SPRING 2017

ECAC NEWS #61

European Civil Aviation Conference Magazine

ACCIDENT INVESTIGATIONS:

Safety Through Understanding

ECAC • CEAC

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ECACNEWS
N°61 – Spring 2017

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Subscription and distribution requests should be made to info@ecac-ceac.org

Printed by Imprimerie Peau.

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Aviation accident investigations: one of the cornerstones of safety

Pekka Henttu
ECAC Focal Point for Safety and Director General of Civil Aviation, Finland

As ECAC Focal Point Safety, I am very pleased to present this issue of ECAC News on the role and value of aviation accident investigations, one of the cornerstones of safety activities.

Accident and incident investigations are characterised by their precise methodology driven by objectivity, transparency, and international cooperation. Leaving aside liability or blame, they rather aim to provide explanations for events by recording findings, analysing and understanding them, and making proposals in order to reduce the risk of a reoccurrence. This is why they have come to be recognised today as a fundamental element to improve safety, and those responsible for investigations have come to be considered by national and international safety authorities as key partners, both on the policy and technical levels.

Safety remains a strategic priority for ECAC. While some programmes have passed across to the European Union, ECAC continues to be a forum in which safety issues are debated, good practice developed, and – in coordination with the European Commission – common positions fostered in view of carrying weight in global fora, particularly at ICAO events. Indeed, ECAC States successfully presented common papers in the field of safety at the last ICAO Assembly in September 2016, notably one dedicated to issuing, monitoring, recording and acting upon Safety Recommendations, a record which is considered a fundamental stepping stone to enhancing aviation safety and preventing similar occurrences in the future.

In the year that has just elapsed, the ECAC Accident and Incident Investigation Expert Group (ACC) – in which a growing number of high-level experts participate – endeavoured to deal with sensitive subjects of major importance, the human aspects of which are considerable.

Reinforcing a climate of trust and cooperation among ECAC Member States with regard to the conduct of investigations, developing a harmonised approach to the practical aspects of assistance to the victims of air accidents and their families, identifying recent trends concerning air accidents: these are some of the top priorities of the safety community that are reflected in this issue.

In concluding this foreword, I would like to express my warm thanks to Jurgen Whyte, Chief Inspector of the Irish Air Accident Investigation Unit, whose six-year chairmanship of the ACC Expert Group are coming to a close. His initiatives, leadership and commitment have shaped and inspired the very valuable work of this unique expert group and, ultimately, contributed to making aviation safer. On behalf of ECAC, I wish Mr Whyte all the best in his future endeavours.

Looking back on six years of chairmanship of the Group of Experts on Accident Investigation

Jurgen Whyte
Chairman of the ECAC Group of Experts on Accident Investigation (ACC) & Chief Inspector of the Air Accident Investigation Unit (AAIU), Ireland

It is with great pleasure that I welcome you to this edition of ECAC News dedicated to ECAC activities in the field of air accident and serious incident investigation.

The investigation of aviation occurrences is a critical element of any aviation safety regime and in that regard ECAC has dedicated the Group of Experts on Accident Investigation (ACC) to focus at a pan-European and international level on matters related to the air accident and serious incident investigation process. The ACC group falls under the aegis of the Focal Point for Safety, Pekka Henttu, Director General of Civil Aviation in Finland.

ACC is unique in that it brings together heads of ECAC Member States' safety investigation authorities (SIAs) and/or their designates, observers from Indonesia, Israel, Singapore, Turkey and the United States, as well as experts from State safety agencies, organisations and manufacturers. As experts in their field, they all share the common goal of seeking to enhance safety through the investigation of aviation occurrences. ECAC Member States themselves are made up of different-sized SIAs. Some are large due to the fact that they have significant investigative responsibilities associated with a large domestic aviation activity, or in being a State of Manufacture and/or the State of Registry, and some SIAs are small with perhaps only one or two investigators. Of course, reality is such that any State, regardless of its size, can have a major public transport fatal accident visited upon them at any time. And while it is recognised that any State would be tested under such circumstances, it would likely be more difficult for a smaller SIA to conduct such investigations, as it takes significant manpower, expertise, skill and resolve to bring an investigation to its final conclusion with the issuance of a published Final Report.

The added value of ACC is that it offers members and observers the opportunity to come together twice a year, as experts in the field, in order to share the practical experiences gained during investigations already undertaken and to develop best practice, procedures, methods and techniques for the investigations that will be encountered in the future.

The successful development of a Code of Conduct on Cooperation in the Field of Accident/Incident Investigation and the associated Checklist of Cooperative Measures is testament to our ethos of sharing our experiences and offering technical expertise and support to those ECAC SIAs who may seek assistance during an investigation.

ACC also recognises that while investigations are independent and not for the purpose of apportioning blame or liability, such investigations cannot be conducted in isolation. There are many parties involved in the investigation process: victims and their families, crews, manufacturers, operators, ATC, maintenance personnel, regulatory authorities, unions, to name but a few, and all have legitimate reasons to be someway involved or kept informed during the investigation itself. The inclusion of, or interaction from such interested parties during our ACC meetings has clearly helped to understand each other's needs and obligations, while at the same time developing trust, without compromising the objectives of the investigation itself.

Since its establishment in 1992, ACC has held 45 formal meetings and has conducted 10 workshops with diverse investigative topics such as: "The Needs of Victims and their Families", "The Organisation of Investigation Bodies", "Communications", "Drafting and Issuing Safety Recommendations", "Underwater Recovery of Wreckage and Recorders in Shallow Water", "Underwater Recovery of Wreckage and Flight Recorders in Deep Water", "The Investigation of Incidents", "Investigations in Extreme and Hostile Environments", and "Social Communication Associated with the Air Accident Investigation Process" in 2016.

Apart from the sharing of experiences during these workshops, there has also been solid output in the form of the development of guidelines such as Guidance on the Underwater Location and Recovery of Aircraft Wreckage and Flight Recorders, and Guidance on the Investigations in Extreme and Challenging Environments. Such guidance has since been adopted by ICAO and is now included in the organisation's Manual on Aircraft Accident and Incident Investigation (Doc 9756).

In addition, in recent years the ACC group has developed special focus topics during its formal meet-

ECAC Workshop on Social Communication Associated with the Air Accident Investigation Process, The Hague, Netherlands, 10 May 2016

ings. These topics identify areas that may be the subject of future investigations. Areas such as bird strikes, Unmanned Autonomous Vehicles (UAVs), large public transport aero engines, helicopter investigations, Air Traffic Management (ATM), wreckage recovery and wreckage re-assembly have all been covered, with the added value that the ACC group hear directly from experts in the field and in some cases visit the associated manufacturing facilities or organisations where investigators can get up close to the subject matter. An example of such a special focus topic was helicopter investigations, held during our recent ACC/45 meeting in November 2016 and hosted by the Italian *Agenzia Nazionale per la Sicurezza del Volo* (ANSV) at the Leonardo Helicopter facilities at Vergiate, in Italy. There, the ACC group heard first-hand from investigators, experts and manufacturers from different States who had conducted complex and challenging investigations into high-profile helicopter accidents.

The articles that you are about to read in this edition of *ECAC News* are wide and varied and cover such areas as the traits of a good investigator, the evolution of ICAO Annex 13, the use of Remotely Piloted Aircraft Systems (RPAS) for investigation purposes, international cooperation, foreign deployments, the assistance to families and victims, and the outcome of studies on the civil aviation search and rescue service and the safety culture. The authors are all investigators and experts in their own field who have generously offered to share their experiences with us. Hopefully, through these articles you will get a first-hand insight into the complex world of the air accident investigator and the challenging environments and circumstances faced by investigators and involved parties alike during the entire investigation process.

Finally, as I come towards the end of my six years as chairman, I would like to take this opportunity to thank the many States who have hosted ACC meetings and workshops in their countries during my term. To all those people who contributed material and input for those meetings and workshops and indeed to the ECAC Secretariat, my deputy chairman Rémi Jouty (BEA), all ACC members, observers, State agencies, organisations and manufacturers, thank you for your support. It is very much appreciated. ■

Jurgen Whyte has over 40 years' experience in aviation as a pilot and air accident investigator. He joined the Irish Air Corps of the Irish Defence Forces in 1976 and served as an operational, instructional and rating examiner pilot on both single and twin-engined fixed-wing and rotory wing aircraft. He held the positions of officer commanding: Helicopter School, Naval Support Squadron and Search and Rescue Squadron, before retiring from the military flying service in 1995 at the rank of commandant. He joined the Air Accident Investigation Unit (AAIU) at the Irish Department of Transport in June 1995 as an Inspector of Air Accidents. In 1997, he was appointed as a technical expert to the Air Navigation Commission (ANC) of the International Civil Aviation Organization (ICAO) in Montreal, Canada and served for a period of three years, representing a common delegation of six European States, and was chairman of the working group on procedural matters. In 2004, he was appointed Chief Inspector of Air Accidents (Ireland) and continues to hold that position. Currently, he is chairman of the ECAC Group of Experts on Accident Investigation (ACC), board member of the Irish Marine Casualty Investigation Board (MCIB), and member of the ICAO AIG (Accident Investigation) Panel.

The traits of a good investigator

John Owens
Inspector, Air Accident Investigation Unit (AAIU), Ireland

Civil aviation safety has improved immensely over the years. Factors leading to this improvement include more stringent regulation, improved aircraft design and advances in technology. However, the findings and recommendations arising from safety investigations have also contributed significantly to this improvement. The strength of these findings and recommendations is dependent on the thoroughness of the investigation and on the traits of the investigators conducting the investigations.

According to Section 3.1 of Annex 13 [1] to the Convention on International Civil Aviation, "The sole objective of the investigation of an accident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability." Within Europe, this objective is enshrined in Regulation (EU) No 996/2010 [2]. Further to this, it is a requirement of Regulation (EU) No 996/2010 that investigations are conducted by the State of Occurrence and that each Member State "shall ensure that safety investigations are conducted or supervised by a permanent national civil aviation safety investigation authority capable of independently conducting a full safety investigation, either on its own or through agreements with other safety investigation authorities". In order to meet the requirements of Annex 13 and to comply with the relevant legislation, safety investigation authorities must be staffed by competent investigators who are capable of conducting effective safety investigations.

(1) **Annex 13:** International Civil Aviation Organization (ICAO), Annex 13, Aircraft Accident and Incident Investigation.
(2) **Regulation (EU) No 996/2010** of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation.

TRAITS OF AN INVESTIGATOR

Definition

The Oxford English Dictionary describes a trait as a "distinguishing quality or characteristic", with a characteristic being defined as being "typical of a particular person, place or thing". In order to conduct a thorough safety investigation, an investigator must possess a variety of traits.

Background

According to the United States' Office of Personnel Management (1959), "The experience, knowledge, and good judgment of air safety investigators have a direct bearing on safety of human life… air safety investigators must deal impartially and intelligently with individuals or groups of varying interests in the conduct of their work. They must possess the ability to express themselves clearly on technical matters and be able to work under pressure, often under hazardous conditions, in the investigation of accidents. They must be able to draw conclusions without bias from all the facts, conditions, and circumstances involved in an accident."

Furthermore, Lederer, in the first Flight Safety Foundation bulletin (1948), stated that "Intellectual honesty, technical competence, tact, natural curiosity, a critical mind that can formulate logical conclusions, imagination and resourcefulness are the essential characteristics of a good investigator."

Survey

A survey was conducted amongst a small group of safety investigators to ascertain their views on some commonly cited positive traits of investigators. Respondents were requested to list the following traits in order of importance:

- Ability to interview witnesses effectively
- Ability to work as part of a team
- Calm under pressure
- Experienced (technical/ operational)
- Integrity
- Logical
- Open-minded
- Report writing ability
- Thoughtful and understanding with relatives
- Thorough
- Unbiased

The following chart illustrates the results. To display each trait in order of rated importance, each column represents the inverse of the sum of the ratings assigned by each investigator for each trait.

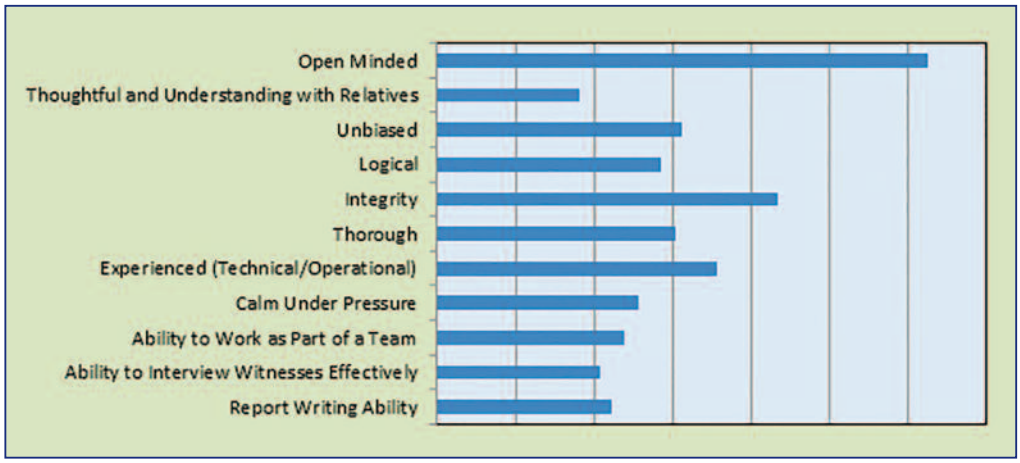

Figure 1: results of survey on investigators' traits

The results reveal that the traits deemed to be the most important were open-mindedness, integrity and experience, with the traits of being unbiased and thorough also featuring highly.

Integrity

According to ICAO, in Part II of their Manual of Accident Investigation (Doc 6920, 1970), "Technical skill, perseverance and logic are the tools of [an investigator's] profession; humility, integrity and respect for human dignity, his guiding rules." In particular, integrity is of vital importance. This is highlighted in the International Society of Air Safety Investigators' (ISASI) Code of Ethics and Conduct (1983), in which the number one principle is integrity. If an investigation is ever found to have been conducted without integrity, the content of the associated report and all findings will be brought into doubt.

Open-minded

Regarding the trait of open-mindedness, it is stated in the ICAO Manual of Accident Investigation (Doc 9756, Advance Edition) that it is imperative investigators keep an open mind so as not to focus on one aspect and thus overlook others. This is mirrored in the results of the survey, in that it was the most desirable trait identified.

It can be difficult to remain open-minded throughout an investigation, as inevitably an investigator will have formed a preliminary hypothesis regarding probable cause. Such a stance is understandable in order to make progress in an investigation. However, it is important to be aware of the development of any biased opinions, which have the potential to adversely affect the investigation.

Experienced (operational/technical)

The requirement to be experienced, which in the context of the author's brief survey related to operational or technical experience acquired in a person's career before becoming an investigator, was the third most highly rated trait. To be considered for a position in a State investigation authority, applicants are normally required to have spent several years working in the aviation industry, either as a pilot or an engineer, depending on the position being applied for. However, it is also recognised that some larger investigation authorities may employ graduates or less experienced personnel and allow them to gain experience within their organisation.

Dealing with relatives

Certain traits may only be required rarely, yet in certain situations that particular trait could be the most important one that an investigator possesses. For example, the ability to be thoughtful and understanding with relatives is absolutely essential following a fatal accident. This skill can be improved upon with experience. However, similar to integrity, it is probably more of an inherent trait.

Report writing ability

In addition to the other traits discussed, the ability to write a readable report that clearly describes the occurrence and sets out and analyses the pertinent facts, leading to logical findings and recommendations, is an essential requirement for an investigator.

Even though this skill was quite low-scoring in the survey, the true significance of this skill is emphasised by Tench (1985) when he stated that "Writing an accurate and properly assessed accident report is by far the most difficult part of the investigator's task, but it is the investigator's only end product. No matter how efficiently the investigation has been conducted, an inadequate report nullifies the effectiveness of the investigation."

Issues that need to be resolved in terms of biases

A trait or skill that is related to open-mindedness and featured highly in the survey is the ability to remain unbiased. An awareness of the ingrained nature

of bias would help in this regard. One form of bias, confirmation bias, is defined in the United Kingdom Civil Aviation Authority's (CAA) Paper 2013/02 *(Monitoring for Pilots)* as a "type of selective thinking whereby one tends to notice and look for what confirms one's belief and disregard any conflicting [information]". Confirmation bias is a sub-conscious activity which can result in an investigator ignoring evidence that contradicts any preconceived causal theories. According to another CAA publication, CAP 737 *(Flight Crew Human Factors Handbook),* "In experiments, when asked to question their own hypothesis, it is regularly found that people ask questions that attempt to confirm it."

Bias can also lead to an investigator from a particular background (e.g. a pilot or an engineer) sympathising with a person from a similar background who was involved in the accident or serious incident. Again, an awareness of this possibility can help prevent it adversely affecting the investigation.

Normally, the aim of human factors training is to assist investigators in understanding the actions of others which resulted in a negative outcome, such as an accident or serious incident. Such training may include guidance on bias and how it affects the decisions that were made by someone at the 'sharp end' of an occurrence (a pilot or engineer for example). However, to reduce the possibility of bias adversely affecting the investigation process, investigators may benefit from training in this area of psychology, specifically aimed at illustrating how it affects their evidence-gathering and analysis.

Another way in which bias can be identified is by continuous peer review throughout the investigation process. This can be achieved by openly discussing an investigation with colleagues as the investigation progresses. Additionally, when the resulting investigation report is in draft form, circulating the report to colleagues and inviting their comments can also ensure that bias is minimised.

Developing desired traits and investigative skills

ON-THE-JOB TRAINING

Regardless of what other desired attributes investigators possess, successful investigation requires investigative experience, in addition to operational or technical experience. New investigators will normally attend an investigator training course. However, investigative experience can only be gained by the investigation of actual incidents and accidents. To allow experience to be gained in a controlled way, a new investigator will usually receive some form of on-the-job training.

In accordance with the European Network of Civil Aviation Safety Investigation Authorities (ENCASIA) Investigator Training Guidelines, on-the-job training can be achieved by shadowing qualified investigators in their daily work and when they respond to an accident or serious incident. During this training phase, new investigators can practise the techniques they learned during initial training on a real accident site under the watchful eye of an experienced colleague.

LIFELONG LEARNING

Respondents to the survey had the opportunity to highlight other desirable traits in addition to those listed. One trait added to the list was a commitment to lifelong learning. To become an expert in any field takes many hours of practice. Some researchers have suggested that the magic number for true expertise is 10 000 hours (Gladwell, 2008). Investigation is no different, and although successful investigations can be carried out by newly trained investigators who have completed the required training courses and undergone a period of on-the-job training, there is no substitute for time spent investigating.

According to Walldock and Kelley (2013), expert investigators see things that are not noticed by inexperienced investigators and they are more readily alerted to the potential significance of seemingly insignificant details. To become more expert and to develop his or her investigative skills, an investigator must commit to continual learning, in terms of formal training and during each new investigation.

SPECIALIST TRAINING

A wide variety of investigator training courses are available at institutes such as Cranfield University in the United Kingdom, the National Transportation Safety Board's (NTSB) training academy, the Embry-Riddle Aeronautical University and the University of Southern California in the United States. In addition, several State investigation authorities such as the Air Accidents Investigation Branch (AAIB) in the United Kingdom and the *Bureau d'Enquêtes*

et d'Analyses pour la sécurité de l'aviation civile (BEA) in France are working closely with manufacturers such as Rolls Royce, Turbomeca and Airbus to provide specialised investigator training courses. These courses are essential for ensuring the continual learning that investigators require.

Some investigation authorities, such as the AAIU (Irish Air Accident Investigation Unit), encourage their investigators to complete the Safety and Accident Investigation MSc programme at Cranfield University. A formal qualification such as an MSc from Cranfield provides an invaluable, formal way of demonstrating a certain level of expertise.

Conclusion

Accident investigators have a vital role to play in aviation safety. The findings and recommendations developed as a result of their investigations lead to continuous improvement. To be successful, an investigator needs to be experienced in aviation and must possess a wide variety of desirable traits, including integrity, the ability to remain unbiased, be open-minded and have the ability to write readable reports. As conceded by Taylor (1996), the ideal air safety investigator is unlikely to exist. Nevertheless, if an investigator is aware of what is required, is well-trained and constantly strives to improve his or her skills, coupled with increasing experience, investigations are more likely to be effective. ■

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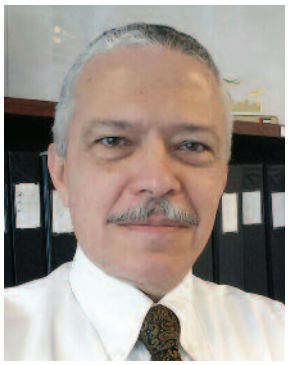
John Owens has been an engineering inspector with the Irish Air Accident Investigation Unit since 2013. He previously worked in a major Irish airline for 24 years, the last 6 of which were in the airline's air safety office, where he became the chief air safety investigator. Before moving to the air safety office, he worked in technical quality assurance for six years and before that, in aircraft line maintenance (11 years) and aircraft component overhaul. While working in quality assurance, he completed an Honours degree in Mechanical Engineering with the Dublin Institute of Technology, Bolton Street, graduating in 2006. He is currently completing the MSc programme in Safety and Accident Investigation with Cranfield University.



Evolution of ICAO Annex 13 on Aircraft Accident and Incident Investigation

Marcus Costa
Chief of the Accident Investigation Section, International Civil Aviation Organization (ICAO)

The AIG Section is the custodian of ICAO Annex 13 – Aircraft Accident and Incident Investigation, providing assistance for the application and interpretation of its Standards and Recommended Practices. To this end, AIG is the ICAO Section in charge of developing policies for aircraft accident and incident investigations conducted by Member States. AIG also develops and maintains guidance material to support investigations as established in Annex 13. In this article, ICAO AIG Chief of Section Marcus Costa presents the principal safety recommendations contained in the global document and their most recent critical evolutions.

Following a fatal accident with a commercial jetliner, which may be the most fearful enemy to the aviation community, chaos may sometimes be inevitable, especially when the crash site is located in a densely populated area. Headlines may pave the way for different public perceptions on what really happened. Media speculation will likely ensue, adversely impacting actions of the various parties involved in follow-up procedures, such as search and rescue operations, and on-site investigation actions including the gathering of relevant information. While accident investigation authorities would be primarily concerned with the identification of causes and contributing factors to the accident, airport and airline personnel would be involved with other equally important matters.

One must be realistic: aviation being a human endeavour, accidents will continue to occur and preventive actions, such as safety recommendations stemming from those events, will be necessary. Challenging as it may be, the investigation of accidents is an absolute necessity for the progress of safety. In truth, accidents represent windows of opportunity for the advancement of aviation.

The aviation industry should not lose sight, nor underestimate, the importance of safety investigations, which personify the ultimate gatekeeper for safety. To this end, accident investigators often go the extra mile to thoroughly identify the root causes and contributing factors of mishaps aiming at preventing recurrences.

ICAO is attuned to the needs of accident investigation authorities to discharge their obligations called for in Annex 13 – Aircraft Accident and Incident Investigation. Much effort has been spent in the last few years with the goal of improving the efficiency of investigations in an increasingly budget-minded aviation industry. Among the several initiatives to assist investigation authorities worldwide, there are three deemed to be of utmost importance.

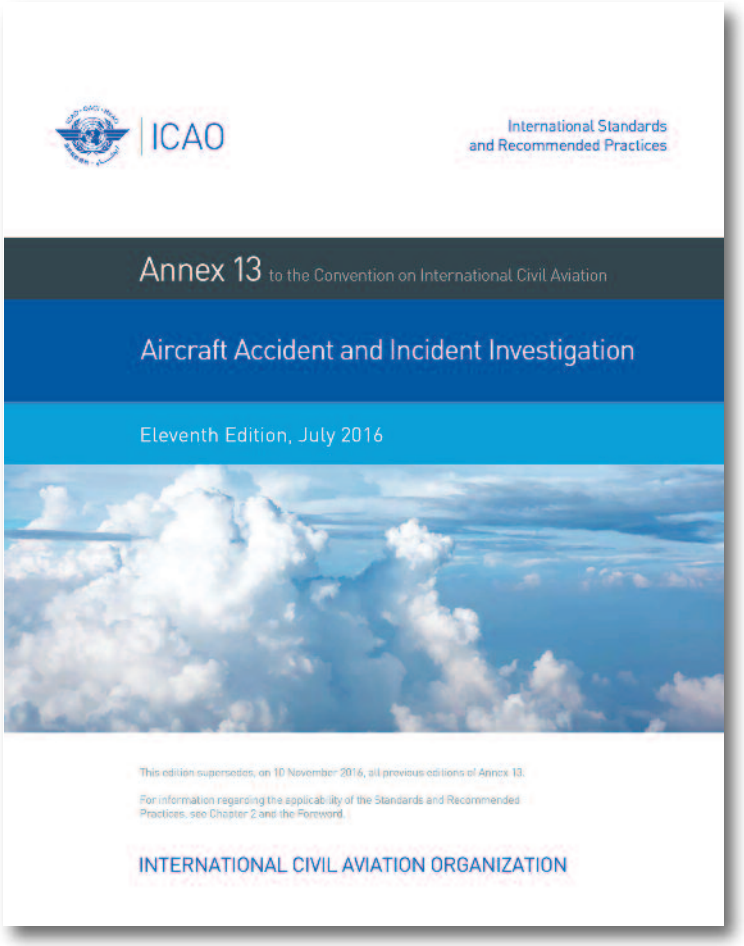
Regional investigation systems

It has been identified that many States have not yet developed the capability for effective accident and incident investigations. The ICAO Universal Safety Oversight Audit Programme (USOAP) has identified through its audits that a number of States have not yet been able to implement an effective investigation system due, in general, to a lack of human and financial resources, lack of appropriate legislation and regulations, as well as insufficient training systems and equipment to conduct investigations.

Mindful of the need to eliminate the duplication of efforts and that some States lack the capability and resources to carry out investigations, ICAO published the Manual on Regional Accident and Incident Investigation Organization (RAIO) (Doc 9946) in 2011, following the insertion of the concept of RAIO in Annex 13 in 2010.

The ICAO Manual on Regional Accident and Incident Investigation Organization provides guidance on the establishment and management of a regional investigation system and outlines the relevant duties and responsibilities of participating States.

The principal objectives of an RAIO are to: a) enhance cooperation and collaboration among its Member States with respect to the investigation of aircraft accidents and incidents; b) ensure the establishment of an adequately funded, professionally trained, independent and impartial regional accident and incident investigation organisation; c) enhance cooperation within the region and internationally with respect to the sharing of information on accidents and incidents; and d) ensure that all aircraft



accidents and incidents occurring in Member States are investigated in compliance with the provisions of Annex 13.

A regional investigation system must be "independent" and also perceived to be so. It is necessary to ensure that a clear separation exists between the organisation responsible for investigations and the civil aviation authorities responsible for regulation and safety oversight. "Independence" in this regard means that the accident investigation authority must be **functionally** independent from other organisations, particularly from the civil aviation authority whose interests could conflict with the tasks entrusted to the investigation authority. Such independence enhances the credibility of investigations and avoids real or perceived conflicts of interest.

The RAIO should have a clearly defined mission statement in the agreement document. The mission statement will depend on what Member States agree should be the extent of the duties and responsibilities of the RAIO, i.e. only providing oversight of States' investigations, or actually conducting the whole or part of the investigations on behalf of Member States. The mission statement should also provide for the implementation of common regulations, standards, procedures and documentation relating to standardisation of processes and procedures for accident and incident investigation.

Such guidance has been of utmost value in regions exploring the development of regional investigation systems. Several initiatives are presently underway in different regions of the globe, attesting to the value of mutual cooperation among States during investigations. Working together, States of a particular region can better fulfil their investigation obligations and help secure a safer international air transportation system.

While being necessary and essential for accident investigation authorities to be independent from State aviation authorities and other entities that could interfere with the conduct or objectivity of an investigation, such status has proven to be challenging for some States to achieve due, in part, to existing legislation and regulations.

Independence of investigations

For over 15 years, ICAO guidance on investigations has been calling for the independence of investigation authorities. The Manual of Aircraft Accident and Incident Investigation, Part I – Organization and Planning (Doc 9756), in particular, states that the accident investigation authority must be strictly objective and totally impartial and must also be perceived to be so, and that it should be established in such a way that it can withstand political or other interferences or pressures. Some States have achieved this objective by setting up their accident investigation authority as an independent statutory body or by establishing an investigation authority that is separate from the civil aviation administration. In these States, the accident investigation authority reports direct to congress, parliament or a ministerial level of government.

Likewise, the Manual on Accident and Incident Investigation Policies and Procedures (Doc 9962) states that maintaining independence in the conduct of investigations will result in enhancing the credibility of the investigation

authority and its ability to avoid situations that have the potential to create conflicts of interest. Maintaining independence of the investigation function is equally important for investigations. The intent of "independence" is that the accident investigation authority needs to be functionally independent, in particular of the national civil aviation authorities responsible for airworthiness, certification, flight operation, maintenance, licensing, air traffic control or airport operation.

Notwithstanding the aforementioned, ICAO USOAP audits have identified that over 25 per cent of States have not designated in their legislation or regulations a specific agency to conduct aircraft accident and incident investigations. Some States have not been able to implement an effective investigation system due, mainly, to a lack of human and financial resources, and lack of appropriate legislation and regulations. Yet, over 50 per cent of States have not enacted legislation or regulations to provide for the independence of the accident investigation authority.

While being acknowledged that Annex 13 already contained provisions calling for the independence of the process followed in the conduct of investigations, there were no requirements for the independence of the accident investigation authority.

In 2016, following a thorough consultation with States, a new standard in Annex 13 came into force which requires that States establish an accident investigation authority that is independent from State aviation authorities and other entities that could interfere with the conduct or objectivity of an investigation. The context of "independence" hereto is not to imply that the investigation authority would not be administratively supervised and accountable to a government ministry/parliament/congress for its finances, administration, policies and working methods. Rather, independence means a situation in which the investigation authority is functionally separate from State aviation authorities and other entities that could interfere with the conduct or objectivity of investigations. Such independence avoids real or perceived conflicts of interest and enhances the credibility of the accident investigation authority.

For States without the required resources for investigations, the establishment of an RAIO is unquestionably a pragmatic solution to achieve the effective implementation of an investigation system. As previously addressed, the ICAO Manual on Regional Accident and Incident Investigation Organization (Doc 9946) provides guidance to States on how to establish and manage a regional investigation system.

Another subject presenting continuous challenge to investigation authorities relates to the protection of safety information from inappropriate use, since its use for other than safety-related purposes may inhibit the future availability of such information for investigations, adversely impacting safety. This fact was recognised by the 35th Session of the ICAO Assembly, which noted that existing national laws and regulations in many States may not adequately address the manner in which safety information is protected from inappropriate use.

Protection of investigation records

A variety of initiatives and efforts are ongoing in ICAO to advance investigation techniques and procedures, aiming to further help investigation authorities worldwide meet their obligations. Much work has been done in the area of protection of safety information, particularly relating to accident and incident investigation records.

Challenges faced by accident investigation authorities in properly protecting investigation records, the multiplicity of parties, interests and agendas involved in investigations required an enhanced protective framework for investigation records. Accordingly, comprehensive deliberations were held during eight consecutive years in ICAO, including the establishment of two expert groups composed of experts from States and international organisations, namely the Safety Information Protection Task Force (SIP TF); and the Group of Experts on Protection of Accident and Incident Records

(GEPAIR). This herculean effort led to a recent major amendment to Annex 13 addressing the protection of accident and incident investigation records.

The new protective framework in Annex 13 focuses on enhancing States' ability to implement the protection of records generated or obtained during investigations; provides an effective means to protect the records in the custody or control of the accident investigation authority; accommodates different legal systems; considers different methodologies and practices in implementing protection of investigation records; provides transparency on the use of investigation records; and strikes a balance between the objectives of the investigation and other public interests. In addition, a new requirement calls for cooperation between the accident investigation authority and judicial authorities in order to ensure that both authorities have appropriate access to information.

The framework also prioritises the level of protection to those records that are more sensitive in nature. The extent of protection of cockpit voice recorder (CVR) recordings and airborne image recorder (AIR) recordings and any transcripts from such recordings remains the same. For other records, protections shall be afforded only when they are in the custody or control of the accident investigation authority. This differentiation recognises that other legitimate forms of investigation may need to access the records from the original source.

States are called upon to establish adequate provisions for the protection of investigation records within their national legal frameworks. Establishing the protections at this level is essential since information contained in these records, which includes information given voluntarily by persons interviewed during an investigation, can be utilised for purposes other than aviation safety, inhibiting its continued availability.

To that effect, the ICAO Manual on Protection of Safety Information, Part I – Protection of Accident and Incident Investigation Records (Doc 10053) was published in June 2016. This manual provides States with guidance material for the implementation of appropriate protection for accident and incident investigation records. In this connection, a series of six workshops addressing protection of investigation records, as well as independence of accident investigation authorities, is underway in all regions to assist States in the implementation of the new provisions.

Another significant milestone for the investigation community relates to the establishment by ICAO of the first Accident Investigation Panel (AIGP) in 2014. The AIGP's mandate is to research and develop solutions related to obstacles and impediments faced by States to undertake timely and effective investigations as set forth in Annex 13.

We all want to reach the "zero accident" goal, which should guide any and each safety action. Reality, however, has proven such a goal to be challenging. ICAO continues to stand ready to advance, with the assistance of its expert groups, investigation techniques, procedures and methodologies for the progress of safe operations. ■

Opinions expressed in this article represent the author's opinion and do not necessarily reflect the views of ICAO.

Marcus Costa began his safety career as a flight safety officer in 1981 with the Brazilian Air Force, where he was a flight instructor and involved with operational and maintenance-related safety matters. In 1985, upon graduating from the University of Southern California's Flight Safety Officers Course in the United States, he was assigned to the CENIPA (Brazilian Safety Centre) where he was a senior faculty member for 19 years and held numerous positions including chief, training division (in charge of safety investigation courses), and chief, research and analysis division, where investigation Final Reports were produced. Mr Costa also chaired the working group that developed the Program for Assistance to Relatives of Air Accident Victims and the Brazilian Confidential Safety Reporting System. He was a member of the Aviation Safety Committee of the airlines' union and a qualified civil aviation inspector. He took his master's degree in aviation safety with the Central Missouri State University (United States), from 1992 to 1994. Later on, Mr Costa was appointed deputy chief of CENIPA, and chairman of the National Committee for Accident Prevention. Subsequently, he was chief of CENIPA from February 2002 to February 2004. He then opted for an early retirement from the Brazilian Air Force to continue his safety career. After working as safety adviser with INFRAERO (Airport Authority of Brazil), Mr Costa joined ICAO as Chief, Accident Investigation Section in November 2004.

The benefits of using drones at aircraft accident sites

Stuart Hawkins
Senior Inspector of Air Accidents,
United Kingdom Air Accidents Investigation Branch (AAIB)

Aerial images of accident sites are very useful for a number of reasons. They can capture the whole site from the initial impact point to the wreckage's final resting location. The ground marks and wreckage distribution help to identify how the aircraft hit the ground. Aerial images are also useful for showing the relative positions of obstacles – such as trees or buildings – that may have been struck before ground impact. They help to reveal the surrounding terrain and environment that the pilot faced if there was an attempted forced landing. And when it's a large aircraft at an accident site, aerial images help to document the damage to its upper surfaces.

The UK AAIB has, in the past, been primarily reliant on police helicopters and sometimes search and rescue helicopters to obtain aerial images. These images have been useful but did not always capture the angle or detail we wanted, and often we would not receive the images until a week or more after the accident. The AAIB could charter a helicopter but this is expensive and can take time to organise.

About three years ago, I noticed that small unmanned aerial vehicles (UAVs), or drones as they're now more commonly referred to, had become significantly less expensive and could provide us with aerial images within minutes of arriving at an accident site. And by controlling the drone's camera ourselves, we could capture all the angles and details we needed.

We bought our first drone, a DJI Phantom 2 Vision, in February 2014 and first used it at an accident site on 14 March 2014 (Figure 1). The drone's 14-megapixel camera provided excellent stills, although the video quality was shaky due to a lack of a gyro-stabilised mount. After using it at five different accident sites we upgraded to a newer model, the Phantom 2 Vision Plus, with a gyro-stabilised mount, in July 2014 (Figure 2, left), which we have used at 11 accident sites. As well as taking stable video, the additional benefit of the newer model was that the camera could be tilted 90 degrees downwards to take a series of overlapping images to map the whole accident site.

I expected to be able to use photo-stitching software to stitch all the images together, but the trials we did were of objects laid out in fields, and the lack of variation in the images, because they were mostly of green grass, was beyond the photo-stitching software. This led me to examining what photogrammetry software could do and I learned that not only could it generate 3D models from a series of overlapping images, but it could also create a stitched overhead image that was true to scale: an image that is called an orthomosaic.

The photogrammetry software we ended up buying is called Pix4Dmapper Pro. We obtained some good photogrammetry results using the drone, and then in September 2015 we upgraded to the DJI Inspire Pro drone (Figure 2, right), which can operate in winds up to 20 knots and has a higher quality camera that can stream high-definition (HD) video to two tablet devices. This model is also available with dual controls for the pilot and camera operator.

Figure 1: first use of the AAIB's Phantom 2 Vision drone at an accident site on 14 March 2014

Figure 2: DJI Phantom 2 Vision Plus (left) and DJI Inspire Pro (right)

How the AAIB operates drones

Under UK regulations, the AAIB can operate drones at accident sites under the standard regulations for recreational users, because we are not classed as a commercial operator flying for reward. The main limits are maintaining visual line-of-sight, a minimum distance of 50 metres from people, buildings and vehicles that are not under our control, and 150 metres from congested areas. Since we primarily operate inside a police cordon where everyone can be under our control, these limits have not restricted our operation.

We have an operations manual that lists flight limitations and training and currency requirements for our operators. At the moment, we have two main operators, and they are our engineering support staff. One of the operators will normally deploy to an accident site to assist with wreckage recovery and will fly the drone. The engineering investigator onsite will normally operate the camera. The AAIB requires two people to operate the drone, because to fly the drone safely the pilot needs to be heads up watching the drone and looking out for obstructions and people. To take good pictures, you need to be heads down. The only time single-operator flight is allowed is when the drone has been programmed to fly an automated route and automatically take stills; in this case, the operator is monitoring the flight and is able to override the autopilot.

Benefits of drones for accident site imagery

The main benefits of using drones over manned airplanes or helicopters are:

- Significantly lower cost (a suitable drone can be obtained for about €700).
- Drones can be deployed immediately on arrival at site.
- The images and video from the drone can be viewed live on the ground.
- The engineering investigator has full control over the images and videos that are taken.
- A drone can be easily relaunched to take additional footage.
- A drone can be flown close to trees and wreckage to obtain close-up images without disturbing them with rotor downwash.
- A drone can be easily programmed to take a series of geo-tagged and overlapping overhead shots for photogrammetry purposes.
- A drone can operate in low-visibility and low-cloud conditions that would prevent an airplane or helicopter being operated.

The uses we have identified for drones at accident sites are as follows:

- Wreckage and site survey
- Wreckage search
- Tree/object height estimations
- Site safety assessments, and
- Flight path reconstruction/ visualisation.

Figure 3: the AAIB's Phantom 2 Vision Plus being used to supervise the recovery of wreckage from a Jetranger helicopter that crashed in the sea below the cliffs

Creating orthomosaic images and 3D models of accident sites

With photogrammetry software like Pix4Dmapper Pro you can create orthomosaic images and 3D models of accident sites using drone imagery. An orthomosaic is an image that is composed of multiple overhead images and is corrected for both perspective and scale, which means that it has the same lack of distortion as a map (Figure 4). The images are obtained by pre-programming the drone to fly in a grid pattern and to automatically take a series of overlapping shots with the camera pointing 90 degrees down. The total flight time to capture the 59 images used to create Figure 4 was nine minutes using our Phantom 2 Vision Plus. The processing time using a typical PC took about two hours but it can take longer for larger projects.

The photogrammetry software also generates a 3D point cloud and a 3D mesh from the images. An example 3D mesh is shown in Figure 5. The quality of the 3D model is improved by taking oblique images, and in this case we took images while flying the drone around the aircraft wreckage at two different heights with the camera pointing at the centre of the wreckage.

The 3D model can be used to take measurements of the site. In trials that we have conducted we have obtained measurement accuracies of up to 1 cm using drone images captured from a height of 40 metres. Details of these trials are in the full ISASI paper online.

Figure 4: Pix4D orthomosaic generated from 59 overlapping images taken with a Phantom 2 Vision Plus from a height of 50 metres (a digitally zoomed-in section of this orthomosaic is shown in the lower right corner)

Benefits of photogrammetry software for processing accident site imagery

Taking aerial images of an accident site and processing them with photogrammetry software has a number of benefits.

- The 3D model is very useful for briefing people who have not attended the accident site. You can manually zoom in and out and rotate the model to show all the ground marks and wreckage distribution. This can make it easier for people to visualise the site compared to flicking through a number of still images.
- You can also use Pix4D to create an animated video of the 3D model that can then be sent to people to view who do not have the Pix4D software.
- If some time has passed between attending the accident site and writing the report, then viewing the 3D model can serve as a useful refresher.
- The orthomosaic images serve as a very detailed wreckage plot.
- Measurements of the site can be made using the 3D model or orthomosaic that are more accurate than using a hand-held GPS, and can be up to 1 cm in accuracy.
- The orthomosaic is also a useful tool to search for missing wreckage and it can be reviewed in slow time back in the hotel or office.

Figure 5: 3D mesh created from oblique video from Phantom 2 Vision Plus while flying two circles at two different heights around the main wreckage

Conclusion

The AAIB has found drones to be a very useful new tool at accident sites. They are very good for capturing the scene before we start disturbing it. They can be used to help us search for missing wreckage and to perform final flight path reconstruction/visualisations. A drone costs significantly less to operate than a manned aircraft and can be deployed immediately on arrival at site. A drone can be easily relaunched to take additional footage, and the investigator has full control over the images and video taken.

A drone can be easily programmed to take a series of geo-tagged and overlapping overhead shots for photogrammetry purposes. Photogrammetry software like Pix4D can then be used to create geo-referenced maps, orthomosaic images, and 3D models of an accident site. These are useful for both visualising the accident site, recording relative wreckage locations and for taking measurements. ■

Adapted with permission from the author's technical paper 'Using a Drone and Photogrammetry Software to Create Orthomosaic Images and 3D Models of Aircraft Accident Sites' *presented during ISASI 2016 in Reykjavik, Iceland, 18-20 October 2016. The full text of this paper can be found on ISASI's website at: www.isasi.org/Library/technical-papers.aspx*

Stuart Hawkins is a senior inspector of air accidents (Engineering) at the United Kingdom Air Accidents Investigation Branch (AAIB) where he has worked for the past 15 years. During this time he has investigated over 190 accidents and incidents, including over 60 field investigations. Prior to joining the AAIB he worked as a flight test engineer and aerodynamics engineer for Boeing in Seattle and as a flight test engineer for QinetiQ at Boscombe Down in the United Kingdom. He has an honours degree in aeronautical engineering, a private pilot's licence with multi-engine and instrument ratings, and is an AAIB-authorised drone operator. He led the AAIB's project to procure the first drones, helped to develop safe operating procedures for them, and introduced photogrammetry software to the AAIB.

International deployment in accident investigation

The case of the Irish Air Accident Investigation Unit's involvement in the investigation of the in-flight break-up of an A321 over Sinai, Egypt, 31 October 2015

John Owens, Kevin O'Ceallaigh
Inspectors, Air Accident Investigation Unit (AAIU), Ireland

The occurrence: Early on the morning of Saturday, 31 October 2015, inspectors from the AAIU began to receive media reports of an aircraft accident in Sinai in Egypt. It soon became apparent that the aircraft involved was an Irish-registered Airbus A321, which was being operated by Metrojet, a Russian operator, under Article 83 bis [1] (photo No 1).

A sudden in-flight break-up had occurred while the aircraft was en route from Sharm El Sheikh on the southern tip of the Sinai Peninsula to St Petersburg in Russia, resulting in a 16-km-long wreckage trail in the middle of the Sinai Desert. On board were two flight crew members, five cabin crew members and 217 passengers, including 17 children. There were no survivors.

Annex 13 requirements

ICAO Annex 13 lays down the International Standards and Recommended Practices for the investigation of aircraft accidents and incidents. Many States refer to the ICAO standards in legislation, in effect making the standards legally binding. In accordance with Annex 13, the State of Occurrence is responsible for conducting the investigation. In this case, as the in-flight break-up occurred over the Sinai Desert, the responsibility for the investigation rested with the Central Directorate of Aircraft Accident Investigation at the Ministry of Civil Aviation of the Arab Republic of Egypt. However, also in accordance with Annex 13, the State of Registry, the State of the Operator, the State of Design and the State of Manufacture are entitled to appoint accredited representatives (ACCREPs) to participate in the investigation.

AAIU participation

Within hours of the event occurring, AAIU inspectors met at the offices of the AAIU in Leeson Lane in Dublin, to formulate a response. Immediate assistance was offered, via email, to the Egyptian Ministry of Civil Aviation.

John Owens, an engineering inspector with over 25 years' experience in commercial aviation, including experience on Airbus aircraft, was proposed as the accredited representative (ACCREP), and Kevin O'Ceallaigh, a pilot with over 25 years' experience in military aviation with extensive experience of foreign deployments, was proposed as an advisor to the ACCREP. The Irish Aviation Authority also nominated an adviser. While awaiting a response to the offer of assistance and due to the logistical difficulties in obtaining visas over a weekend, it was decided to delay deployment until Monday, 2 November 2015. In the interim period, there were a number of tasks to be completed prior to travelling to Egypt.

Threat assessment – an Irish perspective

Once notification from the Egyptian authorities was received, a process to identify and assess the potential threats, hazards and risks to the AAIU investigators during the deployment commenced. This process would enable an informed decision on whether to launch a team.

The risk assessment process is by now familiar to most aviation professionals. For the air accident investigator this process concentrates mainly on the specific hazards that can be encountered at the accident site location. However, this process is conducted within a strategic environment where the investigator's personal security and

(1) **Article 83 bis:** This Protocol provides for the transfer of certain functions and duties from the State of Registry to the State of the Operator.

safety is a general assumption. This assumption increasingly needs to be examined when an investigator travels to an accident site. Recent events such as MH17 in Ukraine, and Dallo Airlines DAO159 near Mogadishu in 2016 demonstrate that the investigator must consider the wider strategic environment as part of the decision to deploy to a site which may be located in the midst of a geopolitical crisis or conflict.

Photo No 1: accident aircraft: Airbus A321

Threat, hazards and risks

An assumption is often made that object-related risks are associated with hazards, whereas human-related risks tend to be considered a threat. Hence the terms hazard and threat are often used interchangeably. However, this simplification does not recognise the main difference between a hazard and a threat: the activity of the hazard. To reference an analogy by Bruce Newsome [2], "To a person on a riverbank, the river can be deemed to be a hazard. However, if the river floods and overflows its banks it has become a threat as its activity state has changed, even though the person on the riverbank has remained inactive." It can be seen from this that threat is a measure of the hazard's activity level and its potential to harm the investigator.

Conducting the threat assessment

For the Sinai deployment, the challenge was not only to assess the anticipated risks at the accident site, but also the overall threat to the team during the deployment. To achieve these dual goals, the team relied on their training and experience in threat assessment, combined with prior participation in United Nations peacekeeping missions in Lebanon, Chad and the Golan Heights. The assessment focused on three main areas: *weather, opposing elements* and *terrain,* which were then subdivided into specific categories that could be analysed to inform a decision. It should be recognised that, as with the risk cycle, once the initial threat is assessed, the process repeats when new information is introduced or when original assumptions have been superseded.

The assessment was concerned with how a potential threat would attempt to interact with the team. While much of the initial information was open-source, it was also helpful to have contacts with other State organisations that could provide additional analysis to the team. It was recognised that in the early stages of such an assessment, there will be many unknowns. The challenge is to identify gaps in knowledge and to understand the difference between assessment, analysis and speculation in order to make an informed decision.

The decision-making process

Once the analysis of the various factors was completed, the team needed to discuss and agree a final decision for each element of the threat assessment. This decision process also included the identification of critical information requirements (CIRs). A CIR is a piece of information that the team **must** have in order to make a final decision on the threat.

WEATHER

The decision of the team was that the initial threat posed by the weather conditions was assessed as LOW.

OPPOSING ELEMENTS

Prior to deployment, television media outlets broadcast the presence of friendly military forces at the accident site. However, the threat was initially categorised as MEDIUM based purely on an absence of detailed information about the strength, composition and capabilities of these forces. This formed a CIR which also included information on the general security arrangements for the team when not on-site. Until that information was available, the team could not decide if it would travel to the accident site. However, it was considered that travelling to Cairo represented a LOW threat so it was agreed to deploy to Cairo and update the overall threat assessment upon arrival.

TERRAIN

This threat was initially assessed as LOW to MEDIUM. The CIR was identified as the mode of transport being used to move the teams to and from the accident site and how the threat of attack would be mitigated. While road travel seemed impractical and unlikely, helicopter transport introduced a potential ground-based threat during transit. This CIR also included the team's selection of routine local transport each day.

The final decision was made to deploy to Cairo initially but not to deploy to the accident site until the CIRs identified during the threat assessment were answered satisfactorily.

(2) Newsome, B. (n.d.), *A Practical Introduction to Security and Risk Management.* 1st ed.

The AAIU has a Memorandum of Understanding (MOU) with the Irish Department of Defence, which includes the provision of air transport, if available, for inspectors of air accidents to airports outside Ireland. The chief inspector of the AAIU made a formal request for military transport during this deployment and this arrangement ensured a smooth and swift deployment of the team and the associated investigation equipment.

Completing the cycle

Upon arrival in Cairo, the team met with other investigation team members some of whom had already visited the accident site and were therefore able to update the threat assessment in real time. The *weather* and *terrain* elements of the initial threat assessment proved to be accurate. The *opposing elements* concerns were addressed through the provision of an Egyptian protection force at the accident site with a lightly armoured escort during local travel between evidence sites along the wreckage trail. The possible threat to helicopter transport from ground fire was mitigated through the provision of an airborne escort during helicopter flights to and from the accident site. The team hotel had internal and external security. It was agreed that these mitigations reduced the threat to LOW and the decision was taken to deploy to the accident site the following day.

The investigation team

The multinational investigation team in Cairo ultimately comprised 29 investigators from Egypt (State of Occurrence), 6 from the BEA [3], France (State of Design), 2 from the BFU [4], Germany (State of Manufacture), 7 from IAC/MAK [5], representing Russia (State of the Operator) and 2 from AAIU Ireland (State of Registry). In addition, there were several advisers from Airbus (the aircraft manufacturer), one adviser from Ireland (representing the Irish Aviation Authority) and one adviser from the European Aviation Safety Agency (EASA). Most of the investigation team stayed in the same hotel - ensuring the use of a single hotel is important when deploying to a major accident site in terms of transport to and from the site and for subsequent investigative group work.

The accident site

The main wreckage site was located approximately 265 km east of Cairo International Airport (Figure No 1). Egyptian military personnel and, due to the large number of Russian citizens who lost their lives, a comprehensive Russian emergency response team, had assembled extensive camps at the main accident site (Photo No 2). Additional camps had also been set up by the Egyptian military at other areas along the main wreckage trail.

Transport to the accident site for the investigation team was arranged by the Egyptian Central Directorate of Aircraft Accident Investigation, including road transfer from the hotel to a military air base, near Cairo, from where helicopter transport to the main wreckage site was provided by the Egyptian Air Force. Upon reaching overhead the Suez Canal, the Egyptian Air Force provided additional airborne security for the helicopter as it continued its journey across the Sinai Desert. The helicopter journey time was approximately 80 minutes. Egyptian military and Russian emergency response four-wheel-drive vehicles provided transport between the main wreckage site and other parts of the aircraft distributed along the lengthy wreckage trail.

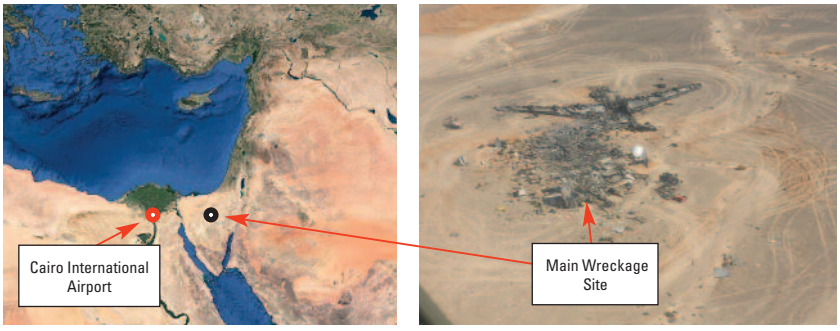


Figure No 1: main accident site, located in the Sinai Desert, approximately 265 km east of Cairo International Airport (AAIU)

Photo No 2: camps at the main wreckage site (AAIU)

(3) **BEA:** *Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile.*
(4) **BFU:** *Bundesstelle für Flugunfalluntersuchung.*
(5) **IAC/MAK:** Interstate Aviation Committee/*Межгосударственный авиационный комитет.*

Accident site hazards

On any aircraft accident site, investigators need to be mindful of the many hazards that may be present that could adversely affect the safety of personnel working at the site. Such hazards are generally classified as *environmental, physical, material, biological* and *psychological.* In the Sinai Desert, risk assessment was dynamic in that it involved a continuous process of identifying hazards, assessing risk, taking action to eliminate or reduce risk and monitoring and reviewing the situation. The following hazards were present and needed to be considered:

ENVIRONMENTAL

• WEATHER

Due to the constant sunshine, protection cream, sunglasses and hats were required. However, the temperature was manageable, with temperatures ranging between 20° C and 25° C.

• NOISE

Helicopter transport, especially during boarding and disembarking, necessitated the use of hearing protection.

• REMOTENESS

Notwithstanding the support provided by Egyptian Investigators, the Egyptian military and the Russian emergency response team, the remoteness of the site meant that each investigator needed to be self-sufficient, particularly with regard to food and water supplies.

Wind was constantly present in the desert. Therefore, dusts masks were required, due to airborne sand and dust. This was especially the case at the main wreckage site, where the fuselage and wing section were severely burnt, and during helicopter disembarkation and boarding at the site.

• WILDLIFE

The Sinai Desert is home to several venomous snakes, scorpions and spiders. Investigators needed to be mindful of this, especially when looking under pieces of aircraft wreckage.

PHYSICAL HAZARDS

Numerous physical hazards were also present, including sharp edges, entrapment hazards and pressurised vessels such as oxygen bottles, and emergency slide deployment bottles.

MATERIAL HAZARDS

Several parts of the aircraft are manufactured from composite materials, including the aircraft flaps, which, when damaged, can prove hazardous to investigators, particularly when the parts have been burned. In this case, the forward fuselage section and the wings suffered extensive fire damage, resulting in high concentrations of carbon fibre reinforced plastic (CFRP) dust/particles at the site of the main wreckage (Figure No 2). The wearing of appropriate dust masks at all times was therefore essential.

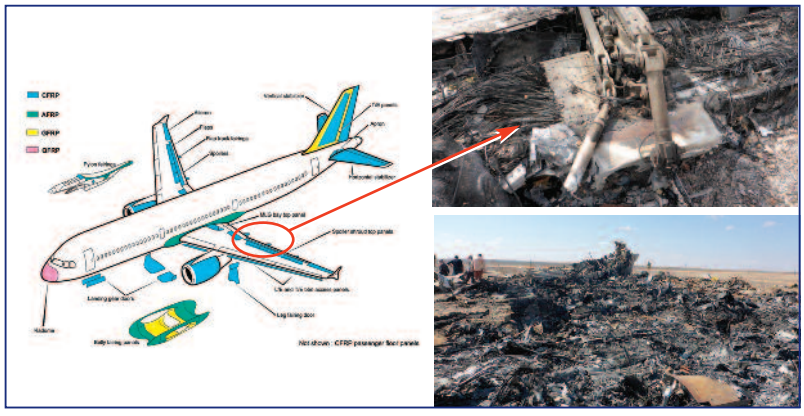
BIOLOGICAL AND PSYCHOLOGICAL

The usual biological and psychological hazards were present.

Conclusion

This was the worst ever occurrence involving an Irish-registered aircraft and due to the number of fatalities, the remoteness of the site and the lengthy wreckage trail, the response to it proved to be challenging for all involved, including the AAIU.

The investigation, which is being conducted by the Central Directorate of Aircraft Accident Investigation at the Egyptian Ministry of Civil Aviation, is ongoing. A Preliminary Report was issued in December 2015. An Interim Report, dated 31 October 2016, was also issued. Both reports are available on the Egyptian ministry's website. ■



© Airbus

Figure No 2: Aircraft composite parts and fire damage

Kevin O'Ceallaigh is an operations inspector with the Irish Air Accident Investigation Unit (AAIU). He previously served for 29 years in the Irish Defence Forces as a military pilot. He has also served with the United Nations Department of Peacekeeping Operations in New York, the Central African Republic and Chad, where he served as the chief of military air operations in 2009. Mr O'Ceallaigh retired as a lieutenant colonel and head of flight safety and joined the AAIU in 2015.

John Owens, see biography on page 7.

The French experience in international cooperation and support

Philippe Plantin de Hugues
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Established in 1946, the BEA *(Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile)* is the French safety investigation authority in charge of conducting accident and serious incident investigations in accordance with ICAO Annex 13 and Regulation (EU) No 996/2010. The BEA is attached to the French transport ministry. By law, in order to guarantee the independence of the investigations, the BEA can neither receive nor request instructions on the conduct of investigations.

France has a large number of airports and airfields creating a dense network. Most of them (more than 400) are open to general aviation, and most of them are state-owned. The Alps are one of the most appealing areas for gliders attracting pilots from many European countries. France has a long history linked to aviation. This has resulted in more than 8500 aircraft possessing a valid French airworthiness certificate and more than15 000 ultra-lights with valid ID cards. As a consequence of this high level of aviation activity, there is a need to investigate accidents and incidents: in 2016, the BEA initiated 116 new investigations following accidents or incidents occurring in French departments and overseas territories in public transport, general aviation and aerial work.

When an event occurs abroad and involves France, in accordance with the provisions of Annex 13 the BEA can be nominated as an accredited representative of the French State, and predominantly as the State of Design or Manufacture. The delivery of Airbus's ten thousandth jetliner is a major achievement in the aircraft manufacturer's ongoing story, beginning more than 40 years ago. The aircraft manufacturer, ATR, with a 35-year history, delivered its one thousand five-hundredth aircraft, and more than 12 000 Airbus helicopters are currently in service. Thus, in 2016, the BEA represented the French State in 275 new investigations conducted by foreign States. The French government anticipated the large number of French-manufactured aircraft flying around the world. The BEA was developed with sufficient human resources and funding to perform the task of in-depth safety investigation and read-out of all western-type recorders or avionic systems. In addition, the engineering department staff developed its capabilities not only to perform read-outs of the various on-board avionic systems but also to develop state-of-the-art software and hardware systems in order to download data from all on-board systems with the highest safety data protection. The use of these capabilities in foreign investigations has in turn led to extending the BEA's international cooperation activities. This article describes the BEA's activity on the international scene in sharing its experience in the various fields of safety investigation.

Sharing of experience

International activity is important for the BEA, and it is by "knowing and trusting each other" before an event that cooperation in a crisis situation can be greatly facilitated. In addition, when a foreign authority calls on the BEA's expertise, the BEA offers technical assistance – predominantly in the field of flight recorder read-outs. More and more accident investigation authorities (AIAs) are developing their own laboratories with capabilities to read out damaged or undamaged flight recorders. The constant objective of the BEA staff is to share their experience in flight recorder opening to help colleagues worldwide enhance their capabilities whilst ensuring maximum protection of the flight recorder data.

Nevertheless, the sharing of expertise is not only reserved to the engineering department. The BEA, through its involvement in a large number of events, integrates on-the-job training (OJT) in the training curriculum of its young investigators. In many States, the AIA has a limited number of permanent staff and they are fortunate enough not to have to face many major accident investigation cases. The BEA does its best to share its experience in this field, accepting OJT training at BEA headquarters for colleagues from other AIAs who are capable of speaking French to allow a better integration among the BEA staff. The trainees share experiences through presentations, discussion and demonstrations by BEA investigators, and attend the BEA's daily meetings.

ECAC workshop on underwater recovery operations, Lanarca, 18-20 October 2010

Multilateral cooperation

The BEA involvement on the European and international scene also includes participation in international conferences, setting up cooperation with foreign investigation authorities, organising training seminars abroad and participating in working groups in international organisations (in particular ENCASIA (European Network of Civil Aviation Safety Investigation Authorities), ECAC's Group of Experts on Accident Investigation (ACC) and ICAO). The aim of such international outreach activities is also to make the BEA's abilities better known abroad and to present the main reports published in order to spread the safety lessons for investigations led by the BEA or to which it contributed.

ECAC's Group of Experts on Accident Investigation was established in 1991 and chaired by Paul-Louis Arslanian (BEA). It assembled the AIAs in the European Union and from the 44 ECAC Member States. ACC also benefits from the participation of observers representing the European Commission, the European Aviation Safety Agency, the Interstate Aviation Committee of the Commonwealth of Independent States, the United States National Transportation Safety Board (NTSB), the Transport Safety Board (TSB) of Canada, aircraft manufacturers, IATA and IFALPA. The ACC group paved the way for the enhancement of regulatory texts. In particular, European representatives jointly prepared key ICAO AIG (Accident Investigation) divisional meetings (1992, 1999 and 2008). Thanks to internal discussions, the robust ACC proposals were frequently taken on board by the meetings and greatly contributed to the improvements to Annex 13 and associated guidance documents. The ACC workshops have also helped to further develop a common approach and guidance material on a number of technical subjects: safety recommendations (Greece 2006), seasearch operations (Croatia 2009, Cyprus 2010), the treatment of incidents (Denmark 2012), extreme and challenging environments (Switzerland 2014).

In any accident investigation, access to the site of the accident and to the wreckage is a first priority. When an aircraft comes down in the sea, the question of access to recorders, aircraft computers or wreckage can become problematic in itself, calling for a well-planned and rapid response, coordinated among the various countries involved. With an average of one or two accidents to large transport aircraft over water per year, there is a crucial need for a comprehensive overview of the procedures and equipment needed for effective responses to aviation accidents with an underwater dimension, by the sharing of learning and personal experience through practical exercises. After leading or participating in ten recoveries of flight recorders over the last ten years following high profile accidents, the BEA recognises the utmost importance of these searches. ACC organised two workshops (Dubrovnik in 2009 and Larnaca in 2010) on the special challenges relating to the location and recovery of aircraft and flight recorders under water. These two workshops, and another organised by Singapore, were the bases for the development of the guidance document Guidance on the Underwater Location and Recovery of Aircraft Wreckage and Flight Recorders, published by ECAC in 2013. The intent of this document was again to spread the community's experience around the world. The ECAC Code of Conduct on Cooperation in the Field of Civil Aviation Accident/Incident Investigation emphasises the need for cooperation and mutual assistance, and this document is another very good example.

In addition to ACC, there are other groups dedicated to accident investigation matters although within a narrower geographical scope. In particular, ENCASIA created a sub-group with the task of promoting mutual assistance within the framework of Regulation (EU) No 996/2010. The BEA actively participates in these activities as well.

ACC is a working body able to adopt broad general positions, rather than a decision-making entity. ENCASIA and ACC complement each other through careful coordination in order to prevent duplication in their activities. Aviation safety is enhanced through this cooperation and the establishment of improved accident investigation procedures.

Bilateral cooperation

Implementation of ICAO Annex 13 Standards and Recommended Practices (SARPs) leads many States to ask the BEA for advice and assistance. As many States have limited capabilities for the playback and analysis of flight recorder information (both voice and data), ICAO invites States to anticipate the best way to perform the analysis and consequently to request assistance from other States. It is therefore essential for the accident investigation authority of the State conducting the investigation to make timely arrangements to read out the flight recorders at a suitable read-out facility.

BEA Director Rémy Jouty with Romanian counterpart Nikola Stoica, Director of the Civil Aviation Safety Investigation and Analysis Center (CIAS) during the signature of the Memorandum of Understanding between their two organisations, September 2016

In order to facilitate the free exchange of information and to promote partnerships in safety investigations, the BEA has signed Letters of Intent on Cooperation with its counterparts in 40 States. These agreements allow the BEA to provide assistance in case of a request, as well as sharing its knowledge and expertise with other safety investigation authorities. Furthermore, these agreements facilitate the conduct of safety investigations in which both States may be involved.

ICAO SARPs amendment related to location of aircraft

The international cooperation promoted by the BEA in the location of an aircraft in distress arising from the AF447 and MH370 accidents resulted in the publication of ICAO SARPs in 2016. The SARPs issued are once again proof of the strength of cooperation. Indeed, in 2010 the BEA led an international working group with more than 150 members to assess the technical feasibility of triggering the transmission of data on indication of a distress situation in order to help locate wreckage after accidents to aircraft over maritime or remote areas. The working group was composed of a wide range of actors: investigation bodies, regulatory authorities, airframe manufacturers, service providers, equipment and satellite manufacturers, and international associations. Aircraft flight parameters can be analysed in real time by onboard equipment, and the use of triggered data transmission by means of logic equation is a complex mechanism. Such systems have already been developed and deployed with airlines for maintenance and monitoring purposes. Nevertheless, to limit non desirable Search And Rescue operations, the robustness of the triggering system had to be demonstrated. The sharing by various AIAs of flight data from real accidents and incidents, to which the BEA had access thanks to its large international experience, was the only way to prove that criteria based on a limited set of recorded flight parameters can detect 100% accidents and incidents of the database created. The work of this group, supported in particular by the European AIAs, led to the development of specifications for the trigger criteria and to the creation of SARPs issued in 2016 in direct line with the results of the work of the BEA working group.

Conclusion

Ongoing contact between investigators to share experience and cultural perspectives is the best way to prepare for the massive workload and challenging issues caused by a major disaster. The exchange of information between investigators, industry and operators through conferences and workshops is important to prepare for new technologies that will make information available worldwide. Strong cooperation between accident investigation authorities is a key factor for the amendment to ICAO SARPs on complex technical issues. Through its active involvement in international cooperation in these various areas, the BEA is demonstrating its commitment to improving aviation safety. ■

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Social and family assistance aspects in safety investigation

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Commercial aircraft accidents are fortunately very scarce but when they cause multiple fatalities they generate a shock wave in the State of Occurrence as well as abroad, in particular in the States having suffered fatalities to their citizens. Expectations in the aftermath of the accident are always very high. Aviation professionals want to know if preventive measures must be immediately taken, while society at large wants to express compassion and emphasise that such accidents are unacceptable! Safety investigations into accidents and incidents are a fundamental part of the aviation system. They provide validated and comprehensive data to the decision makers as well as incentives to improve safety through recommendations. During the investigation process, safety investigators interact with individuals from various backgrounds, including accident victims and their relatives. Prior to unfolding the different phases of the investigation process, the most important phase has always been: PREPARATION.

This article addresses international developments in which the BEA was involved that aim to better prepare safety investigation authorities (SIAs) to respond to a major aviation accident when dealing with social aspects. It complements the article on page 20 entitled "The French experience in international cooperation and support", which highlights technical aspects through international cooperation. Here, the social aspects and their respective challenges will be put in perspective through European activities. In particular, this article will stress emergency plans at national level with a focus on assistance to air accident victims and their relatives. It will also address the initiatives on facilitation in this domain where ECAC has been instrumental through the organisation of two recent workshops.

The growing challenges related to social aspects

The social aspects are the non-technical ones that complement the technical actions conducted by safety investigation authorities after an accident. They notably encompass interactions with:

- Victims/families (relatives [1])/ colleagues
- Political leaders
- Media/the public
- Legal/insurance individuals and organisations.

This social dimension has grown in importance and visibility and become more and more demanding with each succeeding year.

Workshops, training, conferences, etc. represent very useful vectors to share experience and procedures in order to further improve the efficiency and effectiveness of the accident response.

Assistance to air accident victims and their relatives

In October 2000, the ECAC Accident and Incident Investigation Expert Group (ACC), chaired by the former BEA Director, Paul-Louis Arslanian, organised the first symposium on assistance to victims of aviation accidents and their families in Tallinn, Estonia. About 100 representatives from governments, airports, airlines and families of victims attended that event. It took place in the aftermath of the Concorde accident and in a State that had been strongly influenced by the disaster of the ferry *Estonia* on the Tallinn-Stockholm route in September 1994, which killed 852 people out of the 989 people on board.

During these years, at the international level ICAO and the European Union had been active. The last ICAO Assembly on the matter decided (Resolution A32-7) that a circular on family assistance would be prepared by the Secretariat. That circular [2], which was in its final stages, was presented and discussed during the symposium. Hans Ephraimson-Abt from the American Association for Families of KAL007 victims gave the perspective of the bereaved family associations. He later established a unified movement to aid air acci-

(1) EU legislation refers to *relatives* while ICAO documentation mentions *families*. This is because there is no uniform definition of "family" amongst the EU Member States.
(2) Circular 285 (guidance on assistance to aircraft accident victims and their families) was issued in 2001.

dent victims' families. Another important milestone was the International Conference on Air Law and the Convention on the Unification of Certain Rules for International Carriage by Air signed in Montreal in May 1999 that modernised the liability system and addressed financial compensation of accident victims. Subsequently, the European legislation [3] was amended to include provisions on timely financial assistance to meet some of the immediate needs of those having been affected by an accident.

In 2010, the European Parliament and the Council adopted more provisions related to the assistance to victims of air accidents and their relatives in Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation. These requirements covered the following topics:

- Psychological assistance for victims and their relatives
- Availability of a list of all the persons on board in a two-hour maximum deadline
- Possibility of indicating an emergency contact person
- Information to victims and their relatives on the investigation progress
- Designation of a contact point for families
- Obligation for Member States to establish emergency plans
- Obligation for airlines to establish crisis plan
- Obligation of minimum insurance for the compensation of victims and their families.

In 2013, ICAO published the first edition of the ICAO Policy on Assistance to Aircraft Accident Victims, which recommends that States reaffirm their commitment and establish legislation to ensure that adequate and sufficient assistance is provided to aircraft accident victims and their families.

Civil aviation emergency plans at national level

Article 21 of Regulation (EU) No 996/2010 requires the establishment of a civil aviation accident emergency plan at national level, which shall also cover assistance to the victims of civil aviation accidents and their relatives. To help Member States harmonise procedures on this subject, in January 2014 the European Commission organised a dedicated workshop on civil aviation emergency plans at national level. Member States and stakeholders shared good practices and underlined the need to develop additional guidance. It was noted that the "Member States that have faced major civil aviation disasters have, based on their experience, reinforced their procedures in relation to their national emergency plans and notably regarding the assistance to the victims and their relatives." On the other hand, a number of Member States reported having experienced some difficulties in relation to their administrative structure. For example, for those structured around regions, the coordination of a unique plan or of consistent plans at regional level has been very challenging. Other challenges can be geographical location and language barriers when the authorities have to deal with victims and their relatives with various nationalities and cultural backgrounds.

When the Commission reviewed Regulation (EU) No 996/2010, many SIAs reported that they did not find Articles 20 and 21 appropriate in the Regulation. These provisions are addressed at the level of the Member State while the rest of

(3) Regulation (EC) No 889/2002 of the European Parliament and of the Council of 13 May 2002 amending Council Regulation (EC) No 2027/97 on air carrier liability in the event of accidents.

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The President of the French Republic François Hollande, the German Chancellor Angela Merkel and Spanish Prime Minister Mariano Rajoy, gathered near the crash site the next day to express their solidarity. Like safety investigators, the three heads of States rushed towards the crash site. They wanted to be present with the victims' relatives and to express the condolences of their respective countries. This short time interval (24 hours after the event) highlights a new political and media dimension for safety investigators. It is likely that for future major civil aviation accidents in Europe, political leaders will replicate this situation. Safety investigators and the other responders deployed on site have to be prepared in order to address the logistical, media and other challenges related to the presence of political leaders. The Germanwings flight 9525 crash is a watershed case, in particular regarding this new political dimension of the safety investigation.

the Regulation is about safety investigations. For example, it could imply that SIAs should produce the list of passengers or develop assistance plans. Nevertheless, the Commission SWD [4] on the implementation of the Regulation puts strong emphasis on the need for preparation. It is crucial that a major accident should be treated with the same level of efficiency and effectiveness wherever it occurs in the Union. It cannot be excluded that certain Member States, which until today have not faced a major accident on their territory, may not be sufficiently prepared to face the challenges raised by such a disaster.

Therefore, the Commission and the Member States have continuously supported preparatory activities and peer review exercises, and fostered cooperation at the level of the European Network of Civil Aviation Safety Investigation Authorities (ENCASIA). Regarding these overarching emergency plans at national level, the Commission has studied possible synergies, like the ad hoc committee dealing with civil protection in the Member States.

These plans have in common to address a tragedy caused by a civil aviation accident with strong emphasis on assistance to victims and their relatives.

Towards European guidance material

In August 2015, the social aspects were specifically addressed during the tutorial/workshop organised in conjunction with the ISASI [5] International Annual Seminar held in Augsburg, Germany, on the theme "Independence does not mean isolation".

The event brought together people with various backgrounds, in particular safety investigators, regulators, industry actors, communication/media specialists, insurers and accident victims. It endeavoured to understand how accident victims and their relatives cope with sudden death during the investigation process. During the workshop, the BEA provided its feedback on the use of the new ICAO guidance with emphasis on the role of a national coordinator, who has interfaces with all entities. When dealing with the progress of the safety investigation, it is important that where possible, families are directly informed by the SIA responsible for its conduct.

The workshop recommended the development of a practical guide in the form of a manual or leaflet. This guide was to be specifically prepared for victims and their relatives to facilitate their understanding of the role and the different phases of a safety investigation, as well as its relationship with the other entities involved in dealing with the accident. ENCASIA included this recommendation in its 2016 Work Programme [6]. Subsequently, an ad hoc working group has developed two specific documents:

1) The leaflet, which is a practical guide on safety investigations for air accident victims and their relatives, describes the main milestones of the investigation of accidents to commercial air transport aircraft and explains to the victims and their relatives the role of a safety investigation authority.
2) The memo, specially prepared for safety investigators, aims at helping them to interact with air accident victims and their relatives during the different phases of the investigation.

The leaflet was subsequently presented and discussed in the following two ECAC workshops.

ECAC Workshop on Social Communication Associated with the Air Accident Investigation Process

ECAC Workshop on Social Communication Associated with the Air Accident Investigation Process: The Hague, Netherlands, 10 May 2016

To address some of the above-mentioned challenges, the ECAC Accident and Incident Investigation Expert Group (ACC) organised a workshop on social communication [7] to focus on the non-technical aspects of communication in the investigation process of an aviation disaster. The following topics were covered:

- The organisation of communication and potential issues (i.e. accident investigation authorities, government, national emergency plan).

(4) SWD (2016) 151 final: Commission staff working document on the implementation of Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation. Available at: https://ec.europa.eu/transport/sites/transport/files/modes/air/safety/accident_investigation/doc/swd%282016%29151-part-1-of-2.pdf
(5) International Society of Air Safety Investigators.
(6) https://ec.europa.eu/transport/sites/transport/files/2016-work-programme_en.pdf
(7) That workshop echoed the workshop on "Communication Associated with Aircraft Accident and Incident Investigations" organised by TAIEX and ECAC in Bucharest in May 2005.

ECAC Workshop on Assistance to Victims of Air Accidents and their Families

- Communicating with victims of air accidents and their families, with an emphasis on meeting their expectations.
- Managing media expectations and the impact of social media on the investigation.
- The balance between the need to inform third parties (e.g. media, families) and the need to maintain the integrity of the investigation.
- Best practices for developing communication plans and media strategies.
- The concept of confidentiality and its meaning when defining a communication strategy.
- Challenges associated with communicating with judicial authorities.

The workshop, chaired by Jurgen Whyte (Chief Inspector of the Air Accident Investigation Unit of Ireland), took place in The Hague, Netherlands, in May 2016 at the invitation of the Dutch authorities. The Dutch Safety Board explained its communication actions to next of kin and media during the MH17 investigation. The BEA also shared some lessons learned from recent accidents, involving close collaboration with international counterparts. The perspectives of airlines, manufacturers, politicians and journalists, amongst others, were discussed. The draft ENCASIA leaflet was also presented and benefited from the feedback of the participants.

(8) In October 2016, the Assembly directed the Council to give further consideration to the development of standards in its Resolution (A39-27) on assistance to victims of aviation accidents and their families.

ECAC Workshop on Assistance to Victims of Air Accidents and their Families: Malaga, Spain, 9-10 June 2016

In June 2016, ECAC organised another workshop entitled "Assistance to Victims of Air Accidents and their Families", in Malaga. It was moderated by the chair of ECAC's Facilitation Working Group, Frédéric Rocheray (Federal Office of Civil Aviation, Switzerland), and was preceded by an emergency drill at Malaga airport, which involved the respondents to an air accident (airport staff, police, fire brigades.)

Victor Aguado, the Representative of Spain on the ICAO Council, drew attention to a draft Spanish working paper that would be presented at the upcoming ICAO Assembly. The Spanish initiative covered the new recommendation in Annex 9 (Facilitation): "Contracting States should establish legislation, regulations and/or policies in support of assistance to aircraft accident victims and their families". This new recommended practice became applicable on 25 February 2016. Spain asked for support to have it upgraded to a standard [8]. Marcus Costa, the ICAO representative, described the establishment of the Assistance to Aircraft Accident Victims Policy Task Force (AVPTF) in March 2012 and stressed how fast it had adopted the ICAO policy and updated the circular, compared to other ICAO processes. In particular, he highlighted a couple of provisions which put strong emphasis on the "purpose of accident prevention".

Martine Del Bono, BEA representative

During the workshop, the BEA representative (also a Member of the AVPTF), Martine Del Bono, addressed the interactions between safety investigation authorities and families' expectations. There are a number of challenges with families throughout the different phases of an investigation, in particular at the time of the publication of reports. It has been essential to make these reports easy to understand by victims and their relatives because they contain a large quantity of technical and complex information.

Like in The Hague a month earlier, the draft ENCASIA leaflet was presented and well received by the participants, in particular by the representatives of the victims' associations. The victims of the following accidents were represented:

- Flight SK686 on 8 October 2001 at Milan Linate, Italy: "8 October 2001 – So as not to forget"

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Presentation of the AH5017 Swiftair accident by BEA Director Rémi Jouty

- Flight JK5022 on 20 August 2008 at Madrid Barajas, Spain: "Association Affected Flight JK5022"
- Flight AF447 on 1 June 2009 in the Atlantic Ocean: *"Hinterbliebene der Opfer des Flugzeugabsturzes AF447"*
- Flight ED202 on 28 July 2010 at Islamabad, Pakistan: "Airblue Crash Affectees Association (ACAA)"
- Flight GWI9525 on 24 March 2015 in the French Alps: *"Asociación de Afectados del Vuelo GWI-9525".*

ENCASIA has initiated the process to make the leaflet available on its website in all EU languages and with the addition of a list of victims associations' websites.

In its conclusions, the chairman highlighted the achievements of the recent years and underlined the ongoing initiatives, such as the changes in Annex 9 and the upcoming publication of the practical guide.

Each year, ECAC updates Doc 30, Part I on Facilitation, which is the reference document that guides its Member States. As it is publicly available other countries and stakeholders can also use it. To encourage and further harmonise good practices, the 2017 release of Doc 30 will probably incorporate the leaflet "A practical guide on safety investigations for air accident victims and their relatives" in an appendix.

Conclusion

This article covers international and European initiatives where the BEA was directly or indirectly involved in improving the handling of the social aspects related to safety investigations. The new guidance material represents a concrete step in that direction. Of course, there have been additional initiatives focusing on family assistance with the same objective of reinforcing preparation and acknowledging the political importance of this subject.

Those who hold responsibilities must be aware and have full information on the requirement for States to be prepared and organised on this subject which does not allow for any improvisation.

It is worth restating that within the aviation system, safety investigations represent a key element in accident prevention, when carried out within a precise methodological framework and characterised by objectivity, impartiality, openness and international cooperation. The investigation aims to explain events and propose avenues of progress without apportioning blame or liabilities. ICAO Standards and Recommended Practices as well as Regulation (EU) No 996/ 2010 underline that the information to victims and their relatives shall be undertaken in a way which does not compromise the objectives of the safety investigation.

Air accident victims and their relatives may find some appeasement in the results of the investigation; in any case, this has been the hope of safety investigators, and a factor of motivation. ■

Olivier Ferrante has worked in the field of safety investigations since 1999 with secondments at the Transportation Safety Board of Canada (TSB), the United States Federal Aviation Administration (FAA) and more recently at the European Commission in the aviation safety unit. Between January 2012 and July 2016 he followed up the implementation of the European rules on the investigation and prevention of accidents and incidents in civil aviation (Regulation (EU) No 996/2010). In particular, he worked on the establishment of the European Network of Civil Aviation Safety Investigation Authorities (ENCASIA). He was also the policy officer responsible for the adoption of Commission Regulation (EU) 2015/2338 as regards requirements for flight recorders, underwater locating devices and aircraft tracking systems. He had previously been the head of the AF447 underwater recovery group.
Mr Ferrante is currently responsible for managing and developing the BEA strategic plan, which aims to address the new challenges of the safety investigation. Mr Ferrante is the chairman of the ENCASIA working group that deals with family assistance. He holds a master's in aviation engineering from ENAC (the French National Civil Aviation School), a graduate certificate from the McGill Institute of Air and Space Law (IASL) and a pilot's licence.

Study about the civil aviation search and rescue (SAR) service in Switzerland – conclusions for improving effectiveness

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In recent years, accidents involving general aviation aircraft in which it has been possible to locate the aircraft and recover the crew only after a considerable delay have repeatedly occurred in Switzerland. In the context of the safety investigation of these accidents, it has been established on various occasions that the organisations involved in the search and rescue service (SAR) have not been able to ensure swift search and rescue. It also became evident that even many experts and civil aviation users only had inadequate knowledge of SAR and its features. Therefore the Swiss Transportation Safety Investigation Board (STSB), in collaboration with the transport entities involved, has carried out a comprehensive study on the theme of SAR.

As a starting point the organisation and operation of the SAR service in Switzerland were described in detail, as such information was not readily available. To illustrate the procedures and the way the interfaces work, and to evaluate the effectiveness of SAR, several exemplary cases from recent years were examined in detail in the study. All of these cases have a distinct connection to SAR, though these connections can vary. Cases were deliberately selected from different aircraft categories and with different operational backgrounds. In the following, some essential elements of the study are briefly summarised and some safety advice or conclusions for improving effectiveness for both providers and users of the SAR service are compiled.

In the event of an accident, every minute counts for any survivors. The length of time from the accident to first aid at the site of the accident or to admission to a suitable hospital is the most important factor for chances of survival and prospects for recovery. The most urgent objective must therefore be to ensure that this duration is as short as possible, for both the persons involved and for the organisations involved in SAR from an operational viewpoint, in terms of optimum provision of their services. In all phases, both the service providers and the users of services can influence the time between the accident and rescue. The following indicates the contributions each individual and the organisations involved in SAR can make to improve effectiveness.

Service users

In general, rapid assistance from the SAR services is guaranteed if it is clear that assistance is needed and where it is needed. Therefore, in the event of an accident, the alarm should be raised immediately and should include the precise location of the accident. Those directly involved can contribute greatly by taking personal precautions.

For alerting SAR task forces after an aviation accident and for localising missing aircraft, ICAO has designated as a technical aid the installation of emergency location transmitters in aircraft, and it regulates their installation. After activation, emergency location transmitters transmit a distress signal that can be received by satellites, aircraft and ground receiving stations. On the internationally agreed emergency transmitter frequencies various alerting and localisation services are provided.

In addition, systems such as transponders, radio or Flarm [1] can enable important conclusions to be drawn about the history of the flight and the flight path. They have the advantage that they allow the flight path to be tracked retroactively, either completely or at least in part. But it must be borne in mind that these systems do not automatically trigger an alarm in the event of an accident. They can therefore serve only as complementary aids in any SAR action.

Small portable transmitters such as personal locator beacons (PLB) or satellite emergency notification devices (SEND) – not specifically developed for aviation – which must be activated manually in an emergency, can be used effectively on an individual basis as aids for SAR. Their alarm signals are received by satellites together with the current position of the device and are forwarded via a ground station to a mission control centre.

The future might involve systems that enable live tracking, such

(1) Editor's note: FLARM (acronym based on 'flight alarm') is the proprietary name for an electronic device used as a means of alerting pilots of small aircraft, particularly gliders, to potential collisions with other aircraft which are similarly equipped.

as Open Glider Network (OGN). Such systems would, for example, enable the SAR services to have web-based applications with a recording of the flight path in question at their disposal very rapidly.

Mobile telephones can be of great assistance to a SAR mission. The search area can be greatly restricted by means of an emergency search. If an IMSI-catcher (2) is used, in an ideal case localisation of the mobile telephone is possible. Special apps on smartphones also enable localisation of a mobile telephone, provided that the access data for the corresponding applications is known.

If a flight plan has been filed, the air traffic control alarm service automatically informs the SAR services of overdue aircraft. This fact should be exploited in a targeted manner by those directly involved even if no flight plan is mandatory, as for most VFR (visual flight rules) general aviation flights. On the other hand, discipline is required when declaring and closing flight plans such that false alarms are not triggered.

Flying groups and associations can set up effective local alarm systems at little expense. Take-off lists or local flight notifications with essential information about a flight can result in automatic triggering of an alarm subject to agreed criteria. In addition, every pilot should take precautions on a personal, individual basis that on the one hand can serve the purpose of triggering an alarm sub-ject to predefined criteria and on the other hand enable tracking the flight path. Information such as mobile telephone numbers, access data for localisation systems such as smartphones or SPOT Satellite Messenger, Flarm-identification code, emergency contacts, etc. should rapidly be made available for a possible SAR mission.

In Switzerland, a small country with well-established infrastructure coverage, rescue is generally not an issue. Once it is known that an event has occurred and the precise location is available, focused, professional assistance with adequate resources generally follows. However, a rescue mission can be made considerably more difficult by circumstances such as the weather and the terrain. This can lead to complex and therefore time-consuming actions. Apart from the personal precautions that are intended to contribute to minimising the duration between accident and initial treatment at the site of the accident, the necessary attention should therefore also be paid to personal equipment.

In a nutshell, the following safety advice to possible SAR service users was issued:

- Raise the alarm immediately: at the slightest suspicion of an aviation accident, inform the rescue coordination centre (RCC).
- Make arrangements that ensure the alarm is raised immediately and that it simultaneously includes the exact location of the accident.
- Leave traces that enable rapid and simple reconstruction by the SAR services.
- "One system is not a system!" Since individual provisions may remain ineffective, as many different arrangements as possible should be made in parallel.
- Prevent false alarms and report triggered false alarms to the RCC immediately!
- Gain time! First inform the RCC and only then make your own assessments in consultation with the RCC!
- It may take several hours for the rescue forces to arrive at the site of the accident. Personal equipment should allow several hours of survival unharmed at the site of the accident and should include aids to increase visibility.
- In almost impassable terrain, stay with the wreckage until the rescue services arrive.

Service providers

The SAR organisations must cooperate efficiently and purposefully. In the event of an ambiguous triggering of an alarm, where there are only signs or various indications of an accident, they must take the necessary steps to analyse and filter all the information. They must also recognise and eliminate false

(2) Editor's note: IMSI-catcher ('International Mobile Subscriber Identity') is a phone monitoring kit that provides active intercept capabilities.

Excerpt from STSD study on SAR

alarms. Rapid detection of genuine alarms or elimination of false alarms will always remain an essential task within the RCC, even if it proves possible to reduce the large number of false alarms (in Switzerland currently approximately 97%). RCC personnel can recognise the overwhelming majority of false alarms in a timely manner by making further enquiries. With regard to the remaining unclarified cases, the question arises as to whether the SAR services should in principle be alerted after a given time in order to save any endangered lives. The analysed cases showed clearly that RCC can recognise a genuine alarm more easily if information about an accident is received several times through different channels.

If the precise location of the accident is not known, the search must be organised in a targeted and coordinated manner, in order to be able to determine the exact location of the accident as rapidly as possible. Expertise and working techniques within the RCC are crucial for rapid search and rescue: assessing and classifying detailed information, deploying external specialists and resources from different organisations, interpreting and continuing to apply acquired knowledge correctly, and initiating the necessary measures in a focused manner: all this demands extensive aviation expertise in all areas of flying together with experienced RCC personnel.

In the race against time, the RCC must organise its coordination activities in such a way that the deployment of specialists and organisations, as well as its own investigations and decisions, can take place in parallel, as far as possible. Sufficiently skilled and experienced personnel plus the appropriate form of organisation are prerequisites for this. The delivery of SAR with its multilayered and complex operational procedures inevitably requires the cooperation of various specialists. These are often found in existing organisations which specialise in the provision of specific services.

The national civil aviation authority, as the SAR supervisory body, and the RCC, as the coordination centre of a SAR mission, therefore have the crucial task of organising the interfaces appropriately in advance and maintaining a constant exchange between the organisations. In an emergency, it must be possible to turn immediately and effortlessly to the organisations needed in each case and on their expertise.

For more complex SAR missions, a fundamentally different form of working in an interdisciplinary team at a common location would be conceivable. This would enable parallel working, direct exchanges, continuous interaction and critical enquiry, thereby leading to cross-fertilisation between the different organisations.

Conclusion

To summarise, the following can be concluded with regard to SAR service providers:

- The task of coordination in the RCC demands extensive expertise in all areas related to aviation.
- If necessary, deploy additional expert personnel, according to the situation.
- Expertise and working technique are especially critical for success in the RCC in the case of search operations which extend over a long time.
- When the situation is unclear, trigger an alarm after a predetermined period of time.
- In the case of complex SAR missions, an interdisciplinary team should work together at a common location.
- The basics for efficient teamwork in an emergency are regular exchanges of information between the SAR organisations, appropriate interfaces and practical exercises involving all participants in the interface. ■

Daniel W. Knecht is director of the investigation bureau at the Swiss Transportation Safety Investigation Board (STSB). In this role, he leads two divisions: one responsible for the investigation of accidents and serious incidents in civil aviation, and one dealing with accidents and incidents of railways, trams, funicular railways, inland boats and ocean-going vessels. Mr Knecht holds a master's in interdisciplinary sciences (physics, mathematics and chemistry) from the Swiss Federal Institute of Technology Zurich. He was trained as a fighter pilot in the Swiss Air Force, is a former commander of an air defence squadron and is still an active flight instructor on the Pilatus PC-7 Turbotrainer. Until now he has been an investigator in charge of more than 100 accidents and serious incidents of commercial air transport aircraft, large helicopters and all kinds of general aviation aircraft. Mr Knecht holds an active airline transport pilot licence for both airplanes and helicopters.

Outcome of the safety culture survey in the Greek civil aviation industry

Athanasios Binis
Chairman of the Hellenic Air Accident Investigation and Aviation Safety Board (AAIASB)

George Fassoulas
External advisor to the AAIASB

"Safety culture" is the term that identifies the way safety is perceived, recognised and prioritised within a system. Aviation is a system with a multitude of components, each having its own approach to identifying hazards, containing threats and achieving a safe level of operation. Each sovereign State is required to implement a State Safety Program (SSP) that in turn requires each aviation-related entity to establish a safety management system (SMS). In aviation, the different entities are constantly interacting so that the aviation industry can produce an end product with the required quality – or better, translated into aviation terms: expected safety. Do all of these components share the same values as those the legislator had in mind? Are all these product-quality values in line?

In an attempt to assess the safety culture within the Greek civil aviation industry, in mid-2015 the Air Accident Investigation and Aviation Safety Board (AAIASB), as an independent authority, conducted a survey addressed to all persons involved in civil aviation in Greece.

The survey comprised 29 questions targeting the commercial aviation sector, 25 of which targeted the general aviation sector. The questionnaire was drawn up from similar questionnaires used in past surveys conducted for Olympic Airlines (2006) and the Irish Aviation Authority (2011) or described in the Safety Culture in Air Traffic Management study (EUROCONTROL 2008 and 2013). Each question was carefully selected to address an aspect of the safety culture concept.

Participation in the survey was anonymous and all answers were completely nameless. The survey used only online questionnaire forms, was hosted on the Google Drive platform and used the Google Forms software.

The questionnaire was bilingual in order to facilitate the participation of non-Greek speaking persons active in Greek aviation. Besides the introductory page, the questionnaire included a demographic section, the main section comprising the questions, and a third part where the participant was able to add comments in free text format. The questions were answered using a "satisfaction or agreement" scale. All questions had a rating scale of ascending satisfaction or agreement from 1 to 4. The odd number of possible selections was not preferred, to avoid the convenient comfort of a neutral position.

The survey was open from 20 April to 15 June and was initially disseminated through posters in work places, information letters to safety managers, the AAIASB website, personal email notifications and systematic promotion through social networks (Facebook and LinkedIn). Participation averaged at 22 responses per day, with a daily high of 92 and a low of 3. Some reactions opposing the conduct of the survey were also noted.

Of the 1254 answers received, 20 had to be disqualified as they were either completely empty, or identical with a difference of less than 30 seconds in their logged submission time, or the entries in the demographic section were not adequate enough to establish the participant's direct connection with aviation. In any case, the number of disqualified answers did not affect the validity of the results.

A total of 171 free text comments were collected. Most of the comments provided positive feedback on the survey, with suggestions for future improvement. There were a lot of comments expressing concern about the effectiveness of existing SMS in Greek aviation organisations. A large number of comments were complaints about the lack of aviation infrastructure and the inadequate response of the country's public sector. A substantial number of comments highlighted the need for more frequent safety updates and more effective communication.

Sector	Population (estimate)	Answers	Confidence level	Margin of error
Hellenic Civil Aviation Authority	2700	317	95%	5.0%
Air operators	3500	246	95%	6.0%
Ground-handling services providers	3000	388	96%	5.0%
General aviation	1200	123	95%	9.0%
Miscellaneous (AIA, ATOs, MROs etc.)	1000	160	95%	7.0%
TOTAL	**11 400**	**1234**	**98%**	**3.5%**

Table 1

Given that the estimated population of the Greek civil aviation industry is 11 400 persons, the 1234 valid responses to the survey demonstrate a confidence level of 98% with a margin of error of 3.5%. Participation was deemed satisfactory and thus the collected results can lead to safe conclusions.

At the time of the survey, aviation industry sectors in Greece were considered to be air operators, ground-handling service providers, general aviation and the Hellenic Civil Aviation Authority, which incorporates the air navigation services provider and all the airport operators except Athens International Airport (AIA). All other aviation activities such as maintenance, repair and overhaul (MROs), approved training organisation (ATOs) and AIA were included in the miscellaneous sector due to the relatively small populations involved in these activities. The breakdown of the survey reliability per aviation industry sector is presented in table 1.

In order to facilitate the task of processing the results, for each question the average value of the collected answers was calculated for the entire population, for each individual industry sector and for the total population excluding the particular sector. The average value was then presented as a percentage of the rating scale taking as 0% the lowest grading value (1) and 100% the highest value (4). The threshold for excellent performance was set at 95% (or average value of 3.85) and the threshold for concern at 75% (or average value of 3.25). The goal of the survey, besides assessing the safety culture, was to compare the answers given by the different sectors of the industry and identify areas of convergence, but also most importantly to locate areas of significant divergence.

The unweighted average value of the collected answers is 3.3, placing the industry's safety culture at a slightly positive level, a position that can be interpreted as the system's readiness to accept actions and ideas that will push it to more positive grounds. On the other hand, this value also indicates that in the present aviation environment there are areas that need significant improvement. By calculating the safety culture index for each individual aviation sector the Hellenic Civil Aviation Authority has a value of 3.1, air operators 3.3, ground-handling services providers 3.5, the miscellaneous sector 3.4 and general aviation 2.9.

The initial evaluation of the results reveals that both the Hellenic Civil Aviation Authority and general aviation are below the threshold value that marks acceptable performance. On the other hand, the air operators sector, even though in a position slightly above the threshold for concern, has a long way to go to reach excellence - a strange situation considering that this sector was the first to make proactive safety principles either mandatory or voluntarily implemented, the latest being SMS (see table 2).

By assessing the individual SMS pillars, an understanding of the respondents' perception, acceptance and level of endorsement of the SMS principles can be construed. This assessment effort can be achieved through the combination of relevant question groups (see table 3).

For the country's entire aviation industry, the group of questions relating to **safety policy** and objectives averages 3.4, a value that reveals the respondents' perception of the level of the industry's commitment to safety. An overall high value reflects the considerable steps that have been taken towards safety, but at the same time it leaves ample room for improvement. It seems that even though SMS implementation is almost a decade old, it still has a long way to go before it gains the community's full and undisputed support. The

Sector	Safety culture
Hellenic Civil Aviation Authority	3.1
Air operators	3.3
Ground-handling services providers	3.5
General aviation	2.9
Miscellaneous (AIA, ATOs, MROs etc.)	3.4
TOTAL	**3.3**

Table 2

	TOTAL	HCAA	Air Ops	Grd Hdl	Misc	GA
Safety policy	3.4 (80%)	3.2 (75%)	3.4 (79%)	3.6 (87%)	3.6 (85%)	2.8 (60%)
Risk management	3.3 (75%)	3.0 (67%)	3.2 (74%)	3.6 (85%)	3.4 (81%)	2.7 (58%)
Safety assurance	3.0 (67%)	2.7 (56%)	3.0 (67%)	3.4 (80%)	3.3 (76%)	2.3 (42%)
Safety promotion	3.1 (69%)	2.7 (57%)	3.0 (67%)	3.5 (83%)	3.2 (74%)	2.6 (53%)
Training	3.4 (80%)	3.2 (73%)	3.4 (80%)	3.6 (88%)	3.6 (85%)	3.1 (72%)
Education	2.9 (62%)	2.4 (47%)	2.8 (59%)	3.1 (69%)	3.0 (68%)	2.0 (34%)

Table 3

lack of an SSP might explain the marginal 3.2 calculated for the Hellenic Civil Aviation Authority and the low value of 2.8 for the general aviation sector. The distribution of answers also indicates that a contributing factor might be the industry's over-regulation with its multitude of regulatory requirements and procedures.

Another disturbing issue revealed by the same analysis that needs to be addressed in order to reinstate safety policy's contribution to the SMS success is the underlying impression that in both the air operator and the general aviation sectors, procedural delinquency is encouraged, either by peer pressure in the working environment or by non-verbal managerial behaviour.

Following a comparable reasoning to assess the respondents' perception of **safety risk management,** a similar group of relevant questions was used and the resulting average for the entire industry was 3.3. For the sector of the Hellenic Civil Aviation Authority, the value was 3.0, for general aviation, 2.7 and for the air operators, 3.2. On the other hand, the ground services providers sector was 3.6. A more detailed analysis revealed that notions like hazard, threat, error and risk are not adequately clarified. The most important deficits seem to originate from deficiencies in the reporting system and from uncertainties about the system's ability to distinguish the difference between human error, gross negligence and deliberate delinquency.

Safety assurance is considered to be the third pillar of SMS. As a term it includes both the SMS internal quality process, and the validation of the system's safety goals and of the methods used for the operational risk assessment. The average for the entire aviation community was calculated at 3.0. This value is a clear indication for further action. There are sectors, like ground handling services providers, miscellaneous aviation activities (MROs, ATOs, AIA, etc.) where safety assurance scored 3.4 and 3.3 respectively. On the other hand, the Hellenic Civil Aviation Authority and the general aviation sectors scored 2.7 and 2.3 respectively, values that can be attributed to the lack of the SSP. Furthermore, the low value of 3.0 for the air operators indicates the possible existence of deeper causal factors for this discrepancy. By reference to the relative questions, it seems that delinquent behaviour sometimes goes undetected by the sector's safety assurance but does not go undetected by the sector's human resources, rendering the safety assurance unreliable in their eyes.

The fourth SMS pillar is **safety promotion.** Safety promotion is carried out through training and education. Safety promotion seems to be in a very low position for almost the entire country's aviation industry, as the average value was 3.1. Breaking it down, training was calculated at 3.4 and education at the extremely low 2.9, indicating that almost all the aviation industry is in need of educational actions to promote safety.

In order to understand the safety culture of the entire community, using the above reasoning, the safety culture elements were examined through groups of relevant questions (see table 4).

Informed culture indicates the level of understanding of the principles of threat identification, hazard containment and unnecessary risk avoidance. For the entire industry the calculated value is 3.1. With the exception of the ground-handling sector, it seems that almost all the other industry sectors are below the threshold.

Just culture indicates the human element mindset that dis-

	TOTAL	HCAA	Air Ops	Grd Hdl	Misc	GA
Informed	3.1 (69%)	2.8 (58%)	3.0 (68%)	3.3 (78%)	3.2 (73%)	2.7 (56%)
Reporting	3.2 (72%)	2.8 (61%)	3.1 (71%)	3.5 (85%)	3.4 (81%)	2.5 (49%)
Learning	3.2 (74%)	2.8 (61%)	3.2 (73%)	3.6 (86%)	3.4 (80%)	2.7 (56%)
Just	3.4 (80%)	3.4 (79%)	3.3 (76%)	3.6 (86%)	3.5 (83%)	2.9 (65%)
Flexible	2.9 (62%)	2.8 (59%)	2.7 (58%)	3.1 (69%)	2.9 (64%)	2.6 (53%)

Table 4

tinguishes between human error and deliberate delinquency. The overall value of 3.4 indicates that the human part of the system is well aware of the thin line between the different kinds of errors.

Reporting culture is the degree to which human resources feel encouraged to freely and voluntarily report hazards, difficulties and errors encountered during their operational functions. The overall value of 3.2 reconfirms the findings during the previous analysis about dysfunctions in the reporting system.

Learning culture is the measure of the human element's resistance to changes mandated by trend analysis, audit findings or investigation recommendations. The overall value is 3.2. Further investigation of the issue is closely related to trust in the reporting and the education system.

Flexible culture is the measure of the human element's resistance, adaptability speed and effectiveness level to changes that the dynamic evolution of the aviation environment mandates. As a general remark, the country's safety culture seems to be extremely low in flexibility. The calculated value of 2.9 reveals small variations over the entire spectrum and can be attributed to the inadequacy in the communication system across the entire span of the industry.

Overall conclusions of the safety culture survey

The overall conclusion of the safety culture survey may be summed up as follows:

Participation in the survey was satisfactory and the results obtained led to reliable conclusions (high levels of trust and small margins of error) for most of the main sectors of activity in the Greek aviation industry.

Safety culture in Greece is at a positive level but there is a lot of room for improvement.

General aviation results deviate from those of the total civil aviation industry both within the SMS pillars and also for the safety culture elements.

There is a lot of room for improvement across the aviation industry in the safety promotion area, both in training and education. Also, the survey recognised the critical role of safety promotion in aviation safety.

Safety culture's level of flexibility is low and this can by attributed to the low level of communication and its lack of effectiveness within the entire span of the industry. There is a lot of room for improvement in the reporting system, for follow-up actions and in the feedback loop.

The upcoming privatisation of 14 major airports, the independence of the air navigation services provider from the Hellenic Civil Aviation Authority and the reform of the Hellenic Civil Aviation Authority organisation chart are the major reforms the Greek aviation industry will see within the year. AAIASB has established a series of regular safety-related events targeting the general aviation sector and a series of regular safety industry-wide meetings in order to establish sound communication links within the aviation community. The effects of the ongoing events and upcoming reforms to the country's safety culture will be assessed with the next safety culture survey that is planned for 2018. ■

Athanasios Binis has been chairman of the Hellenic Air Accident Investigation and Aviation Safety Board (AAIASB) since February 2014. He is a graduate engineer of the National Technical University of Athens and has a master's in business administration. He also holds a Part 66 B1 & C Aircraft Maintenance Licence. He has been working in the aviation industry for nearly 30 years (since May 1987), the majority of which (22 years) was spent in the technical operational department of the former Olympic Airways. His last position was as the production planning and performance control director. Following his career at Olympic Airways, Mr Binis spent three years as an airworthiness inspector in the Hellenic Civil Aviation Authority. Besides the positions listed above, he was also assigned to the position of chief executive officer and member of the board of Olympic Fuel Company, Athens International Airport's hydrant refueling system, and member of the administrative council of the Hellenic Organisation for Standardisation.

George Fassoulas is an external advisor to the Hellenic Air Accident Investigation and Aviation Safety Board. He has been involved in aviation since 1981 and has extensive flying experience as an airline pilot. An airline captain since 1995, instructor since 1997 and examiner since 1998, George has several career distinctions. He has been involved in aviation safety since 1989, having served as the director of safety and security at Olympic Airlines for several years, gaining hands-on experience in SMS (Safety Management Systems), human factors, incident investigation, FDM (Flight Data Monitoring), reporting systems, audits, accident prevention, ERP (Emergency Response Plan) security management, and safety culture. George holds a BSc in physics from the University of Athens and is currently involved in simulator training.

Singapore's Transport Safety Investigation Bureau: developing investigation capabilities in a cooperative environment

Ng Junsheng
Senior Air Safety Investigator,
Transport Safety Investigation Bureau (TSIB) of Singapore

In October 2002, the Air Accident Investigation Bureau of Singapore (AAIB) was established as a department of the Ministry of Transport. The AAIB's mission was to promote aviation safety through the conduct of independent and objective investigations into air accidents and incidents. The AAIB grew from a two-person outfit into a unit with 11 investigators.

On 1 August 2016, the AAIB was restructured to form the Transport Safety Investigation Bureau (TSIB). The TSIB is an independent investigation authority, responsible for the investigation of air and marine accidents and incidents in Singapore.

Growth through close ties

In the early days of the AAIB, it was clear that an insular approach would impede its development of investigation capabilities. Rather than reinventing the wheel, the AAIB established close ties with foreign investigation agencies and communities to learn from their experience.

The AAIB and latterly the TSIB's participation in the activities of the various investigation communities, such as ECAC's, has provided opportunities for us to continually learn from the experience of others and understand contemporary investigation-related issues.

Regional investigation cooperation

Recognising the value of close relationships within the investigation community, the TSIB (and its predecessor the AAIB) has been promoting regional cooperation in investigations. The TSIB is involved in three networks of Asia Pacific accident investigators:

- at the level of ASEAN (Association of Southeast Asian Nations)
- at the level of the Asian Society of Air Safety Investigators (AsiaSASI)
- at the level of ICAO Asia and Pacific (APAC) regions

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Cooperation within the ASEAN framework

Singapore is a member of the Association of Southeast Asian Nations (ASEAN), a regional organisation comprising ten Member States. Modelled on ECAC's investigation cooperation framework (ECAC Code of Conduct on Cooperation in the Field of Civil Aviation Accident/Incident Investigation), the ASEAN Member States concluded (in May 2008) a Memorandum of Understanding (MOU) on investigation cooperation, which covers mutual support in the areas of investigation manpower, facilities, equipment, training, observer attachment, and exchange of information.

Cooperation within the AsiaSASI framework

The TSIB is a founding member of the AsiaSASI, which is the Asian regional chapter of the International Society of Air Safety Investigators (ISASI), of which the TSIB is a corporate member. The AsiaSASI was formed in 2009 to promote ISASI's objectives of broadening professional relationships among members and enhancing air safety through the exchange of ideas, experiences and information about aircraft accident investigations.

Since AsiaSASI's inception, the TSIB has been serving as its Secretary. Four AsiaSASI workshops have been organised since 2012.

Cooperation within the ICAO framework

ICAO established the Regional Aviation Safety Group – Asia and Pacific Regions (RASG-APAC) in 2010. One of RASG-APAC's subsidiary bodies, the Asia Pacific Regional Aviation Safety Team (APRAST), formed an accident investigation ad hoc working group (APRAST-AIG AWG) that held its first meeting in June 2012. Inspired by the success of the ECAC Expert Group on Aircraft Accident and Incident Investigation (ACC), the APRAST-AIG AWG was restructured in 2013 into a permanent framework, the Asia Pacific Accident Investigation Group (APAC-AIG). The APAC-AIG serves as a platform for investigation authorities, industry partners and professional bodies to exchange views, practices and experiences.

Chan Wing Keong from the TSIB has been serving as chairman of the APRAST-AIG AWG and APAC-AIG since their inception. The APRAST-AIG AWG and APAC-AIG have held a total of seven meetings and four workshops with the purpose of:

- assisting States and administrations to keep abreast of developments in the area of accident/incident investigation;
- enhancing the capabilities and professionalism of the accident/incident investigation bodies;
- promoting the sharing of expertise, experience and information among accident/incident investigation bodies;
- developing and strengthening cooperation among the accident/incident investigation bodies.

In 2012, the APAC-AIG developed an Asia Pacific Code of Conduct on Cooperation Relating to Civil Aviation Accident/Incident Investigation, which was modelled after the ASEAN MOU on investigation cooperation. To date, 20 Asia Pacific States have pledged their support to the Asia Pacific Code of Conduct.

Benefits of regional cooperation

Under these various investigation cooperation frameworks, the investigation agencies in the Asia Pacific region have organised many investigation-related events (training, exercises, workshops, etc.) and invited their counterparts to attend. In recent years, the training events the TSIB has taken part in include:

- wreckage mapping exercises
- mountainous terrain investigation training
- desert environment investigation training
- sea search and flight recorder recovery exercises.

These events have allowed the TSIB to appreciate investigation-related issues that we may not encounter in Singapore and also to forge stronger ties with our counterparts.

The TSIB has also organised a number of specialised investigation training events with the help of other investigation agencies (Australian Transport Safety Bureau, United Kingdom Air Accidents Investigation Branch, United States National Transportation Safety Board), industry partners (e.g. Rolls Royce, Turbomeca) and extended the training to our foreign counterparts in the Asia Pacific region.

In recent years, the TSIB has also been invited by our regional counterparts to conduct investigation workshops to contribute to the development of investigation capabilities in the host countries. These workshops typically cover basic investigation techniques, investigation management, handling and analysis of flight recorders, underwater flight recorder search and recovery, and accident site hazards and risk management.

International Accident Investigation (IAI) Forum

Since 2010, the TSIB has been organising the triennial International Accident Investigation (IAI) Forum. The IAI Forum has received strong support from ICAO, ECAC, ISASI and the Flight Safety Foundation. The IAI Forum aims to bring together the world's top government investigation officials and experts to discuss issues relating to the organisation, infrastructure and management of accident investigation. It serves as a useful platform for ICAO to inform, explain, and discuss with the safety investigation community regarding the developments and issues being pursued by ICAO. The TSIB is pleased to have welcomed over 150 participants at each edition of the IAI Forum held so far.

ICAO's 'No Country Left Behind' initiative

Consistent with ICAO's 'No Country Left Behind' vision, in 2016 the ICAO Asia and Pacific Regional Office launched an initiative: the Asia Pacific Combined Action Team (CAT) programme, with the aim of helping Asia Pacific States improve their effective implementation of ICAO requirements. CAT missions will typically include conducting gap analysis and offering suggestions for capacity building and the implementation of ICAO requirements. The TSIB has volunteered to take part in this programme. Such missions have been very beneficial for the TSIB because frank exchanges with the States concerned have allowed the TSIB to consider better ways of working.

Conclusion

Accident investigators operate in an increasingly globalised air transport system and complex environment. Investigation agencies need to continuously enhance and deepen their cooperation in order to be ready to face investigation challenges and conduct the investigation effectively. In the Asia Pacific region, this is even more critical as the investigation agencies are at varying degrees of maturity and investigation capabilities.

Aviation safety is a collaborative effort. The close ties with our counterparts and their assistance has been instrumental to TSIB's growth over the past 15 years. We will strive to continue to maintain the close relations and endeavour to contribute to the enhancement of regional and global investigation capabilities. ■

Singapore Shangi airport, control tower

Ng Junsheng is a senior air safety investigator with the Transport Safety Investigation Bureau (TSIB) of Singapore. He is currently the head of TSIB's Technical Support Section, which performs read-outs of flight recorders and provides analysis of the data. Mr Ng Junsheng began his aviation career in maintenance and holds an aircraft maintenance licence. As a licensed aircraft maintenance engineer, he carried out and certified aircraft heavy maintenance and passenger-to-freighter conversion work on various wide-body types. Prior to joining the TSIB, he was a quality engineer in a maintenance repair and overhaul organisation where he helped to establish a quality system to fulfill the regulatory requirements as well as dealing with compliance matters.

The ECAC Behaviour Detection Study Group (BDSG)

Interview with **Sven Keijsers**
Chair of the ECAC Behaviour Detection Study Group

ECAC established a Behaviour Detection Study Group (BDSG) in 2011 with the aim of facilitating the exchange of information, validation results and best practices among States that have active behaviour detection programmes in place. Appointed in October 2015, BDSG's chair Sven Keijsers presents the main features of behaviour detection in aviation, its objectives and added value within the overall security scheme in aviation.

Q: What are the main objectives of the Behaviour Detection Study Group (BDSG)?

A: Currently, the BDSG is the largest forum in the world to examine this issue, assembling eight States that work together to discuss, promote and share best practices as well as develop guidance material on behaviour detection. The BDSG is uniquely positioned to optimise behaviour detection approaches and advise policymakers on innovative behaviour detection developments with potential application to the wider aviation security environment.

Taking into account the overall industry shift towards a more risk-based approach to screening and other relevant developments, we have recently refocused our strategy in order to maintain its momentum and guide future collaboration.

Q: For those who are not familiar with the subject, behaviour detection sounds mysterious. How would you describe it to non-experts?

A: Basically, behaviour detection offers an additional approach to enhancing security at airports, for example at screening checkpoints or in landside areas. Instead of detecting an object or a prohibited item, behaviour detection focuses on the person and identifies anomalous behaviour by individuals with malicious intent. Whilst further research is needed to fully understand the range of capabilities, this approach may offer a significant advantage over traditional detection techniques as it is threat-agnostic.

Behaviour detection draws on scientific research which indicates that individuals who pose a threat to aviation may exhibit behavioural indicators (for example verbal, non-verbal, physiological) that stem from a fear of discovery.

The behaviour detection techniques can be used as part of an overall approach to aviation security to help mitigate threats before an attack or to provide a deterrent effect. The data we gathered also shows that behaviour detection at airports contributes to improving the overall levels of safety and security by identifying criminals, illegal traffickers and other persons of interest to law enforcement agencies.

Q: How does behaviour detection fit in the current aviation security system?

A: We all know that over the past few years, airports have implemented enhanced security measures to address an increased number of terrorist attacks and related incidents in the aviation sector. These enhanced measures also mean that security procedures are now more time-consuming, costly, complex, and not always as passenger-friendly as they ought to be.

As a result, there are limitations to the continuous increase in security measures. More than ever, there is a need for a system that is robust enough to mitigate current threats, and flexible enough to adjust to future ones.

Current airport security techniques are characterised by a 'one size fits all' approach, which means that in principle all passengers undergo identical screening procedures. Within the current model, resources are often allocated towards individuals who do not pose a risk to aviation security: this is the majority of the travelling public.

A far more efficient approach is to offer varying levels of screening. If passenger risk can be assessed before the actual security screening, the appropriate level of screening can be applied and resources can be focused on those individuals who pose a higher risk. This shift also forms a basis for a new way of thinking about the role behaviour detection can play and the way in which it could be integrated into existing security processes.

We believe that behaviour detection has the potential to contribute to a more effective and efficient security process, targeted to address existing and future threats.

Q: How is the work undertaken by the BDSG helping to achieve the objectives you are referring to?

A: The ECAC Behaviour Detection Model Programme and the relevant research and development initiatives conducted by BDSG members have contributed to a more successful implementation of these techniques at airports around the world.

In addition, the BDSG has produced guidance material on the use of behaviour detection that offers numerous deployment options in a range of locations including landside, airside and checkpoints.

Last but not least, in November last year the Security Programme Management Group adopted the ECAC Strategy on Behaviour Detection developed by the BDSG. This document will lead our actions in the next years. We are committed to achieving the objectives defined by the strategy and some activities are already being implemented. As aviation is international by nature, we also need international solutions, hence the need to strengthen our cooperation in the field of behaviour detection with other States, ICAO, and industry partners like IATA and ACI.

Q: Should a State be interested in developing a behaviour detection programme, what would you recommend?

A: My first advice would be to contact the ECAC Secretariat. It will provide the basic information on behaviour detection so that the State can investigate its real needs and expectations. Then, should a State be committed to implementing a behaviour detection programme and to receiving mentoring from the BDSG, it would be invited to provide more information to the BDSG on its particular needs, the resources available and the level of political commitment towards this project. ■

Sven Keijsers has been working for the Appropriate Authority for civil aviation security of the Netherlands since 2012. His main areas of responsibility are innovation, human factors and new and emerging threats. In his current position he also serves as the national representative in the ECAC Common Evaluation Process Management Group, the ECAC Study Group on Cyber Threats to Civil Aviation, and he chairs the ECAC Behaviour Detection Study Group.

ECAC/EU Dialogue with the European air transport industry

Challenges and opportunities in financing aviation

Rome, 27 – 28 June 2017

ECAC is delighted to present the preliminary programme for the tenth ECAC/EU Dialogue, which will offer the chance to connect with more than 150 high-level aviation decision makers, senior industry leaders and aviation specialists to discuss the challenges and opportunities in financing aviation taking into account the evolution of the air transport sector in a context of global liberalisation.

ECAC/EU Dialogues are held every three years and provide a unique forum for attendees to share experiences, exchange insights, ask questions and freely discuss the key issues and challenges on the table.

PRELIMINARY PROGRAMME
(subject to change)

MONDAY, 26 JUNE

Welcome cocktail
Radisson Blu Hotel, Rome

TUESDAY, 27 JUNE

Welcome and opening by **Ingrid Cherfils,** President of ECAC and **Henrik Hololei,** Director General, DG Mobility and Transport, European Commission
Keynote address by **Fang Liu,** ICAO Secretary General

SESSION 1: STATE OF PLAY – EUROPE'S NEEDS IN INVESTMENT
Investing is a prerequisite for further development of the aviation sector and to ensure its short- and long-term sustainability. Does aviation attract investors? Under what conditions? How is the aviation sector financed today in Europe, and how does this compare to other regions?

Keynote address • Presentations • Open forum discussion • Session conclusions

SESSION 2: CHALLENGES AND SOLUTIONS – HOW CAN WE MAKE EXISTING SOLUTIONS WORK BETTER?
What are the constraints for financing aviation development? Are existing costs a hindrance to investment? What solutions exist to promote investments in aviation? How could constraints for financing in aviation be solved by today's approaches?

Part I: Investing on the ground
Part II: Investing in the air

Keynote address • Presentations • Open forum discussion • Session conclusions

Gala dinner

WEDNESDAY, 28 JUNE (morning)

Presentation of the main outcomes of Session 2

SESSION 3: GAME CHANGERS – WHAT ARE THEY?
Game changers and far-reaching solutions are needed to finance innovation in aviation. States' strategies are needed for promoting investment in aviation. What needs to change, and who should finance innovation?
What are the consequences of the evolution of business models for airlines and airports?
Multimodal investment: how do we do it?
How do we promote airport development towards "airport cities"?
What are the future evolutions of airline business models?
Ownership and control rules: is liberalisation a leap ahead? What would it bring along?

Round-table debate (stakeholders) • Open forum discussion
Round-table debate (regulators) • Open forum discussion
Short- and long-term proposals and recommendations • Concluding remarks

Visit the ECAC website: **www.ecac-ceac.org/web/ecac-eu-dialogue-rome/welcome** for more information about the Dialogue and regular programme updates.

Member States News

> *Albania* – Appointment of Lilika Radovicka as Acting Executive Director of Civil Aviation.
> *Cyprus* – Appointment of Panayiota Demetriou as Director General.
> *Czech Republic* – Appointment of Zdenek Jelinek as Acting Director General.
> *Malta* – Appointment of Charles Pace as Director General of Civil Aviation.
> *Norway* – Appointment of Lars Kobberstad as Director General.

On 6 December, ECAC's Directors General gathered in Paris for their ninth annual Forum

The theme of this year's Forum – «Remotely Piloted Aircraft Systems» – was particularly timely. With the drones market currently one of the fastest developing technology branches, awareness of regulatory, safety, security and privacy issues, amongst others, is growing, and concerns need to be addressed rapidly. Organised this year under the leadership of Raul Medina Caballero (Director General of Civil Aviation, Spain), recently appointed ECAC Focal Point for RPAS matters, this one-day event dedicated to free and open exchanges amongst ECAC's Directors General, assembled over 80 participants and welcomed contributions from a number of guest speakers from ECAC Member States, the industry, Israel and the United States. The discussions were spread across three sessions expertly moderated by Filip Cornelis – Acting Aviation Director, European Commission, Mr Medina Caballero and Pekka Henttu – Director General of Civil Aviation, Finland.

Mr Medina Caballero set the scene by sharing the outcome of the drone survey conducted by Spain across the ECAC region. The first session then examined the European legal and regulatory framework. Mr Cornelis gave a presentation on the creation of an EU drone ecosystem by 2019, while Patrick Ky (EASA) introduced the future regulatory framework in the EU. Yves Morier (EASA) outlined the ongoing activities of JARUS (Joint Authorities for Rulemaking of Unmanned Systems), its recent key deliverables and the way forward. George Firican (ICAO European and North Atlantic Office) closed the session by presenting an overview of ICAO's RPAS activities.

The second session explored Member States' experiences with RPAS. Javier Barcala (Indra) provided information on TARGUS, the evolution of manned aircraft to an OPV (optional piloted vehicle) for public services, and Elena Lynch (United Kingdom Department for Transport) gave an overview of the RPAS safety challenges, current action and future steps in the United Kingdom. Stein Erik Nodeland (Norwegian Civil Aviation Authority) focused on the security risks associated with unmanned aircraft, whilst Anna Masutti (EALA) explored privacy and data protection issues.
Finally, Patrick Gandil (Director General of Civil Aviation, France) presented the French Civil Drone Council and France's perspective on a public-private partnership to develop the industry.

The final session brought the wider perspective to the table offering views on progress made and challenges faced in the RPAS field outside the ECAC region. Earl Lawrence (United States Federal Aviation Administration) spoke about the prospects for the integration of unmanned aircraft systems in the National Airspace System, Benny Davidor (Israeli Civil Aviation Authority) offered an overview of activity in Israel, the lessons learned and future challenges, and Christian Struwe (DJI) presented the worldwide market prospects for RPAS.

Speakers at the ninth ECAC Forum

ECAC Directors General at DGCA/147

Last meeting of 2016 for ECAC Directors General

ECAC Directors General held their 147th meeting on 7 December in Paris. Their third gathering of the year mainly focused on reviewing the outcome of the 39th Session of the ICAO Assembly against Europe's objectives. They looked into the results of the ICAO Council elections and praised the enlargement of the ICAO Council and the Air Navigation Commission adopted during the Assembly. They assessed Europe's achievements in various fields, highlighting the adoption of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) as the Assembly's main achievement. The meeting reiterated Europe's commitment to provide technical assistance to non-EU ECAC Member States and States in other regions in order to support the CORSIA implementation. It agreed that the good cooperation with international partners and other regional organisations had enabled Europe's success in achieving its objectives.

ECAC adopts fourth edition of ECACDoc 29 on the Standard Method of Computing Noise Contours around Civil Airports

ECAC States Directors General endorsed the latest version of ECAC Doc 29 at their 147th meeting. This is the fourth edition of the «Report on Standard Method of Computing Noise Contours around Civil Airports» to be issued since it was originally developed by the ANCAT task group on aircraft noise modelling (AIRMOD) in 1986. This version is the outcome of four years of work by the AIRMOD and ANCAT working groups. Its main purposes are (i) to reflect and incorporate the scientific progress achieved since the previous edition; (ii) to improve the clarity of Volumes 1 and 2 of the third edition to prevent any variations in interpretation; and (iii) to include the first part of a new Volume 3. For more information, please visit: https://www.ecac-ceac.org/news/-/asset_publisher/

Events to come

MARCH

1-2/	EU Regulatory Committee meeting for Civil Aviation Security (EU-AVSEC), Brussels
7-8/	15th annual meeting of ECAC auditors (AUD/15), Paris
9-10/	23rd meeting of the Security Forum (SF/23), Paris
15-16/	26th meeting of the ANCAT Sub-Group on Aircraft Noise Modelling (ANCAT-AIRMOD/26), Switzerland
21-22/	3nd Behaviour Detection Study Group Research & Development Workshop (BDSG-R&D WKSHP/3), Madrid
22-23/	17th meeting of the Behaviour Detection Study Group in aviation security (BDSG/17), Madrid
23-24/	34th meeting of the Training Task Force (TrTF/34), Zurich
29/	178th meeting of the Coordinating Committee (CC/178), Paris

APRIL

12/	54th meeting of the Facilitation Working Group (FAL/54), Paris
12-13/	CASE Project – 2nd Regional Workshop on Cargo Security, Maputo
25/	33rd meeting of the Common Evaluation Process Management Group (CEP-MG/33), Paris

MAY

3/	7th Familiarisation Course for Directors General (DG-FAMCOURSE/7), Paris
4/	148th meeting of Directors General of Civil Aviation of ECAC Member States (DGCA/148), Paris
5/	5th meeting of the Economic Working Group (ECO/5), Paris
11-12/	26th meeting of the Study Group on Cyber Threats to Civil Aviation (CYBER/26), Lausanne
17/	25th meeting of the Security Programme Management Group (SPMG/25), Rome
22-23/	46th meeting of the Group of Experts on Accident Investigation (ACC/46), Dublin
31/	22nd meeting between the Coordinating Committee and the US authorities (CC/US/22), Washington D.C.

One year in the CASE Project…

The implementation of the EU-funded and ECAC-implemented Civil Aviation Security in Africa and the Arabian Peninsula (CASE) Project officially began on 1 November 2015, in accordance with the grant contract signed by the European Commission and the Italian *Ente Nazionale per l'Avazione Civile* on behalf of ECAC.

The operational inception phase followed shortly thereafter, with the dedicated Project Team – part of the ECAC Secretariat – starting progressively from early January 2016 onwards. The Project's initial year of activity saw the implementation of a first wave of State-level as well as regional activities, thus clearly demonstrating the ability of the Project to deliver. A total of 13 on-site activities were completed in 2016, covering the full range of the Project's components: regional workshops, national mentoring activities, national training and coaching activities, and national risk management activities.

Due in particular to the success of a series of technical workshops (on cargo security, security equipment, threats to civil aviation and risk management), the most recent of which was organised in January 2017, that ensure the sharing of expertise between European, African and Arabian experts, 37 African and 5 Arabian countries are currently Partner States of the Project. The priorities for 2017 are both to keep expanding the Project's geographical scope and to increase the number of national activities implemented in those countries that have been identified as Partner States by their hosting, contributing speakers and/or sending experts to participate in regional workshops.

A range of tools have been employed to ensure the constant exchange of information and, even more importantly, lessons learned, with stakeholders such as yourselves, notably through the strong representation of the CASE Project at international meetings and conferences, the organisation of two Project Steering Group meetings in 2016 and the production of CASE News, an electronic newsletter dedicated to the Project's activities. The addition of this new regular feature in ECAC News is the latest of these communication tools aimed at affiliated entities, Partner States and other stakeholders, whose respective contributions are equally central to the Project's success.

It is our strong belief that the Project has managed to establish trusting and mutually beneficial relationships with its key stakeholders, first and foremost of whom are the regional organisations that serve as facilitators, as well as with its Partner States, both actual and potential, who are actors of the Project and not just beneficiaries, and with those affiliated entities that release and thereby provide Partner States with qualified security experts, which is what this ambitious and innovative Project is all about.

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For further information about the CASE Project, please contact the Project Coordinator: Antoine Zannotti, azannotti@ecac-ceac.org - Tel.: +33 1 46 40 37 69.

Mitigating the MANPADS threat in Burkina Faso

Ouagadougou, 21 November -2 December 2016

Following Uganda in June and Senegal in July, the third Partner State of the CASE Project to benefit from the mentoring activity dedicated to the assessment and mitigation of the MANPADS threat was Burkina Faso, from 21 November to 2 December 2016.

The kick-off mission for this activity was conducted under the auspices of the CASE Project by two French experts from the *Gendarmerie des Transports Aériens* and the French Air Force. Together, they trained 23 managers and supervisors from all entities concerned with the MANPADS threat and responsible for the implementation of counter-measures. Following a first week of classroom training, the second week was in the field and dedicated to identifying potential launch sites, assessing their respective features and defining possible mitigation measures.

The training was opened and closed by the Director General of Civil Aviation, Abel Sawadogo, while the team also had the honour to meet with the Minister of Transport, Souleymane Soulama.

Burkinabé aviation security personnel practice counter-MANPADS measures in the field

Best Practices for National Auditors Training in Togo

Lomé, 5-10 December 2016

The CASE Project's second Best Practices for National Auditors - Level 1 training and subsequent Certification of National Auditors took place from 5 to 10 December 2016 in Lomé. The training was officially opened and closed by Colonel Dokisime Gnama Latta, Director General of Togo's *Agence Nationale de l'Aviation Civile (ANAC)*, providing further evidence of the interest and involvement of the Appropriate Authority in capacity-building activities delivered by the CASE Project, following a mentoring activity delivered in June 2016 and aimed at improving the use of available technology.

Nine national auditors representing several entities involved in compliance monitoring participated in the training, which incorporated a combination of classroom learning and practical exercises. This mixed participation fostered cooperation between the organisations involved and contributed to overcoming potential administrative barriers. The training and certification were delivered by an expert from the ECAC Secretariat and a CASE Project short-term expert, nominated by the French *Direction Générale de l'Aviation Civile* and released for this specific assignment.

In addition, and as for all national activities conducted under the CASE Project from now on, an ECAC Standard Test Piece (STP) designed to verify the image quality of screening equipment (x-ray equipment and explosive detection systems) used for aviation security purposes, was offered to ANAC by the Project in order to further support quality control activities undertaken in the field of aviation security.

CASE Project experts with Col. Gnama Latta, Director General of Civil Aviation, and Togolese auditors involved in the Best Practices training

Joint Cargo Security Audit in Lebanon

Beirut, 12-15 December 2016

At the invitation of the Lebanese Directorate General of Civil Aviation (DGCA), the CASE Project carried out a joint cargo security audit at the Rafic-Hariri international airport from 12 to 15 December 2016. This risk assessment activity was delivered by two senior cargo experts designated by the United Kingdom and Finland, who were joined by a national expert, in keeping with the joint nature of this activity. The Director General of the Lebanese DGCA, Mohamad Chehab El-Dine, met with the experts upon completion of their audit.

This activity provided the Partner State with an expert external assessment on its level of compliance with a chosen set of international standards, by assessing the actual implementation of aviation security measures in the field of air cargo and mail, and providing recommendations on how to address potential areas of non-compliance.

This was the second cargo audit activity delivered in 2016 by the CASE Project.

CASE Project workshop on risk management in Senegal

Dakar, 23-24 January 2017

Jointly organised by ECAC and the African Civil Aviation Commission (AFCAC), this workshop brought together experts from a record number of 29 African States, 12 of which were participating in a CASE Project activity for the first time: Algeria, Angola, Botswana, Cabo Verde, Chad, the Democratic Republic of Congo, Ethiopia, Gabon, South Sudan, Sudan, Zambia and Zimbabwe. The meeting was opened by Iyabo O. Sosina, Secretary General of AFCAC, and Antoine Gouzée de Harven, Regional Coordinator with the European External Action Service.

Led by moderator Eleanor Travers of the Irish Aviation Authority, participants had the opportunity to engage in discussions and Q&A sessions based on the presentations given by risk management experts from the authorities of Ireland, the Netherlands, Nigeria, Senegal and South Africa, as well as a representative of Air France on behalf of the airline association, A4E. Alassane Dolo, AVSEC Regional Officer of the ICAO Western and Central African Office, also presented ICAO's risk management methodology. In addition, the ECAC expert presented the vulnerability assessment activity offered to CASE Project Partner States, risk assessment being part of a risk management process.

The most highly subscribed CASE Project workshop to-date, 37 participants from 29 Partner States attended the event in Dakar in January 2017

Eastern Partnership and Central Asia Project (EaP/CA)

An EU-funded and EASA/ECAC–Implemented Project

The European Union-funded and ECAC/EASA-implemented EaP/CA Project (supporting the implementation of aviation agreements in the European Partnership countries and upgrading civil aviation safety and security standards in Central Asia) was launched in mid-2016.

The overall objective of the Project is to support the sustainable development of civil aviation administration systems in the Partner States – Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Ukraine and Uzbekistan.

In relation to aviation security, the Project contains the following three specific objectives focusing on air cargo and mail security:

- to promote a thorough understanding of international requirements;
- to support the review and amendment of existing legislation and regulations in the Partner States to ensure their compliance with international rules and best practices in the field; and
- to support the development of a self-sustaining compliance monitoring system for cargo and mail security.

A number of activities in the cargo and mail security field are planned by ECAC under this EaP/CA Project. Among others, ECAC is responsible for the organisation of:

- workshops on cargo and mail security, including specific workshops on screening of cargo and mail;
- mentoring activities on cargo/mail security regulations with a view to supporting Partner States in further developing their cargo and mail security regulations and programmes;
- best practices for cargo inspectors training courses; and
- audits and on-site evaluations of cargo and mail security in order to assess levels of compliance with international requirements.

As far as the Eastern Partnership countries are also ECAC Member States, this Project will be supported by activities already organised for the benefit of these countries under the ECAC Capacity Building Programme.

Regarding implementation, ECAC organised the first cargo and mail security evaluation in Kazakhstan from 5 to 9 December 2016. The main objective was to assess the compliance of current aviation security legislation and operational procedures with international rules and best practices. Then, to strengthen the oversight capabilities of Partner States, an ECAC Best Practices for Cargo Inspectors (BPCI) Training Course took place at Amsterdam Airport Schiphol (Netherlands) from 21 to 23 February 2017. The main objective was to further develop inspectors' knowledge and understanding of national compliance monitoring activities on cargo and mail security in accordance with international and European requirements. The training comprised classroom lectures and practical exercises conducted at a regulated agent's premises.

In addition, a workshop on cargo and mail security will be held at the ICAO/ECAC offices in Paris on 28 and 29 March 2017. The main objectives of this workshop are to outline international and European standards on cargo and mail security (secure supply chain), familiarise participants with the main concepts surrounding the secure supply chain, and introduce participants to the challenges relating to cargo screening. Partner States are welcome to send their nominations to attend the workshop.

From left to right: Armands Klotins - Beken Seidakhmetov, Chairman of the Civil Aviation Committee - Anna Jankowska, ECAC Secretariat - Erzhan Zhakenov - Zhanat Abdugalimov - Baurzhan Umiraliyev

ASSOCIATED BODY OF ECAC

News from the JAA Training Organisation (JAA TO)

Editorial

Paula V. de Almeida, *JAA TO Director*

"I am very pleased that this year's first ECAC News magazine is focusing on air accident investigations. Addressing the importance of this kind of investigation helps the industry further develop into one of the safest industries in the world.

JAA TO offers two courses providing aviation professionals with the competencies to perform an effective accident and incident investigation. You can find more information about these courses on the next page.

MILESTONES

During the first months of 2017, JAA TO has already accomplished a few milestones, reflecting the continuous growth of our organisation:

→ **Rob Huyser joins JAA TO Foundation Board**

The ECAC Coordinating Committee has appointed Rob Huyser, Director for Civil Aviation in the Netherlands, as a new member of the JAA TO Foundation Board. This appointment means that the JAA TO Foundation Board is now complete. I am absolutely confident that Mr Huyser will contribute to JAA TO's success and commitment to qualifying the most competent aviation professionals.

→ **Recertified as Ramp Inspection Training Organisation**

I am proud to announce that JAA TO has been recertified by the European Aviation Safety Agency (EASA) as a fully compliant Ramp Inspection Training Organisation (RITO). Following the periodical evaluation, EASA confirmed that no findings had been raised. In turn, JAA TO received its recertification to continue to provide the EU Ramp Inspection Programme (former SAFA) courses.

→ **Partnership with Jeppesen**

JAA TO and Jeppesen, a Boeing company, have signed a Memorandum of Understanding. The agreement will combine JAA TO's expertise in delivering high quality regulatory training courses with Jeppesen's extensive pilot training, flight dispatch and licensing preparation capabilities. The first training course to be delivered will be the Flight Dispatch Essentials Course. Training courses to follow will feature blended learning on varying subjects, including other flight dispatch elements and regulatory and administrative operations for airlines and aviation operators, to fully prepare participants for the rigours of the aviation profession."

Overview of air accident investigations related courses

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INTRODUCTION TO ACCIDENT AND INCIDENT INVESTIGATION TRAINING COURSE

13 - 15 March 2017, Hoofddorp, Netherlands
1 - 3 May 2017, Abu Dhabi, United Arab Emirates
15 - 17 May 2017, St Julian's, Malta

The course is intended to provide participants with the basics to perform an investigation on safety-related issues within their organisation.

ADVANCED ACCIDENT AND INCIDENT INVESTIGATION TRAINING COURSE

29 - 31 March 2017, Hoofddorp, Netherlands
17 - 19 July 2017, Hoofddorp, Netherlands

The Advanced Accident and Incident Investigation Training Course is a practical application of the theory of the Initial Course. Participants will work together in groups and use a case study from which they collect and analyse data, draw their conclusions and make recommendations. The end result will be an actual Incident Investigation Report.

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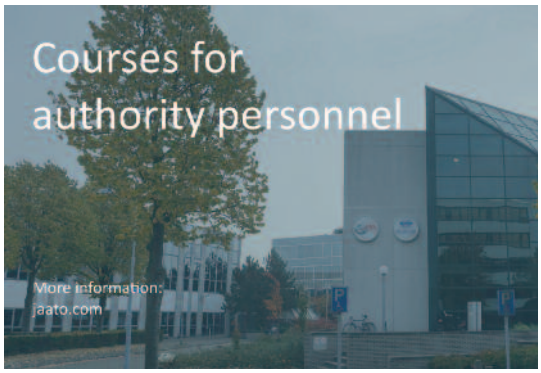
Selection of courses for authority personnel

EU RAMP INSPECTION PROGRAMME (SAFA) INITIAL THEORETICAL & PRACTICAL

19 - 22 June 2017, Hoofddorp, Netherlands

The EU Ramp Inspection Programme is a mandatory safety programme within the European Union (EU). All the other non-EU Member States (ECAC and non-ECAC) that have working arrangements with EASA are performing EU Ramp Inspections on foreign operators. In order to be able to perform EU Ramp Inspections, the inspectors must have followed, amongst other requirements, initial EU Ramp Inspection Programme Theoretical and Practical training.



ICAO SMS AND EASA MANAGEMENT SYSTEM REQUIREMENTS – INTRODUCTION

29 - 31 May 2017, Hoofddorp, Netherlands
11 - 13 April 2017, Abu Dhabi, United Arab Emirates

This course is specifically designed to provide involved personnel, such as accountable managers, safety managers and authority representatives, with a basic understanding of the elements and functions involved in a compliant ICAO Safety Management System (SMS) and EASA Management System (SM).

For more information about our training courses, please visit our website: **www.jaato.com**

ECACNEWS is published by the European Civil Aviation Conference (ECAC)

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