SAFE360° Key Points

Key Points (Short Summary - Full Summary from Page 4)

Introduction and Keynote:
- Aviation is still feeling the after-effects of COVID – we face multiple challenges also from the war in Ukraine and Cyber threats as well as the traditional aviation risks.
- We must show our commitment to modernisation, green measures and integrated risk management.
- SAFE was all about providing a forum for industry to share opinions and learn together.

Safety Landscape Panel:
- The system is stretched, at a pivot point from an environmental perspective, facing challenges to attract new talent and deal with multiple threats.
- From a pilot perspective we see challenges with basic skills, compounded by the loss of experience across the industry.
- We need to coordinate effectively across the domains, be bold and help industry to get its mojo back.

Flash Talk – Safety Culture:
- Safety culture is quite a remote term – how do we make it relevant to our staff.
- It's a learning mindset – if you screw up, own up – we are not interested in who, we are interested in why.

D4S Panel:
- D4S is a voluntary partnership between industry, Member States co-funded by the EU.
- The goal is to provide an insight into safety risks that any one organisation alone doesn't have access to.
- EASA is now launching the next, operational phase of D4S to get more organisations involved.

Flash Talk – Integrated Risk Management:
- We know management systems are vital for safe operations.
- Currently many systems are siloed for safety, security, environment and quality – but they use similar principles, methods and data sources.
- Integrated risk management makes sense as a business approach (efficiency and effectiveness) but there is still work to do.

SAFE360° Summary and Key Points

**Flash Talk – How to Prioritise Safety Issues:**

- The Safety Issue Prioritisation Index (SIPI) is a way to calculate the importance of safety issues across the aviation system.
- It doesn't just look at occurrence data but also includes expert judgement/ other data.

360° Panel – Approach Path and Energy Management

- Approach path management is a high priority safety issues from both data and the SIPI – 19 actions are now proposed in the collaborative analysis.
- Energy management is also critical, TEM in approach path management has been identified as a key mitigation.
- We need to work together on the combination of risk management strategies.

360° Panel – Safe Airpsace Integration of UAS

- We want to share the skies, not say that they belong to one group of stakeholders.
- It is important to share traffic information across all parties to avoid collisions and to continue the safety promotion across the industry.
- The most powerful risk mitigation is the establishment of geo-zones to keep drones and aircraft apart.
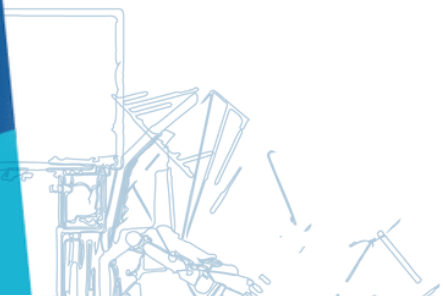
SAFE360° Summary and Key Points

Flash Talk – Why do you risk classify occurrences:
- Safety reporting gives you data, but for risk management, you need knowledge. The ERCS bridges this gap.
- It is for risk assessing occurrences, not a risk assessment tool.

360° Panel – The Human Performance Challenge
- The challenge was defined as "Having enough competent people who are operationally ready and fit for duty"
- It is important to help understand how to encourage people into aviation and then ensure competencies for all staff are understood.
- We need to better understand the concept of "Fitness for work" as opposed to just fatigue.

Flash Talk – Extending SMS into Ground Handling:
- SMS is now extending into ground handling and the management systems should be appropriate to the size and activity of the organisation.
- The challenge is also to get a positive culture everywhere with the added challenge of so many integrated stakeholders.

360° Panel – The Management of Repetitive Defects in Safety Critical Systems
- Tracking, reporting and resolving repetitive defects is a continual challenge.
- It is vital to capture these challenges in the management system and also to communicate with crew as well as the technical departments.
- Pilots could also better explain technical issues to help the engineering departments.

FDM Breakout Sessions
- Closed the loop on new FDM good practice produced by EOFDM and Data4Safety, to address operators' needs.
- It included industry presentations demonstrating the benefit of advanced computation methods in FDM, and providing practical examples of implementation.
- Topics included monitoring take-off performance, approach path management and using FDM to support the management of change.

SAFE360° Conference Summary

DAY 1- 13 September 2022
**INTRODUCTION AND KEYNOTE**

- Luc Tytgat, EASA's Strategy and Safety Management Director welcomed the conference attendees highlighting the challenges since the last in-person SAFE360° in 2019. While air traffic is now at more than 80% of 2019 levels, we are still feeling the effects as an industry. Long lines of passengers waiting to check-in, or collect luggage, flight cancellations. European aviation is also facing recruitment problems, we have an image as a less stable employer, something we need to take into account.

- While passenger operations have suffered, cargo operations have grown by over 20%. However, while it has grown, its accident rate has grown correspondingly. We must remain vigilant to aviation safety risks. Aviation is facing multiple challenges: the threat of COVID has been almost eclipsed now by the very real safety and security consequences of the war in Ukraine. This further disruption to a world already recovering from the pandemic, and one where we were already suffering the financial consequences, creates still more pressures in a now inflationary environment with energy constraints.

- The need to divert traffic away from Russian and Ukrainian airspace concentrates traffic on our eastern borders, increases flight times and adds pressure to rosters. It increases fuel burn, required by the new trajectories, and thus environmental risks and airline costs. Yet we are expected to be greener and more sustainable. That is why EASA is developing the ECO label and certifying alternative fuels.

- We must show to the public our commitment as an industry and as EASA to modernisation, green measures and of course safety. These are not competing, but complementary. EASA is creating an integrated risk management concept, whereby we can manage the different risks that interface with safety.

- As a community, the complexity of demands on the aviation system continues to grow. But we can be proud of the way in which we have faced the challenges of the past few years. The conference was urged to put aside reservations about sharing your concerns, experiences, opinions, so that we can all learn and benefit.

HIGH-LEVEL PANEL - NEW SAFETY LANDSCAPE

John Franklin (EASA), Yannick Malinge (Airbus), Jasper Daams (Amsterdam Schipol Airport), Giancarlo Buono (IATA), Luc Tytgat (EASA)

- The panel began by discussing the perspective that we are not yet out of the COVID crisis. The system is stretched, under tension, which is not good from a safety perspective. Experience levels in the industry have dropped, due to the loss of staff. Aviation is at a pivot point in terms of the environmental context, thus we have a challenge to attract new talent who may not see the industry as desirable and to help industry get its mojo back.

- There were reflections on what has been happening from an airport perspective. If we think of Charles Perrot's accident model, we have new close-couplings in the system now. Passenger management pre-security impacts flights, delays and workload. We have to work together closely on safety management using an integral approach.

- A recent serious incident involved an aircraft trying to go-around without adding power. The airline is in the process of implementing Evidence-Based Training (EBT), so added additional call-outs to their go-around procedure, instead of providing additional training to ensure that its second nature to add thrust when you pull back. A risk seems to be a reduction in basic airmanship. This is compounded by the loss of experience in the industry during COVID.

- The panel agreed the landscape is still not back to 'normal', with indirect consequences of the pandemic still playing out. We cannot continue to manage safety in silos, considering safety risks independently to other risks. We hope that emerging domains, newcomers to aviation, do not degrade the aviation industry's culture and safety record. In AI, we have a clear strategy as to how we implement it, authorise it, but it also has required new approaches and forays into the IT domain. This leads to the consideration of cyber-security. We have seen an explosion in the growth of cyber-attacks, probably because of the war in Ukraine. Overall the landscape is more sophisticated and complicated across all domains. Reporting occurrences remains important as it provides an integrated picture.

- This is not the first crisis, but perhaps the worst. The main problems are arising in the infrastructure – less able to adapt rapidly. Airlines have had to adapt, but we need to ensure that infrastructure is also flexible. Also important to emphasise that qualification is not enough, exposure, expertise, skills all contribute to competencies. It takes 3-5 years to train an ATCO to the desired standard. Training needs to be modified and modernised.

- On cyber security and digitalisation, it has been a concern for many years. In terms of regulations, the way systems are developed on board aircraft. There is now a strict system architecture to isolate aircraft systems. To date, there have been no cyber-events that compromise aircraft safety. Airbus will be opening a small university course to train people in cyber-security in aviation.

- It was asked "When we are told that you're missing expertise and experience, does it mean that the industry is less attractive." The panel didn't explore the detailed mitigation measures, but if you want to get the right expertise, you have to pay for it. Meanwhile, the industry is under economic threat, so the integrated risks cannot be ignored.

- On the environmental point, we are working on improving our competitiveness and will be able to calculate comparisons with the railway sector, so that we can communicate our improvements.

- We need to do more to encourage young people into the industry. It's an exciting time and an opportunity for the younger generation to put their mark on the industry.

- We face not a single crisis, but one from multiple sources, so we must work together. COVID has sped up some problems in the industry and so now we are much more aware than we were before. To set a straight course in turbulent times, we need to do it together.
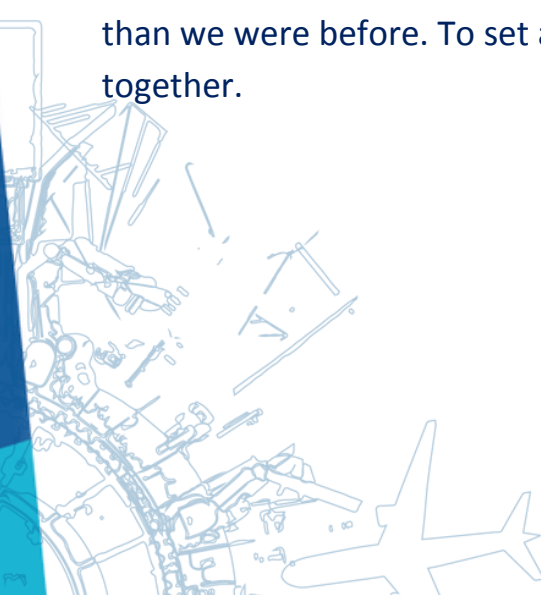
FLASH TALK - WHAT IS SAFETY CULTURE ANYWAY?

Colin Russell (Lilium)

- When we talk to the people we're inspired to lead and motivate, do we use the language we all understand? Do we use the language we use with our families and friends? Can we visualise safety culture? We have lots of written material, but it's hard to visualise.

- We can visualise aircraft safety, as a thousand million marbles, a swimming pool full of marbles. An accident probability of 10^{-9} could be one red marble in a swimming pool full of marbles. But in safety management terms, perhaps everyone has a bucket of marbles, from the pilots, ground handlers, ATCOs and so on.

- Safety culture seems a remote term, but what we mean is mindset. A safety mindset. A just mindset. A learning mindset. A just mindset could be 'if you screw-up, own up – not interested in who, interested in why'. That is a language that the oldest and youngest in an organisation can understand.

- We have to bring to life the safety mindset in an organisation, not just print out a safety policy in small font. We need to understand that an organisation is a tribe, with tribes within it. Their mindset needs to be influenced as a tribe. Do leaders get the culture they deserve? Leaders set cultures, people do safety. And people need to care for their colleagues and employees. If you care about your team, they will care about what matters to you.

- The myth of measurement: when we set safety targets, especially around safety mindset, be really careful. There are second and third order consequences to targets and measurements. Balance the data with the people.

- Why not replace 'just' with 'fair'? The words aren't very important, so long as you understand them.

- Have the last two years been the truest test of safety culture? Yes and we can do a lot more in this area.

HIGH LEVEL PANEL - D4S ANNOUNCING THE NEXT PHASE

Léopold Viroles (EASA), Bert Bonke (ECA/ VNV), José-Luis Lozano (AESA) Jim Pegram (Easyjet)

- D4S (video here) is a voluntary partnership between the industry and Member States, co-funded by the EU. Together they have built a strong governance over the data usage. The benefits are clear and an example was provided, whereby FDM data was analysed at EU level. Blind benchmarking was also demonstrated. The goal for D4S is to eventually involve all those organisations willing to be involved.

- It provided an insight into safety risks that an operator just doesn't have access to. Trust has been a critical element. We have found the trust from all different elements of the industry and that is a huge achievement. The speed with which it has been built is impressive.

- ANSPs and Airports are important stakeholders to bring into D4S next. In terms of easy wins in the analysis, looking at the TCAS data would be the next step, being pragmatic.

- We're in a strong position to expand the data gathering. From a practical perspective, not just because we will get more data into the system, but more stakeholders will share their experiences and exchange on how to identify safety issues. An important dimension is the sharing of experiences, not just data analysis.

- It is not possible to open the door to everyone all at once. The bow waves that creates would be overwhelming. We need to expand at a pace we can manage, progressively.

- Pilots may spend more time reporting information we already have, instead of information we don't have. So rather than reporting a TCAS RA, describe what is unique about that event.

- Is D4S working with others to develop the global risk picture? It is already starting to develop algorithms to check data across the globe. It is something for the future, first we have to complete the regional picture

FLASH TALK - INTEGRATED SAFETY AND SECURITY RISK MANAGEMENT: UNREALISTIC CONCEPT OR AN OPERATIONAL NECESSITY?

Dragos Munteanu (IATA)

- We have established over the past few decades that Management Systems are crucial to an organisation. They can make or break an organisation. Any business faces a multitude of risks and have been investing to be more effective and efficient. The Management System balances protection and production. Many airlines have multiple risk management systems, security, safety, enterprise, quality… but there is a better way. These are all similar systems. It makes no sense to manage and audit these separately.

- Many of these systems rely on the same data, so we integrate it. Many of these systems have the same PDCA cycle, so we integrate it. The policies all need to be integrated, not several separate policies: safety, security, environment, quality.

- Integrated risk management is vital but there is still work to do in order to fully connect the traditional safety management systems (SMS) approach in different domains.

FLASH TALK - HOW TO PRIORITISE SAFETY ISSUES?

Rowan Powel (EASA)

- The Safety Issue Prioritisation Index (SIPI) is a means to calculate the importance of safety issues across the aviation system. It uses risk data (based on the European Risk Classification Scheme (ERCS)) and expert judgement to assign scores to individual safety issues. It was developed via an iterative, collaborative process, with an early prototype first being applied to the prioritisation of the COVID-19 safety risk portfolio.

- One of the strengths of the SIPI is that it looks not just at occurrence data, but has the capability to incorporate qualitative or quantitative information. This will be very useful in merging it with the D4S programme. It also means that very different issues can be compared, whether identified through data or expert judgement. Many organisations at the event expressed an interest in learning more about the SIPI and EASA would look at ways to promote this more across the aviation community.

360° PANEL - APPROACH PATH AND ENERGY MANAGEMENT

Renée Pelchen-Medwed (EASA), Laszlo Ekes (Wizz Air Malta), Gunter Ertel (Boeing), Christopher McGregor (ATR), Gabor Vass (CANSO), André Vernay DGAC France

- Approach path management is a high priority safety issue through the review of occurrence data in Europe and an application of the SIPI. Looking at the events in detail, 19 mitigating actions have been proposed and these have been put forward to the Best Intervention Strategy. The team performing the assessment are in the panel. An analogy of energy management is downhill slalom, where energy management is also critical. TEM in approach path management has been identified as a key mitigation.

- Airport infrastructure is important. For example when would the industry would ensure that every runway is serviced with lateral vertical guidance? While there is a move in this direction, removing NDB approaches, etc. In the meantime, the safe landing concept is critical. It is hard to accept that the technology is available to support APM, but that it is not always implemented. This is not something that we should accept. The continuous improvement of the product has to be matched by the infrastructure.

- Training crew members to be assertive, not only in the cockpit, but with air traffic control, is important. They should feel able to say 'no' and a pilot should never have to justify a go-around decision. Unexpected shortcuts are quite a significant contributor to unstable approaches. Controllers don't necessarily know enough about aircraft energy management – they are aware of the issue but don't necessarily have sufficient practical tools. Sending controllers on familiarisation flights is an effective measure.

- Manufacturers, operators and ANSPs need to work together. Working together as colleagues is much more effective, since it is a combination of risk mitigation strategies that resolve the issues. Technologies that work on prevention and intervention can be very helpful and there are a number of examples on the market.

- Continuous descent approaches and approach path management – is an environmental measure a safety risk? Not necessarily, safety measures still apply. They should be designed by all actors and consider approach path management aspects.

360° PANEL - SAFE AIRSPACE INTEGRATION OF UAS

Renée Pelchen-Medwed (EASA), Rob Akron-Punselie (ECA), Maria Algar Ruiz (EASA), Olivier Mrowicki (EUROCONTROL), Jan-Eric Putze (Droniq GmbH), Martin Timmons (IAA)

- We want to share the skies, not say that they belong to one group of stakeholders. The impact of a drone collision on an aircraft depends on the category of drone. While some see drones as a nuisance, they help society in many ways – such as, rescuing a cardiac arrest patient in Sweden. But they are also being used for drug deliveries into prisons and flying them in areas dangerous to aircraft. For some reason, drone events often happen outside of working hours – on Sundays!

- In terms of regulations, UAS operations has had a high priority over the past five years. All airspace users need to operate safely and fair access needs to be provided. EASA based our regulations on three categories of drone (Open, Specific and Certified).

- From a technical perspective, the use of transponders on all aircraft that have them installed greatly augments see-and-avoid. Some panelists have also experienced encounters with drones directly. New concepts on drones are based on sharing information, but someone needs to be able to use the information in the right way. Member States need to develop a model of communication with drone operators, because the regulations have a lot of freedom for the States, but the cost of freedom is responsibility. This applies to the drone operators too – they need to respect the rules and develop safe operations.

- Open category drones (smaller ones) are the ones causing more incidents around aircraft. However, helicopter windshields are not certified for bird-strikes, making them also vulnerable to drone strikes (EASA has some safety promotion on this soon to encourage the use helmets for rotorcraft pilots). The batteries on drones can also cause fires on impact, as they are Li$^+$ batteries.

- The most powerful risk mitigation in our view is the establishment of geo-zones, which Member States have the right to establish and help to keep drones and aircraft apart.

- Safety promotion work with the drones community is especially important, especially in the open category. EASA, authorities and the wider community are taking a very targeted approach to different audiences with key messages. There are also seasonal campaigns, especially in the run up to Christmas when drones are often given as gifts and there are many new users who need educating.

- Also guidelines on the management of drone events at airports. In addition, we have assessed counter-UAS specifications for aircraft. Overall, a lot of work has been done and a lot of work is still ahead of us to achieve safe integration/ cohabitation.

- A final point was that we (the system) can't place too many constraints on drone development, because they will need to develop their own standards for these unique aircraft.
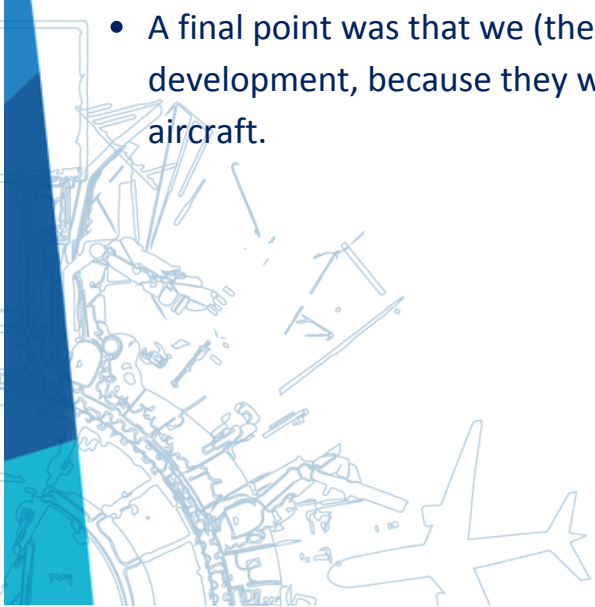
FLASH TALK - WHY DO YOU RISK CLASSIFY OCCURRENCES?

John Franklin (EASA), Brice Reding (Luxair), Andrew Rose (Llanbury Consulting), Yngvi Yngvason (EASA)

- Safety reporting gives you data, but for risk management, you need knowledge. The ERCS bridges this gap. It is for risk assessing occurrences, not a risk assessment tool.

- The ERCS looks at an occurrence and asks 'what was the bad outcome that didn't happen?'. For example, a hydraulic failure can lead to a loss of control. The second question the ERCS asks is 'how close was the event to that bad outcome?' in other words, did the hydraulic system have redundant systems? How did the pilots react to prevent a bad outcome, how did the system planning help and various other factors. In other words, what are the good things we have in our systems that mean the accident didn't happen. It's a Safety II approach. So we know what to worry about, how much to worry and can then work out what to do about it.

- So what use is there for ERCS? As an example at EASA, we use ERCS to identify the key risk areas carrying the highest risk, and we look at the safety issues in the same way. It can be striking that for the safety issues, there can be wide discrepancies between the number of associated occurrences and the aggregated risk of those occurrences.

- At an operator level, implementation of ERCS is an interesting exercise. The risk scores help us to identify high-risk occurrences, so that proper and immediate actions can be taken. The methodology also allows them to look at their barriers and assess them. They can identify which are their most effective or weakest barriers. Using these tools helps us to prioritise our risks and identify those that need to be tackled first – an important activity in an environment with limited resources.

- ERCS can be especially useful for differentiating between common but low risk events and rare but high risk events.

- The participants looked forward to EASA promoting the use of ERCS more widely in the aviation community to help industry understand how they might use it in their own management systems.

360° PANEL – THE HUMAN PERFORMANCE CHALLENGE

John Franklin (EASA), Sanda Bergmane-Behmane (Air Baltic Corporation AS), Mads Eklung (EASA/CAA Denmark), Thomas Leoff (IAAPS/ Lufthansa Aviation Training), Jim Pegram (Easyjet), Florian Zander (Cologne/Bonn Airport)

- The panel asked us (industry) to consider what we mean when we talk about human performance? Fatigue came up a lot. The description "Having enough competent people who are operationally ready and fit for duty" was proposed and broadly agreed with in the poll. Those that didn't agree linked the other areas of the Safety Map of the World (below) recently created by the EASA Safety Promotion Team.

- The panel proposed the 3 parts of "Enough", "Competent" and "Operationally ready and fit for duty". For the last part, this was much bigger than just Fatigue and FRMS. It also covers physical and mental health issues.

- For "Enough" and "Competent", organisations need to cope with the fallout of the pandemic, in terms of retraining people and their wellbeing. We also need to consider the fact that there are a large number of aviation professionals retiring and we have not made our system fit to cope with new technological developments. In pilot training, we are very prescriptive when we need to be competency-based.

- There are also a large number of staff whose competence is not regulated. In these areas, there are also large gaps between work as imagined and work as done, with quite tight timescales for tasks to be performed, difficult working environments and high pressure. For competency, we could work together to better understand the competency needs for non-Regulated staff, including leaders and managers.

- We see how COVID has impacted everyone, and even IT and office staff are affected and have safety effects. From early in the pandemic to the present day, the peer support programmes have been very needed, for all staff. Management need to be supportive of staff coming forward and see it as positive if they say that they are finding something hard or cannot cope. Trust needs to be built and maintained.

- The "Physical Fitness" and "Mental Fitness" aspects of the human performance challenge lead to risks for people outside the operational part of an organisation to manage (HR/ IT etc) - how can we collaborate and support them in this task.

- There is a need to help better understand the role of "Fitness for Work" and not to just "Fatigue Management" - let's work together to define and help implementation. Perhaps we need a Safety Promotion Task Team like in EBT for Flight Crew competence.

FLASH TALK - EXTENDING SMS INTO GROUND HANDLING

Jonathan Heavy (IAA)

- Ground handling needs a fair mindset to be effective and it needs an integrated approach to analysing risk and mitigation. This has led to the extension of management systems into this domain that will come in the new Ground Handling regulations.

- Any management systems should be appropriate for the size of the organisation and the type of activity being undertaken. Thankfully many ground handling organisations already have the part of an SMS.

- There are added challenges because of the integration with the operators SMS and the fact that ground handlers have so many stakeholders to work with. An airline just wants the ground handler to do its job but it's not always that easy.

- The challenge is also to get a positive culture everywhere.

360° PANEL - The MANAGEMENT OF REPETITIVE DEFECTS IN SAFETY CRITICAL SYSTEMS

Emilie Marchais (EASA), Ian Goodwin (Airbus), Radj Jagbandhan (KLM), Alex Scerri (Avioscribe), Swaran Sidhu (Easyjet), Cengiz Turkoglu (International Federation of Airworthiness)

- The engineering world has been dealing with reliability programmes for decades. For repetitive defects there are fleet support engineers who track defects to look for the repetitive ones – whether fleet based or aircraft based. Tracking these until they are removed from the system is an effective means of managing the faults and good fault-finding is vital. Intervening at a senior level is also an important component, to know when to say stop and ground the aircraft. So all this is still controlled by human intervention – human performance is still critical.

- The e-techlog system is really facilitating matters, but other systems are not as straightforward. The main challenges for an OEM is they often find our about repetitive defects at too late a stage.

- Achieving a balance between capturing important defects and crying wolf also needs to be considered. Resetting the aircraft is another consideration, but flight crews and engineers should be encouraged not to do this.

- There's almost unanimous agreement in some definitions and it looks as though the EU system doesn't have a clear definition. However, organisation's management systems may need to define this, not the regional regulator. Not only this, but procedures or processes need to be documented in every organisation's manual.

- When it comes to crew communication about repetitive defects, management systems in organisations should be less siloed to enable positive discussions with crews without overloading them but still informing them on issues they need to know about.

- Pilots could better explain technical issues in the techlogs to help engineering departments at airlines. Safety Promotion could be done in this area. Taking a deep-dive into the techlog during pilot training is useful, so that they understand what is needed and thus expected.

DAY 3 - 15 SEPTEMBER 2022
BREAKOUT SESSION - FLIGHT DATA MONITORING (FDM)

Note: all the presentations that were approved for publication can be retrieved from EASA FDM conferences webpage.

Welcome and Introduction on FDM Promotion Activities

Guillaume Aigoin (EASA)

- Guillaume opened the day with an introduction to the FDM promotion activities, the European Operators FDM forum (EOFDM): see EOFDM webpage on EASA website. Recently an in-depth evaluation of EOFDM was conducted to understand if the objectives of this activity were met (the full report may be consulted here). The main recommendations from this evaluation included that EOFDM visibility be improved, that more FDM guidance is provided on analysis techniques for smaller operators and on unstable approach and take-off performance monitoring. There is also a need to strengthen the link between the FDM programmes and operators' SMSs. Actions have been developed, to address each of these issues. The agenda of today's session is focussed on the completed actions, especially FDM technical guidance.

Monitoring Take-off Performance: EOFDM recommendations

Helder Mendes (EASA)

- Helder began by highlighting the document produced by EOFDM working group B (WGB), Guidance for the implementation of FDM precursors. It covers precursors of accidents and incidents that could be monitored with an FDM programme. They are listed by accident outcome.

- Take-off performance precursors were recently updated based on a survey of the EOFDM members. The guidance could then be used to improve the contents of the EOFDM WGB documentation, but also provide evidence for the revision of EASA Safety Information Bulletin (SIB) 2016-02R1.

- The results of this survey will be published shortly. The updated EOFDM WGB document will also be published soon.

Monitoring Take-off Performance: Focus on Abnormal Acceleration Events on Take-off

Pedro Duarte (Netjets)

- The consequences of an error on take-off parameters can be serious. Many of these events go undetected – a small error does not have an effect that is distinguishable from other factors. Some avionics already perform gross error checks, such as the Airbus take-off monitoring (TOM) function. But the presented FDM method allows to detect small degradation of the acceleration on take-off.

- Initial work was presented at EASA FDM conference in 2016, with the work now being revisited to further refine the measures. In principle comparing expected acceleration with measured acceleration defines the event. However, a mathematical model is needed to calculated 'expected acceleration', based on historical data. Such a model is valid for an individual aircraft, but could be expanded to a group of similar aircraft. It would need to be reiterated upon changes to the aircraft (e.g. new engines, winglets). This activity requires competences around aircraft performance, flight data handling and processing and data science techniques.

- Event analysis of the model shows that when the model is good, the majority of flights' predicted accelerations are within 0.01G of the actual acceleration, with outliers then identified as events. Each one can then be looked at to understand the causes. In summary, the method has been validated. It is important to realise however to use the event as intended – it only identifies errors on the TOM data, it is not designed to capture other contributing factors.

Questions from the Audience on Part 1 - First 3 Presentations

- These errors are being made every day and being caught by a secondary check. One thing done on a different project was to ask pilots to closely monitor an issue for a month and to report every tiny error. This may be something to consider to estimate exposure to the problem. It might also cause people to be more attentive to the issue and make fewer mistakes.
  - Yes, this could be a complementary measure. However, when considering the events mentioned in the SIB 2016-02R1, the take-off parameters were either not cross-checked, or the cross-check did not identify the problem. Time pressure can be an issue here.

- Do runway conditions affect the expected acceleration mode?
  - Yes, this can be variable that we input into the model. The model will tell you if changes to the runway condition has an effect, so you can decide whether you want the variable included or not.

- Do you have any % figures of how many events are classified as invalid after more in-depth analysis?
  - Fortunately, most are! But we have found exactly what we are looking for too. The fact that most are false events is a good indication of the safety margins established, but you can fine tune the model to help you to find the most likely candidates.

Monitoring Approach Path Management: EOFDM recommendations

Helder Mendes (EASA)

- Helder presented recent updates to the recommended FDM methods for precursor RE26 (Unstable approach) in EOFDM working group B, Guidance for the implementation of FDM precursors. The rationale that was used for the revision of RE26 was presented and the measurements and events that will be incorporated in the next revision of the WGB document was presented.

- Then, Hélder presented the Guidance for identifying unstable approach with flight data, which was developed at the occasion of Data4Safety directed study on approach path management. This guidance can be downloaded from Data4Safety webpage. The methods presented in this document were validated on more than 1.4 million flights and more than 8 different fleets, as part of the Proof-of-Concept from D4S.

Monitoring Approach Path Management: Characterisation of Approaches using Machine Learning Tools

Leopold Sartorius (ATR)

- Leopold Sartorius presented a methodology to identify different main families of approaches using clustering algorithms and explained how to feed-it-back into the FDM system to perform a categorisation of each approach.

- The methodology being used is based on the discretization and normalization of the data followed by the computing of the covariance matrix and the clustering of the approach data. Then it was shown how this categorisation could be used for the analysis of FDM data when it comes to stabilised approaches monitoring, such as identifying specific patterns based on destination / approach or aircraft and therefore provide means to address any issue more specifically.

- This methodology allows specific studies to be performed and the consequent identification of airfield/runway from the clusters, where there is more incidence of unstabilised approaches.

Monitoring Approach Path Management: Final Approach Anomaly Detection using Machine Learning
Vincent de Vries (NLR)

- The presentation from Vincent de Vries introduces the use of unsupervised Machine Learning (ML) on FDM data to complement the use of more classical rule-based event detection, which is commonly used in the FDM programmes of the operators.

- An unsupervised ML anomaly detection model was presented, which identifies flights that showed anomalous behaviour during the last 180 seconds of the final approach. As the algorithm is unsupervised, one of the biggest challenges of training a ML model is missing, which is the existence of sufficient training data. Other advantages and disadvantages of the model were explained. Examples of anomalous flights that were detected by the model were shown and different types of anomalies that the model has detected are categorized, one of which being the category unstable approach.

- On the same dataset, a classic rule-based event detection algorithm is used to identify flights that did not meet well-known industry standard stable approach criteria. Thereafter, the outputs of both the ML method and the rule-based method were compared to indicate how and why the use of the ML model can complement the classical FDM rule-based event detection. Since rule-based event detection can only detect events that were defined by an expert, events that are not defined cannot be detected. Therefore, the use of an anomaly detection model can assist safety analysts identify emerging risks in the flight operations that cannot (yet) be detected by rule based FDM.

Using FDM to Address New Challenges and New Technologies
Introduced by Helder Mendes

- The Flight Data Monitoring programme is primarily a component of the Safety Management System of the operators. It provides a valuable tool for hazard identification, risk assessment, and monitoring of the mitigation measures, completely in-line with the Safety Risk Management (SRM) process.

- The typical approach is to identify the safety issues that each operator finds most relevant to their daily operations. In this process, the safety risk portfolios as published by EASA in the European Plan for Aviation Safety (EPAS - Vol III) are one important source, as together they present the most important safety issues as identified and discussed by the industry. But FDM should be regarded as one adaptive tool, in which the operator not only relies on the safety issues identified by industry but also looks internally and produces new FDM analysis out of the operator's risk assessments.

- In this panel, were presented practical uses of the FDM programme, and how it can be of great practical help in the assessment of hazards.

EOFDM document: FDM Analysis Techniques
Darren Beaumont (Bristow) and Şerdar Sahin (Corendon Airlines)

- Darren presented the latest document produced by EOFDM Working Group C: Flight data monitoring, analysis techniques and principles. This document has taken two years of collaborative effort to develop. There were a significant amount of different methods in use and WGC reviewed different statistical analysis techniques in order to support the range of different operators.

- Before an analysis can be performed, the algorithms and the data must be reliable – otherwise garbage in = garbage out. Developing techniques to validate the algorithms is therefore important. The document remains at a high level rather than providing information that would be available in a statistics book.

- Serdar presented two practical cases to illustrate the Chapter III of the document (on producing FDM-based statistics)

- Case 1: Runway excursion score (at landing). 9 FDM events were identified that could be used to help assess the landing phase runway excursion risk. Some basic measurements were also identified: runway length (RL), touchdown distance (TD), remaining distance (RL-TD). A formula for the runway excursion score could then be created. The results were developed into a dashboard that can be presented to pilots. The algorithm will be upgraded to include the runway condition report and to include take-off runway excursion.

- Case 2: Tailstrike risk on take-off. This is based on examining pitch attitude and pitch-rate. Plotted together, you could see a medium positive correlation between the variables. Looking at the values, zones could be identified, for example where pitch rates are significantly higher than ideal and with moderate pitch attitudes. Looking at the timeline of pitch rates, you could identify maxima that look like repetitive peaks. It was found out the peaks belonged to a new ATO-TFO group, so the flight training department was informed. After this, the trend decreased, indicating that the corrective action was effective.

GNSS Interference: Current Situation and How to Identify them with FDM.

Dragos Munteanu (IATA)

- GNSS interference has been a reality for the past 10 years. It causes various types of disruption on other safety systems – EGPWS/TAWS, PBN, ADS-B etc. It has been raised at the ICAO 40th Assembly and was the subject of an ICAO State letter in 2020. IATA is working with the regions to address the problem. ITU has also been made aware.

- The IATA big data programme FDX analysed GPS signal losses from August 2021 to June 2022. The scope was GNSS loss lasting more than 60 seconds.

- The results showed that there are higher rates in summer than in winter globally (all IATA regions!). Looking into the regional aspects: some regions have higher rates than others. Flights between the Middle East and Europe have the highest rates. Then the Middle East and CIS. On flights from Europe to Asia-Pacific, you would fly through these regions and be exposed. 30% of these events are en route and 20% during the last 15 minutes before landing. Looking at the maps, these events are easy to identify as they are recorded with latitude/longitude. the European FIRs with the highest incidence were displayed.

- The FDM data do not contain any information about why the signal is lost in those places, but we can deduce it from the locations. In the CIS, over Ukraine there is no data after 24th February, because there is no civilian traffic anymore.
- We observe a flight crew reporting fatigue, since these events are now common in some areas. It is why flight data is more useful than occurrence reports for monitoring GNSS interference. Typically, these are not easy issues to solve. ICAO has required States to issue NOTAMs.

Supporting the Introduction of a New Safety System (Case of the ROPS)

Rodolfo Tomasoni (Qantas Link)

- Qantas Link presented their experience of adapting to new technologies – ROW/ROPS in the A320 fleet. Runway end Overrun Warning (before landing) and Runway end Overrun Protection System (on landing). ROPS is what we'll focus on. After landing, if the system detects an overrun risk, it will tell the pilot 'MAX BRAKING, BRAKE'.

- Because no ROW/ROPS discrete parameter is recorded in our FDM data, we struggled to develop an FDM event. On the one hand, pilots felt that the system was too sensitive, on the other management were concerned by how often it was triggered. So as an initial step, flight crew were requested to report all occurrences of system activation. In analysing these reports and the FDM, a breakthrough was made: the auto brake logic.

- Factors contributing to ROPS activation were:
    - Correct touchdown zone but slow de-rotation of the aircraft
    - Landing towards the end of the touchdown zone (caused by tailwinds)
    - Pilots removing the autobrake, which eased the deceleration.

- An initial slow auto-deceleration contributed to most of the ROPS activations. In addition the MED autobrake function limits deceleration rate to 2m/s2 in certain circumstances. Whenever pilots were slightly slow in derotating the aircraft, the ROPS would trigger.

- The correct landing technique was reinforced, we incentivised a correct response to ROPS alerts and embedded the lessons-learnt in the training syllabus. Future measures include an upgrade to data frames to include ROPs alerts.

Remaining Questions from FDM Session

- We also experienced this GNSS problem, which we understand and report, but it can also be an insidious problem in that it affects the wider system.
  - We have had unnecessary go-arounds thanks to 'runway too short' warnings.

- On FDM data on the ROPs, had the slow derotation not been monitored previously or was it adjusted for this issue?
  - It was not something that we monitored closely and it would not have been triggered as an event. It was the combination of derotation and runway length.

- Do you have any concerns about algorithms driving behaviour? Is a slow derotation undesirable and something that shouldn't be happening, or are we catering to the algorithm?
  - Yes, this is why we had to be very careful on how we communicated with pilots. But the solution was in the manual. We used the FCTM wording. When we delivered the message, we said 'don't change things because of ops'.

- We have a lot of GPS problems, even GPWS warnings during cruise. Are you working on eliminating these false GPWS activations?
  - Indeed, it would be good to analyse how many EGPWS false warnings occur during GPS outages. Too many false warnings desensitises pilots to the real warnings.

- Do pilots have access to the information presented about their individual RE score on a daily basis or is it kept within the FDM department?
  - Actually we are working on this so that by next year we can start sharing it with pilots.

- When presenting feedback to individual pilots, do you show their performance relative to the rest of the pilot population?
  - Yes, but it is voluntary whether they choose to use it and find it helpful. It can always help to standardise the flying in the long term.
- What is done to speed up the certification of improved GNSS? Multi-system/ band, etc
  - For sure, with SESAR and others we are looking at new technologies, but we need to deal with the root of the issue as otherwise we have to keep ahead of those causing the interference by constantly re-equipping the aircraft.

Remaining Questions from FDM Session

- We have a product that allows pilots to look at their own performance relative to norms.
  - Have you considered joining your GNSS analysis with other industries, such as the maritime world to get a better global picture? Yes, this is why we are working with ICAO and trying to share the information with the widest possible audience. We are trying to find whatever disruption to aviation we can identify – including 5G. We will have to explore the other industries for sure.

Session Wrap-up

Guillaume Aigoin (EASA)

- The FDM breakout provided examples of how FDM can be used to monitor safety issues, such as take-off performance and approach path management. EOFDM documents provide methods to monitor precursors of all the four key risk areas that have consistently had the highest risk score (runway excursion, collision with terrain, aircraft upset, airborne collision).

- Because FDM is a dynamic domain and because operational contexts are so diverse, there cannot be a 'once-for-all' or 'one-size-fit-all' FDM programme. That's where EOFDM plays a key role for us, it provides a toolset that operators can use to enhance their FDM programmes, and ultimately to empower their own SMS, rather than prescribing a uniform way to implement FDM.

- Looking at the future, Data4Safety will collect flight data from more operators, and these data will be used for assessing and monitoring safety issues at EU-wide level. But Data4Safety can also be used to help operators with the implementation of their own FDM programmes, by providing FDM indicators to which an operator can relate their own FDM trends , Or by making it possible for an operator to enrich their FDM data with other data such as weather and traffic data.

- These are examples of possible synergies between the FDM programme and the SMS of individual operators on the one hand, and Data4Safety on the other hand. If necessary, we will adapt our FDM promotion activities to facilitate these synergies.. There are great prospects ahead for FDM, we hope that you will all stay with us and more will join.

SOME IMAGES OF SAFE - A GREAT POSITIVE WEEK OF CONVERSATIONS