ago. In his letter of resignation, submitted to President Frank Del Gandio in April, he said: "It has been my great honor to serve as chairman of the ISASI Reachout program since its inception 8 years ago. During that time, we have moved from a glint of an idea to being one of the main programs of the Society. In achieving that status, I have many individuals and organizations, too numerous to mention, to thank—for without their support and enthusiasm we would not be where we are today. In particular are Caj Frostell and Ron Schleede, who have been there from the beginning, both having taught at the first Reachout workshop in Prague, Czech Republic, and many, many more since then.

"I want to thank all members of the International Council for their support and encouragement, particularly Treasurer Tom McCarthy who has been such a strong influence on how we conducted our financial affairs and a strong supporter of the program from the beginning. Finally, Frank, I want to acknowledge the visible support you have given the program through the *Forum* magazine, at our annual seminars, and in the many other venues where you have taken the opportunity to mention the Reachout program. Your support has been most appreciated by the Committee members and me. I wish continued success to the Reachout program and trust it will long continue to expand the ISASI 'Reach' as we envisaged so many years ago."

John Guselli (MO3675) has accepted appointment to the chairman position of Reachout, tendered by President Del Gandio. John is presently the chairman of the ISASI Air Traffic Service Working Group. His expansive resume includes facilitating international safety management and investigation training in conjunction with operational management for the Singapore Aviation Academy, Eurocontrol, Airservices Australia, the Australian Transport Safety Bureau, the Southern California Safety Institute, Airways New Zealand, and the Civil Aviation Safety Authority of Australia.

Since its inception in 2000, Reachout has conducted 29 workshops in many parts of the world, instructing 1,388 persons related to the investigation field who might otherwise might never have had the opportunity to receive such guidance. Although the original intent of Reachout was to seek venues that might not have the financial wherewithal to attend the ISASI annual international seminar, the workshops' content encompassed so many "necessity" areas that requests for instruction grew to unimaginable proportions. Accordingly, the program expanded its venue and goal horizons to the extent that "need" overcame "idealism."

For example, in April a special program format dealing with accident investigation management was developed and delivered to some air carrier members of the Air Transport Association, umbrella organization for the U.S.'s air carriers. In all, 33 persons representing airline safety, operations, and maintenance departments attended. This venue illustrates the change that need has brought to the ISASI Reachout program.

In the next issue, *Forum* will feature a full report of the Reachout programs conducted in the most recent months: Seattle, Washington, USA; Manama, Kingdom of Bahrain; Jeddah, Kingdom of Saudi Arabia; Hyderabad and Karachi, Pakistan; and Mumbai, India. ◆

Czechs Eye New Training Center

ISASI member Ladislav Mika (Ministry of Transport, Civil Aviation Department) reports that the Air Accident Investigation Institute of the Czech Republic, headed by ISASI member General Pavel Strubl, plans to proceed with a new headquarters building with hangars, lecture rooms, and a crash laboratory with the potential of becoming an important accident investigation training center in the middle of Europe.

He further reported the success of the Southern California Safety Institute, an ISASI corporate member, which continued in its seventh year of conducting accident investigation training courses at the Czech Airlines Training Center. More than 250 investigators have been trained thus far. The most recent training course attracted participants from the Czech Republic, Germany, Greece, Hungary, Norway, Poland, Slovakia, Sweden, and the United Kingdom. Next year the Prague courses will be held from April 20-May 1. Training plans call for an accident investigator course followed by an upgraded accident investigation management course. ◆

Web-Based GIS Eases Investigations *(from page 9)*

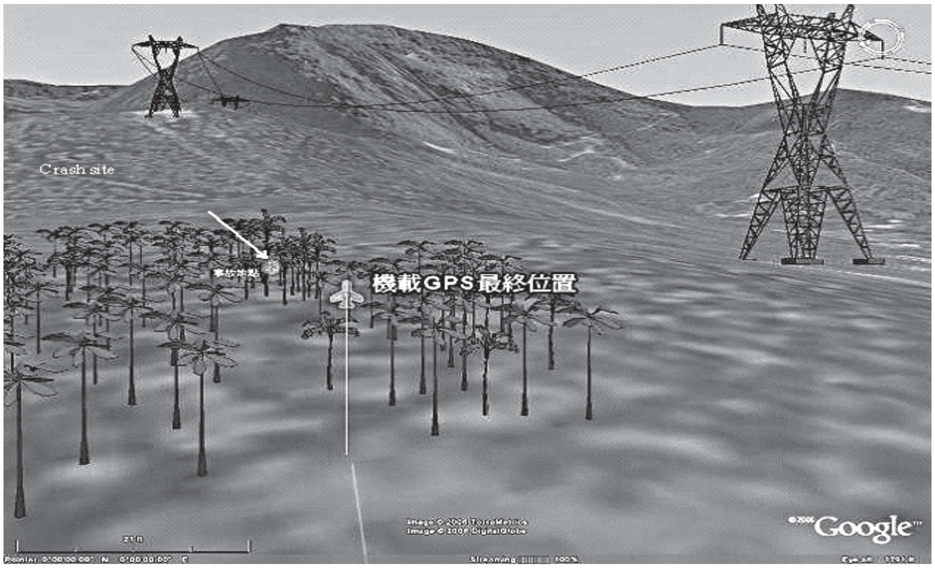

Figure 6. **Illustrates the aircraft crash site environment using web-based GIS.**

marks of the 50 ft and touchdown point, the Jeppesen ILS chart, the ATC tower, and terminal building.

Applications in the crash site

When an aviation occurrence occurs in the mountain area, the initial stage of investigation will be to survey the wreckage distribution, the fire burned areas, and impact marks on the treetops and terrain surface. Using the site surveying data, the investigators could determinate the aircraft's final maneuver. Did the aircraft collide with the terrain at high or low speed? The follow-up could launch the investigation directions on weather, maintenance, flight operational and structural or engine failure, etc.

The results show that web-based GIS has become the important platform to evaluate the sequence of occurrence events, where the investigator could interactively browse the geo-spatial data on PC, with the features of portability and 3D visualization.

The process to reconstruct the sequence of occurrence events is very tedious, time-consuming, and wastes computer resources. Google Earth handles the most complicated data of satellite imageries and terrain data. It allows the user to create the 3-D models and then superpose the models with collected geo-spatial data—for instance, building the electricity tower patterns near the aircraft crash site, in which the electric wires are immediately connected between the electricity towers. Finally, based on site surveying data (collected by differential GPS and a laser-ranging device) the treetops, broken wooden geometry, and 3-D flight path are reconstructed (see Figure 6).

Occurrence investigation objective

The objective of occurrence investigation is to prevent recurrence of similar occurrences. It is not the purpose of such an investigation to apportion blame or liability. Therefore, developing investigation techniques shall have the features of reliability and practicality that lead individual evidence to present consistent analysis result. ASC continues to develop the GIS and flight animation system. The results show that web-based GIS has become the important platform to evaluate the sequence of occurrence events, where the investigator could interactively browse the geo-spatial data on PC, with the features of portability and 3-D visualization.

There are two major concerns for further development of the web-based GIS to assist the aviation occurrence investigation system—(a) improving the KML or KMZ manual translation into batch processing of the geo-spatial data, and (b) enhancing the functions of the geo-data dynamically play back and integration, etc. ◆

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Aviation Law: Kreindler & Kreindler, LLP

(Who's Who is a brief profile of, and prepared by, the represented ISASI corporate member organization to enable a more thorough understanding of the organization's role and functions.—Editor)

Not every Marine Corps helicopter pilot is selected to fly the U.S. president. Nate Brown was among the few. A top-notch aviator, Brown retired from the military to fly for Petroleum Helicopters Inc. (PHI). On Nov. 28, 1996, Brown was killed along with his passengers when the helicopter he was piloting suffered a tail boom separation on approach to landing on an oil rig in the Gulf of Mexico.

His widow, Deborah Brown, couldn't accept the National Transportation Safety Board's probable cause finding that Brown had failed "to use proper emergency procedure." She hired New York aviation law firm Kreindler & Kreindler to bring a civil action against the manufacturer, which was ultimately successful. Still, compensation could not reinstate Nate Brown's good name.

After the litigation, Kreindler & Kreindler presented the NTSB with the results of the firm's own investigation into the cause of the crash and the history of imilar defects on this model helicopter. In an unusual and laudable decision, the Safety Board reconsidered its earlier finding on probable cause and determined that piloting decisions were not a factor in the tragedy.

Throughout its 50-year history representing victims of aviation accidents, Kreindler & Kreindler has shown a continuous commitment to its clients and to air travelers in general.

The Brown petition is one example of how Kreindler & Kreindler uses its pilots, engineers, and investigators to review accident scenes, recover wreckage, reanalyze data, and create animations in order to more fully understand an accident scenario and in some cases identify defects that indicate an on-going problem.

In 1999, four men were killed in a helicopter crash atop a glacier in British Columbia while filming a television commercial. Because of the remote location of the crash, the Canadian government did not recover the wreckage.

Two years later, Kreindler & Kreindler, representing the family of the television producer on board, organized a private expedition—coordinating the recovery of wreckage and bodies and obtaining information that revealed a previously unknown contributing factor in the accident.

KREINDLER & KREINDLER LLP
TRADITION OF EXCELLENCE

The firm's examination showed that the camera mount affixed to the nose of the helicopter was installed without counterweights, altering the airplane's center of gravity and making it difficult to control. The team assigned to the case included two Kreindler & Kreindler partners, former military helicopter pilots whose understanding of aviation was an invaluable addition.

The U.S. Department of Defense looked to Kreindler & Kreindler's expertise when it established a blue ribbon panel in 2001 to assess the safety of the Marine Corps V-22 tilt-rotor aircraft. Kreindler & Kreindler, on behalf of the families of marines killed during the development and test phase of the controversial aircraft, was asked to testify on the flight control problems plaguing the Osprey. As a result, the manufacturers and the Marine Corps were required to slow down the deployment of the V-22 until these hazardous safety issues were resolved.

Kreindler & Kreindler has represented passenger families in nearly every major air disaster, including American Airlines Flight 527, TWA Flight 800, Egypt Air Flight 990, Comair Flight 5191, Swissair Flight 111, the hijacking of Pan Am Flight 73, and the bombing of Pan Am Flight 103. The Pan Am cases and the firm's ongoing September 11th attack investigation has given Kreindler & Kreindler an unparalleled command of the relationship between aviation and terrorism.

Kreindler & Kreindler has also developed expertise in surreptitious ownership of airplanes, air safety hazards from ground-based airport events, and shortcomings in air traffic control equipment and training.

Kreindler & Kreindler understands that aviation disasters are always the result of many contributing factors. The firm is rewarded when, as a consequence of its work, aviation is made safer. At the same time, Kreindler & Kreindler also considers success something as focused and individual as restoring to a pilot's widow her husband's good name. ◆

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