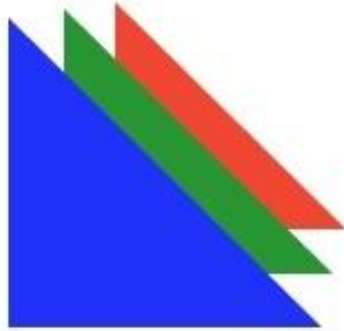




SIRM

Special COVID-19 Bulletin, Ed. 2

June 2021



**SAFETY  
ISSUE  
REVIEW  
BULLETIN**



# A Message from IATA

Mark Searle, Director, Safety

Welcome to the latest SIRM Bulletin. I had hoped to be able to talk, in this publication, about COVID-19 in the past tense and how our beloved industry had returned strongly, and safely, to traffic levels above 2019 but unfortunately the global pandemic is still very much with us. However, that said, we have showed remarkable resilience and are well placed for aviation to return as a prime conduit to connect families, friends and businesses in the near future.



Like most crises, this has been a time to innovate and aviation has most certainly delivered during this time. For example, airlines have made huge efforts to ensure goods may be transported utilizing passenger aircraft and this was critical, in the first instance, to supply Personal Protective Equipment around the world, and now - for the circulation of vaccinations. It has been personally very important that IATA be able to continually support industry during these most challenging times and specifically the sharing of information, as presented in this bulletin, is key.

IATA has been innovating too to support industry and deliver our strategic priority to reduce the aviation all-accident rate, as measured over a 5-year rolling average. The COVID-19 Safety Risk Management Framework (ref. p. 40) has evolved into the IATA Safety Risk Management Framework. This global repository of industry hazards and safety risks shares issues that may need to be considered when conducting a safety risk assessment, and provides guidance material on specific subjects. The intelligence, gathered from information-sharing activities such as the IATA SIRM bulletin, is critical to this, to ensure we grow our collective understanding of issues in a continued effort to mitigate safety risks.

Thanks to all who have contributed to this Bulletin and I look forward to thanking you in person sometime soon.



## A Message from the IATA Safety Group Chair

Mark Burtonwood, Senior Vice President Group Safety, Emirates Airlines



Hello everyone, it has been more than 6 months since our last bulletin, and we continue to find ourselves in challenging times for our industry. We approached the end of 2020 with optimism, hoping for an about turn for the aviation sector, but sadly 2021 has brought new trials with several new variants and subsequent lock-downs and border closures around the globe curbing international travel. With renewed grit and determination, we've continued to demonstrate resilience, constantly looking for new ways to do things, and keep our businesses active. The ability to operate continentally is of course extremely welcome.

As such, COVID-19 is still very topical within this latest bulletin with articles about the Human Factors implications for pilot performance due to the virus, and the impact that it has had on fatigue management. We also explore how aviation has been a key player in the global COVID-19 vaccine distribution, and look at the role that Air Cargo technology has played in this. Many carriers have continued to expand and enhance its cargo operations during the pandemic, and technology has played a critical part in being able to manage the increased workload efficiently and effectively, and of course most importantly safely.

Aside from the constant unknowns related to the pandemic that are keeping us busy, the industry is also facing new obstacles. In this issue, we look at the emerging threat of 5G and how it may impact flight safety: is the introduction of 5G cell sites a threat to aviation safety? The threat of low-level interference during approach and landing is concerning and a collaborative approach to managing this issue is key. Of equal interest is the article containing shared experiences about return to service during and after the pandemic, including parking and storage from an operational perspective, which is a continued threat.

You'll see several other articles of interest on a variety of topics for your perusal in this publication. Thank you to all that have contributed content for this worthwhile resource; learning from one another is one of the huge benefits of our group, and I am constantly humbled by the collective wisdom that we share.

I hope that you are all keeping well. There are certainly glimpses of brighter days with successful vaccine roll outs, and new energized plans to make sure that the parts of the world in need of the vaccine will receive them in larger supply soon, with our industry certainly playing its part.

Wishing you all the best for a continued positive upturn as we work our way towards the end of 2021.



The **Safety Issue Review Meeting (SIRM)** is a biannual meeting, created in 2006 and managed by IATA Safety and member airlines through the IATA Safety Group. The meeting is open to safety professionals from airlines, manufacturers, ground service providers and airports, as well as to invited subject matter experts from academia, pilot associations and other relevant industry stakeholders. The SIRM is held under Chatham House Rule, to create a protected, confidential environment for industry to discuss safety risks, hazards and lessons-learned from accidents and incidents, emerging concerns as well as results of safety studies. The output of the SIRM is the SIRM Bulletin, summarizing the topics and issues presented during the meeting. Information in the Bulletins is de-identified, unless otherwise authorized by the organization, and it is distributed to a wider aviation community.

**SIRM Bulletin** contents do not necessarily constitute the views of IATA or its Members. Any recommendations or suggested best practices are strictly those of the individuals discussing topics and issues during the meeting and have not been developed in conjunction with IATA or its standard setting mechanisms.

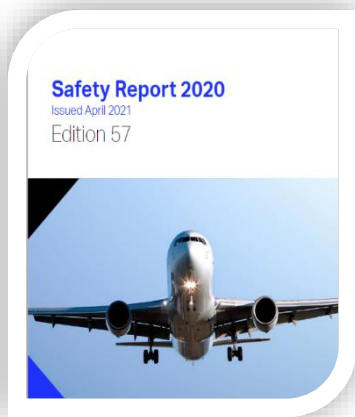
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# COVID-19 – Special Bulletin Articles

**NOTE:** All articles have been de-identified, unless authorized otherwise by the submitting organization.

## 1. Update from the IATA Accident Classification Task Force (ACTF)



The Accident Classification Task Force (ACTF) is a sub-group to the Safety Group (SG) and is comprised of safety experts from airlines and manufacturers. The ACTF meets on a regular basis to review, validate and classify accidents and their contributing factors using a Threat and Error Management concept. This information feeds into the IATA Accident Data Exchange (ADX) repository for all commercial aviation accidents since 2005 that meet the IATA Accident Inclusion Guidelines.

The ACTF met virtually several times in 2020 to review, validate, and classify the accidents that occurred in 2020, with the last virtual meeting held in January 2021 to complete the Q4 2020 accidents. The results of the group’s work is incorporated in the Annual Safety Report. The IATA Safety Report has been IATA’s flagship safety document since 1964 and is now in its 57th Edition. This latest edition provides:

- a snapshot and essential insight into global and regional accident rates and contributing factors based on threat and error management principles;
- the areas of concern identified by the ACTF with determined actions and recommendations, guidelines and measures aimed at preventing accidents; and
- links to a suite of guidance material developed in support of safety risk assessments, developed for operators and other applicable stakeholders to consider.



Looking at the Safety performance in 2020:

- The total number of accidents decreased from 52 in 2019 to 38 in 2020
- The total number of fatal accidents decreased from 8 in 2019 to 5 in 2020
- There were zero Loss of Control – In Flight (LOC-I) accidents (and fatalities) for the first time in over 15 years
- The all accident rate was 1.71 accidents per million flights. This is higher than the 5-year (2016-2020) average rate of 1.38 accidents per million flights
- IATA member airlines’ accident rate was 0.83 per million flights, which was an improvement over the 5-year average rate of 0.96
- Total flight operations reduced by 53% to 22 million flights in 2020
- Fatality risk remained unchanged compared to the five-year average at 0.13

The 2020 Edition of the IATA Safety Report can be downloaded [here](#).



## 2. A Human Factors Discussion on Pilot Performance During COVID-19 Operations

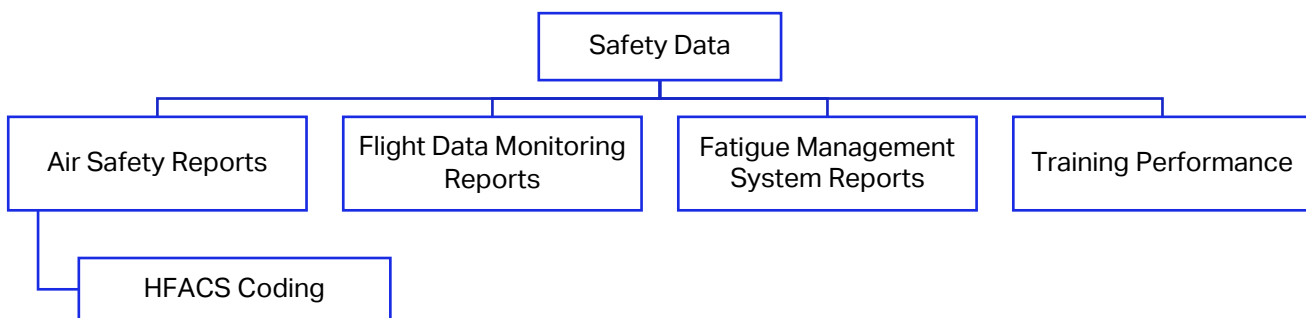
### Challenge

COVID-19 has imposed many challenges to airlines, and one of them is managing pilot recency and competency during the pandemic operations. The 2020 IATA Annual Safety Report showed that global flight operations were reduced by 53% in 2020. Air transport markets have been significantly impacted by travel restrictions such as quarantines, travel bans, and border closures. With the dramatic reduction of flying, air operators have been putting every effort in managing pilot training and licensing to ensure operational safety by applying approved exemptions and other flexible solutions for pilot recency training. The exemptions are great temporary solutions to help pilots and organizations to maintain operations.

The question is, with the industry recovering slower than expected, whether the adjusted training program under the exemptions are still effective in both the provision of pilot recurrent training and ensuring pilot competency and recency.

### Safety Data Analysis

To better understand this question, the airline has conducted a preliminary human factors analysis of safety data to review if pilot proficiency has been impacted by less flying. This analysis assessed different sources of safety data within the SMS, including all medium and high-risk air safety reports in the year of 2020, associated HFACS (Human Factors Analysis and Classification System) coding, Flight Data Monitoring reports and Fatigue Management System reports. Discussions with the flight operations training team on training performance were also conducted to see if there were any significant change in gradings.



### Findings Summary

In total, within our safety report database, approximately 1% of all the reviewed safety reports specifically mentioned recency-related errors or COVID operation introduced human factors-related issues in 2020 (e.g. workload management deficiencies during critical flight phase due to less flying). Among the reports that referenced recency, many of them also involved other contributing factors, such as weather condition, challenging ATC clearance, mental fatigue, and increased workload.



Another key observation from the safety report review was shortened routings to final approach resulting in less track miles, which resulted in less time to decrease altitude, airspeed and to configure the aircraft, which increased the potential for destabilization of the approach.

In addition, the analysis identified some new threats, including less congested airports being distracting to taxi performance, quiet airspace and ATC frequencies causing reduced vigilance level, nonstandard communications or procedures instructed by ATC, frequently changed COVID related policies and procedures, and more disruptive passengers.

HFACS coding data of the safety reports indicated increased rates in procedural errors and some CRM deficiencies (shown in the table below). However, the rate of the errors remains low. No trends were observed from flight data analysis and fatigue management program. The training department also confirmed that no significant change in training element grading was observed in 2020.

#### Top 5 Performance related HFACS categories trending up in Q2-Q3 2020

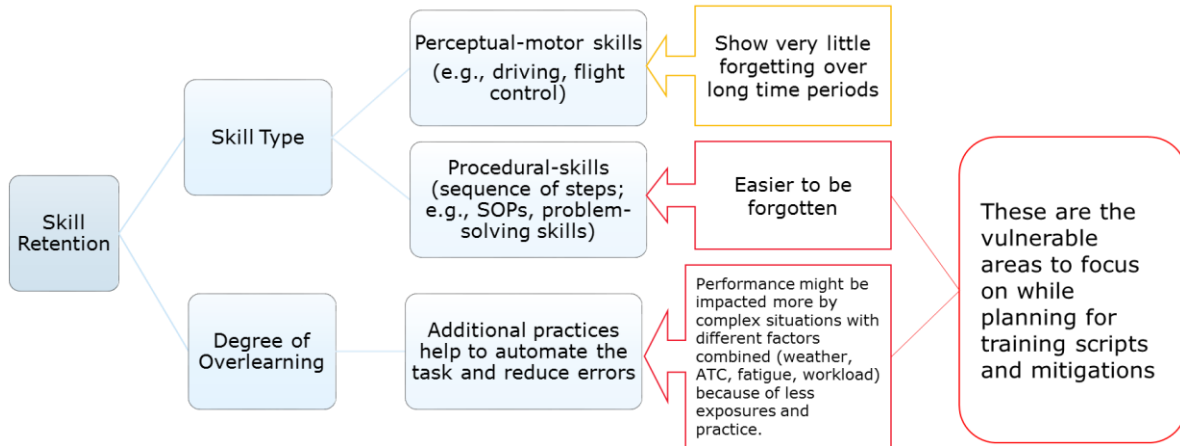
1. Skill-Based Errors: Inappropriate Procedure
2. CRM: Lack of Active Monitoring
3. Violation: Routine Infractions
4. CRM: Lack of/Poor Assertiveness
5. CRM: Failed to Conduct Adequate Briefing/Planning

## Skill Retention Analysis

Despite individual differences, skill retention is often affected by two factors (Rose, 1989): Skill Type and Degree of Overlearning. In general, procedural skills are easier to be forgotten over a long time period. Procedural skills often refer to steps of procedures, functions and operations of equipment. For instance, de-icing procedures, approach ban minima, run through a checklist for diagnosing defects, and problem-solving skills when dealing with challenging scenarios based on a combination of threats (i.e., turbulence, environmental factors and difficult approach procedure). These procedural skills are easier to be forgotten than perceptual-motor skills like basic flight control.

Overlearning is the repeated practice of a skill to strengthen memory and performance. It helps to automate the task and reduce the forgetting rate. For skills that are used daily, practices will occur in the daily performance. However, learning skills related to emergency response procedures will not receive the same level as other daily practiced skills, and their retention will greatly benefit from more practicing in training, especially during COVID operations with reduced flying.

Overall, less flying requires higher vigilance level, some tasks may require more attention to complete, especially under complex situations. Some pilots might also feel mentally less confident due to reduced flying. These areas need to be continuously monitored in safety oversight and addressed in training. According to the skill retention analysis shown in the figure below, the emphasis of training should focus on procedural skills and complex situation management.



## Recommendations

From the statistical perspective, the risk of COVID related performance degradation is low. However, statistical interpretation of these emerging issues is just a review of the past, we believe it is important to continue closely monitoring COVID related performance issues as things are changing rapidly. Managing these new risks requires more proactive, flexible, and continuous mitigation plans.

It is recommended to place emphasis on procedural skills and emergency/complex situation management as those skills are easier to be forgotten over long time periods. Revisiting the grading criteria might be another option to identify gaps within the adjusted training program for COVID operations.

It is also recommended to communicate and increase pilots' awareness of the new COVID imposed distractions. It is also valuable to use safety and human factors data in training design to reflect the most current issues.

As the operation begins to return to more normal levels, a greater focus will be placed on monitoring safety data and operational performance. It is anticipated the demographic of active pilots will change significantly over the next 12-24 months. Many pilots will be returning from furlough and will likely be changing fleet types. This will require our organization to further monitor trends in the data and be able to provide insights to enhance our training products.

### Reference

Rose, A. M. (1989). Acquisition and retention of skills. In G. MacMillan (Ed.), *Applications of human performance models to system design*. New York: Plenum.

## 3. COVID-Related Challenges of Fatigue Management

All of us in the airline industry understand that the challenges, introduced by the COVID-19 pandemic, are different than anything we've ever experienced. These challenges have been especially pronounced for the management of fatigue risk. Shortly after the rapid, drastic reductions in service early on, there was a recognition that there was still an urgent need to repatriate citizens, transport essential workers and move medical cargo. All of this was critical to managing the pandemic.





Due to limitations, such as quarantine requirements, lack of suitable facilities and fear of exposing crewmembers to the virus, many in the industry saw a need to extend existing flight and duty time limits and/or reduce established minimum rest periods in order to accomplish these missions. Due to the perceived sense of urgency, managing fatigue risk was not always at the forefront of consideration. Operations were flown that did not have any basis in current scientific knowledge or operational experience. ICAO was made aware of this and quickly issued guidance to help regulators and operators manage the risk involved with these uncharted operations. This guidance was at least partially adopted by most of the stakeholders around the world.

Over the past months, we've had a chance to analyze some of these situations. What we've seen so far include new areas of potential fatigue risk and changing safety behaviors.

**The new areas of possible fatigue risk include:**

- Reduction in staffing levels having the potential for remaining staff to be working longer, more intense or condensed hours
- COVID-19 health and safety measures may cause a more fatiguing working day
- COVID-19 influencing many aspects of personal life, affecting crews general physical and mental fitness
- Extended duty-times and use of heavy crew to avoid lay-overs due to testing / quarantine requirements
- Use of First class and Business class seats as rest facilities
- Unfamiliar operations, such as new airports for repatriation flights, or new gate locations for cargo vs. passenger facilities

**Some of the observed changes in safety behaviors are as follows:**

- Reduced safety and fatigue reporting by crews
- Increased likelihood of crews not identifying when impaired by fatigue
- A higher acceptance of reduced safety margins within operations
- Rushing or reduced time allocated for safety checks and procedures

These new areas of possible fatigue risk and changes in safety behavior are very concerning due to the fact that we have almost no scientific evidence or operational experience for most of these operations. In our relatively new world of SMS, we are bound by regulation to be data driven and evidence based. In order to further use any of the extreme alleviations that were permitted during COVID, we will need to collect a significant amount of data and perform extensive analysis to validate the safety of these operations. Until then, we need to move back to our established practices as soon as possible.

As we recover from the pandemic, we're seeing an overwhelming drive to return to what we knew as "normal". As with many other items in the industry, fatigue risk management will be driven to a new "normal". In the U.S. the domestic system is quickly recovering to levels we saw in the summer of 2019. We're doing this with companies that have been challenged by severe financial situations, thousands of less employees, the loss of experience that comes with early retirement/voluntary reduction programs, and an ATC system that has operated at a much reduced level since the pandemic started. For fatigue management, new fatigue risks and changed safety behaviors will continue to emerge. To alleviate this, we need to double-down on managing fatigue risk as a normal part of how we manage all other risks on a day-to day basis under an SMS.

Fatigue risk should be looked for and evaluated as part of every safety report, every safety risk assessment and every accident/incident investigation every day.



## 4. Fatigue Risk Assessment - Learning During COVID-19

### History

More than 10 years ago the organization had evaluated all Bio-Mathematical models which were available in those days in respect of validity and effectiveness based on the way the organization rostered crew members. One Bio-Mathematical was found to be best and since then integrated in Fatigue Risk Assessment, later in Crew Planning and further on in Crew Scheduling Software. The Bio-Mathematical model has since been used as a standalone tool and integrated into different software applications.

Over the years, several Safety Performance Indicators (SPIs) had been created using, amongst other elements, the highest calculated fatigue level during a flight duty period. No roster was published if a flight duty period exceeded a certain level. During day to day operations, due to delays, changes or other operational requirements, the tactical flight duty periods often resulted in fatigue levels higher than the set threshold.

By organizational procedures, this would require a replanning (delay, change of flight etc.) of the individual involved until the calculated fatigue level from the Bio-Mathematical model returned to a value below the set threshold. Bearing in mind that the Bio-Mathematical model is "only" a model, and hence not practicable for all crew members due to different sleeping patterns, time adaptations etc., the organization has also created a communication procedure between Crew Scheduling and crew members, whose values are above the set threshold. This has been introduced to identify if a replanning (delay, change of flight etc. ) of the individuals involved is required, until the calculated fatigue level from the Bio-Mathematical model returns to a value below the set threshold; or if the individual in a self-assessment – based, for example, on his/her sleeping patterns - is happy to operate, despite the model showing a higher than acceptable calculated fatigue level.

Except for some combinations, where the organization knew that the Bio-Mathematical model had some weaknesses, this procedure had been working fine since implementation.

### COVID-19

With the start of the COVID-19 pandemic and the reduction of layover stations due to health entry requirements, , the organization had to gradually change the operating patterns of crew members shifting from mainly double-sector basic crew and augmented (3-man) crew, to a large number of double-sector double-crew operations. The organization is a cargo carrier, which means that operations continued throughout the pandemic at very high levels.

Since Safety Performance Indicators had been setup long ago, using the Bio-Mathematical calculated fatigue levels, the organization was able to identify that a slow but continuous trend in higher fatigue levels was creeping into the organization. At the same time, the more double-sector double-crew operation the organization was planning, the more and more problems were identified by Crew Planning up to a point, where crew rosters could not be created anymore due to the Bio-Mathematical model exceeding fatigue levels, partially under complete illogical circumstances.

The Fatigue Expert of the Safety Department of the organization, who had been monitoring the fatigue level trend already, started – in coordination with Crew Planning - to manually analyze the different pairings, using a manual process of entering data into the Bio-Mathematical model software which, in contrast to the version integrated into the crew planning and crew scheduling software, allows for manual allocation of sleeping patterns.



During this exercise, it was identified that not only the Bio-Mathematical model was not fully suitable for double-crew double-sector operation under certain circumstances, which have been prevailing since COVID-19, but also that the integrated version of the Bio-Mathematical model into the crew planning and crew scheduling software had some

limitations, which under the "normal" operation of the operator had not resulted in extreme results, hence never been identified as problematic.

The calculation of more and more incorrect values from the Bio-Mathematical model resulted in Crew Planning being unable to create all rosters. Heavy workload and a lot less effective duty management for crew members had to be activated at a tactical level, bringing the organization to the limits of operating its fleet.

Communication between Crew Scheduling and crew members to identify if higher than threshold levels of fatigue were valid for the respective crew members resulted in additional data, verifying that the way the Bio-Mathematical model was behaving could not be correct.

Monitoring of fatigue reports, especially the fatigue reporting rate, showed no increase in incidents, complaints and "unfit to fly" calls due to fatigue.

All the later elements allowed the Safety Department to compile enough information to confirm that the fatigue risk of the operation had most probably not gone up, but the tools used by the operation were not suitable for the "new" way of operating, mainly double-sector double-crew operation.

## Take-Away

A change within your operation, despite how subtle it looks, requires an early enough Management of Change process to help you identify new hazards and/ or new triggering events.

Do not expect methods, processes, models that you have validated and used for years to continue to work when you change elements in your operations. This includes changes you might identify as small, such as using more double-sector double-crew operations.

The better your Safety Performance Indicators are, the quicker and easier you will identify if the change you are going through is also changing your risk.

Using multiple data sources, like FDM, Fatigue Reports, Communications between Crew Scheduling and crews, a Bio-Mathematical model and any other sources available, allows you to identify where the change is affecting the operation the earliest, and where the change is affecting the operation the most.

## Conclusion

The COVID-19 pandemic has been a good example of organizations needing to change in all different ways. Operators who had to reduce their flying versus operators that had to increase it. Operators who had to change the way operations are organized. Operators who had to rethink and reorganize the philosophy of its organization and many more issues. Despite all these possible differences, there is one element that is the same for all – this element is CHANGE!

CHANGE needs to be assessed early enough, regardless of the magnitude you expect it to be. Do not assess the change too late, as this will either result in a reactive situation in which you are already operating with a possible increased risk, or it will bring you to a situation where the unassessed change might result in a large obstacle in your organization, rendering you unable to continue to operate.

## 5. Parking, Storage and Return to Service - Experiences Shared from the Operational Context

The COVID-19 pandemic led to the unprecedented grounding of a large proportion of the world's fleet. The objective of this briefing is to recall some of the key issues observed and share our experience to ensure a safe and efficient return to service for all. In the previous SIRM bulletin we highlighted aspects from a Maintenance viewpoint, this article gives us the opportunity to share our experiences, with an operational slant.

The examples below are not an exhaustive list, but are among those most frequently reported to Airbus by different operators around the world.

### Pitot Probes Obstruction

#### Synopsis

Since the start of aircraft return to service, Airbus has received multiple reports of unreliable airspeed events (more than 50 events between January 2020 and March 2021). The most common cause is the obstruction of pitot probes (dirt or debris from insects, water or moisture if the probes are not correctly protected, including during washing or in high humidity conditions).



#### Awareness and actions

Airbus supports the recommendations issued in EASA SIB 2020-14 dated 05 August 2020. In addition, to highlight the importance of strictly complying with Standard Operating Procedures (SOPs), Airbus issued a Flight Operations Transmission (FOT) (ref 999.0020/21), which covers in detail best practices:

- During the exterior walkaround, the flight crew must carefully review each element in detail in order to obtain the global status of the aircraft. The check of visible sensors such as AOA, pitot and static probes is essential.
- During the takeoff roll, the Pilot Monitoring (PM) must actively monitor the speeds and engine parameters in accordance with SOPs. The speed monitoring role of the PM is not limited to the announcements of the 100 kt, V1 and rotation speeds. The PM must ensure an active monitoring of the airspeeds from the start of the takeoff roll. In doing so, the PM can detect any anomaly such as, but not limited to:



- Inconsistent airspeed indications between instruments
- Abnormal airspeed
- Abnormal airspeed trend
- Absence of airspeed indications.

Flight crews should be ready to reject the takeoff in case of any detected unreliable airspeeds, and report this in the technical logbook for maintenance actions.

To support this operational transmission, Airbus has also provided Operators and Approved Training Organizations (ATOs) with training recommendations, based on the pilot competencies identified as critical to safely manage the threats associated with unreliable airspeed at takeoff. These are provided in Operators Training Transmission (OTT) 999.0025/21, and cover the key aspects of this issue, including:

- Application of procedure
- Knowledge
- Situation awareness
- Communication
- Leadership and teamwork
- Problem solving and decision making

It is also highlighted that there is the risk of negative training that can be caused by unrealistic failure combinations or scenarios beyond FFS representativeness and cautions syllabus designers to be aware of this.

Further supporting material on this subject has also been made available to Airbus pilots, ranging from videos available on the Airbus WIN (Worldwide Instructor News) website ([airbus-win.com](http://airbus-win.com)) and app (IOS and Android devices) - "What about the exterior walkaround?" and the "Role of the Pilot Monitoring during takeoff" - to articles in the Airbus Safety First Magazine ([safetyfirst.airbus.com](http://safetyfirst.airbus.com)) - "[Unreliable Airspeed at Takeoff](#)", where the subject is looked at in more detail. The objective being to highlight to our pilots the criticality, and importance of identifying unreliable airspeed at take off.

## Non-Revenue Flights (NRF) and Maintenance Check Flights (MCF)

### Synopsis

Airbus has received numerous questions about Non-Revenue Flights and Maintenance Check Flights.





### Awareness and actions

The Non-Revenue Flight is a basic flight cycle (takeoff / landing) within the standard aircraft envelope and without any specific duration or flight profile. No specific test is required, but obviously the flight crew should report any malfunction. Any pilot can perform an NRF, i.e. no specific additional training is required.

A Maintenance Check Flight may be required by local regulations, Operator policy, or after maintenance on items for which satisfactory ground tests are not possible. EASA Part-SPO provides EASA operators with the requirements associated with MCF (in particular the required training for the Pilot in Command). Airbus encourages Operators, even non-EASA, to take this regulation into account.

For both NRF and MCF, it is important to comply with published procedures:

- Maintenance procedures as per AMM (in particular, the parking, storage, and associated return to service procedures). The acceptability of deviations must be assessed with Airbus before releasing the aircraft.
- Flight crew procedures as per FCOM and FCTM (in particular, threat and error management, task sharing and communication as per golden rules for pilots)

## Use of non-certified headsets

### Synopsis

Airbus received reports of flight crews using their personnel boomsets / headsets in the cockpit, for hygienic reasons.

### Awareness and actions

Flight crews must use only Airbus certified boomsets / headsets. Non-certified boomsets / headsets can lead to safety risks, such as interferences, incompatibility with the aircraft audio system, risk of not hearing radio altitude auto-callouts or master caution / warning audio due to inappropriate noise reduction.

## Conclusion

Despite already existing and mature Standard Operating Procedures (SOPs), the massive parking and storage, followed by return to service, leads to many challenges. This is highlighted by the increase of reports and questions coming from our Operators.

The flight crew has a key role to play in order to ensure a safe and efficient return to service. More than ever, it is important to follow the SOPs (procedures, task sharing, standard callouts), apply threat and error management, and use certified equipment in the cockpit.

## 6. Is 5G a Threat to Aviation Safety?

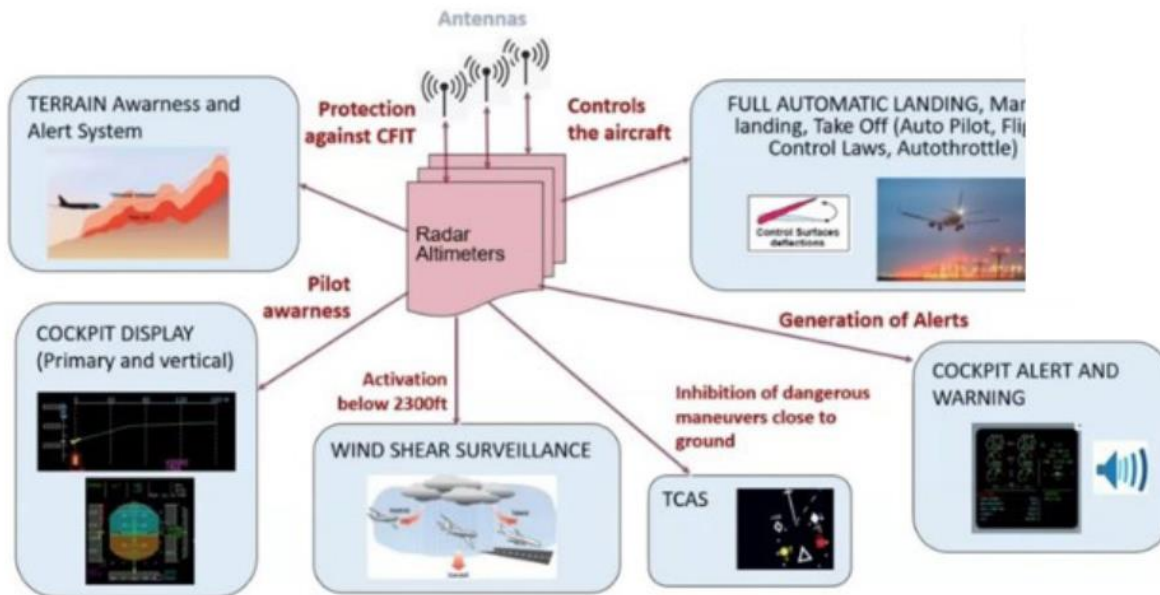
### Situation overview

In its October 2020 report<sup>1</sup>, RTCA revealed a major risk that 5G systems in the 3.7–3.98 GHz band will cause harmful interference to radar altimeters on all types of civil aircraft and helicopters. The results of the study performed clearly indicate that this risk is widespread and includes the possibility of catastrophic failures, in the absence of appropriate mitigations.

As the demand for 5G technologies is quickly growing worldwide, 5G will use a mix of low, mid and high band spectrum. Some of these frequencies are near the frequencies used by aircraft radio altimeters, and could lead to some interference.

### Identified risks

Radio altimeters provide data to numerous systems in the cockpit: autopilot, auto throttle, PFD/ND (Primary Flight Display, Navigation Display), weather radar, FWC (Flight Warning Computer), TCAS, etc.



Those systems wouldn't automatically detect possible radio altimeters erroneous information. It means that in some occasions, the crew would have to take actions and take over the control of the aircraft. It also means that inadequate actions in critical phases of flight could lead to catastrophic results. The greatest risk would be an undetected incorrect height determined by the radio altimeter, especially in a CAT II/III approach (remember the Turkish Airlines crash in Amsterdam in February 2009 where a faulty radio altimeter caused the auto throttle to decrease the engine power to idle during approach).

Other potential risks could be inhibitions of some functionalities of the TAWS (Terrain Alerting Warning System), spurious fault messages or audio in the cockpit, etc.

<sup>1</sup> "Assessment of C-Band Mobile Telecommunications interference Impact on Low Range Radar Altimeter Operations" (RTCA Paper No. 274-20/PMC-2073), October 7, 2020



## Mitigations

In France, the local authority (DGAC) has published a safety bulletin regarding this situation with some precautionary measures, including one, asking all operators to let passengers know that 5G equipment should be in plane mode or turned off during the entire duration of the flight.

Pilots will report any interference suspicion to ATC.

## Lessons learned

Although such interferences haven't occurred yet, recent studies show that measures are above a safe level and that the situation should be closely monitored by authorities, manufacturers, operators and other industry stakeholders.

New Standards (MOPS, Minimum Operational Performance Standards) will be available for next generation radio altimeters, but not before the end of 2022.

# 7. GNSS/GPS Interference Reported in Middle East Region

## GNSS/GPS Vulnerability

Global Navigation Satellite System (GNSS), including GPS, is a vital component for Automatic Dependent Surveillance - Broadcast (ADS-B), Terrain Avoidance and Warning System (TAWS), including Enhanced Ground Proximity Warning System (EGPWS). It is also a critical enabler of Performance Based Navigation (PBN) and modern air traffic management applications.

GNSS/GPS vulnerability, including intentional and unintentional signal interference, has been identified as a major safety issue, as GNSS is embedded in numerous critical infrastructures. The intentional interference presents a substantial safety threat to aircraft and passengers. In addition to the safety risk, when GNSS/GPS interference occurs in airspace with a major traffic footprint, this may also considerably degrade airspace utilization. Therefore, such interference needs to be monitored and its operational risk - assessed.

The recent data analysis, performed by IATA, indicates a notable presence of an on-going risk of GNSS/GPS Interference in the Middle East region, and thus IATA released an Operational Notice to raise awareness of GNSS/GPS Interference to airlines operating in/over that region.

## Data Analysis Finding

A total of 3,373 Aviation Safety Reports which were collected from the IATA Incident Exchange Database (IDX) and the Africa and Middle East (AME) office, were analyzed to identify GNSS/GPS Interference reports from January 2019 to December 2020.

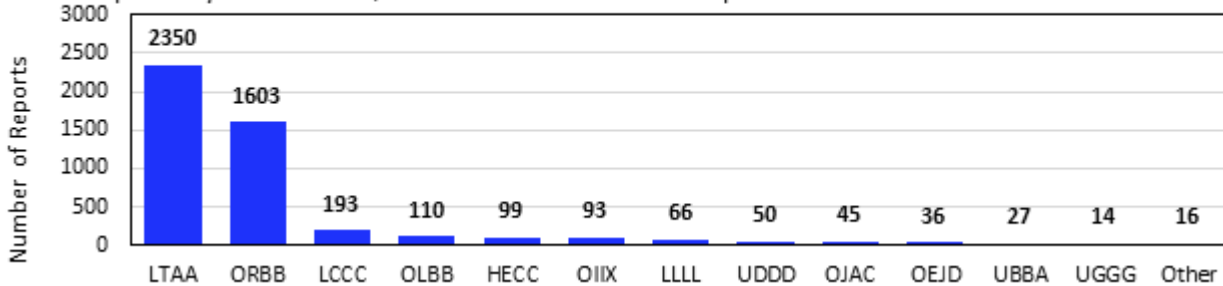


### Flight Information Region (FIR) Distribution

The majority of GNSS/GPS interference was reported in LTAA (Ankara FIR), ORBB (Baghdad FIR) and their respective borders, which sum up to 83.8% of total reports, followed by LCCC (Nicosia FIR) and OLBB (Beirut FIR).

#### Number of Reports by FIR

One report may contain GNSS/GPS interference across multiple FIRs.

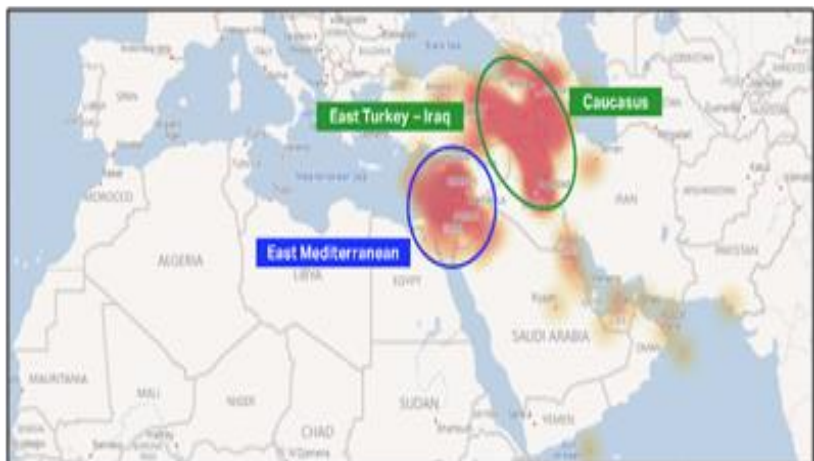


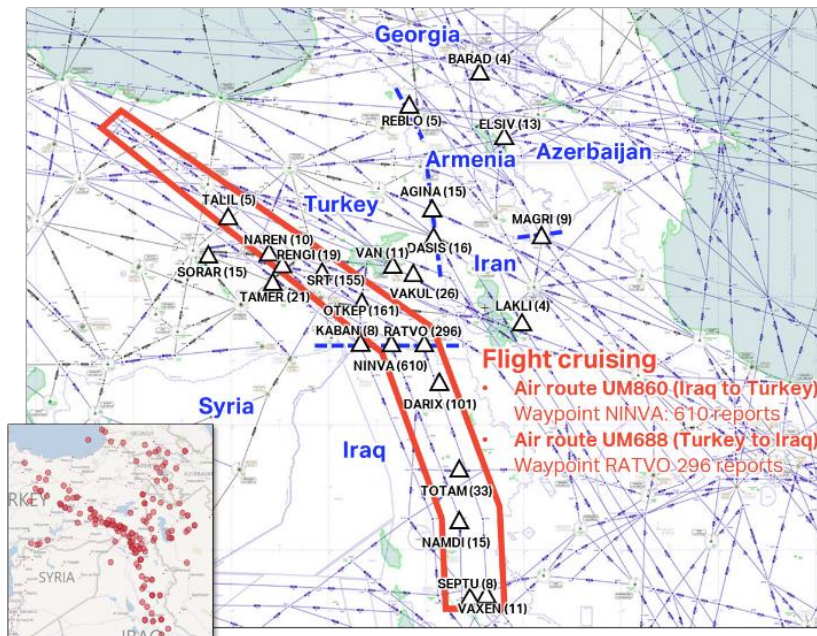
FIR Code	FIR Name	Number of Reports (%)	FIR Code	FIR Name	Number of Reports (%)
LTAA	ANKARA FIR	2,350 (50.0%)	OEJD	JEDDAH FIR	36 (0.8%)
ORBB	BAGHDAD FIR	1,603 (34.1%)	UBBA	BAKU FIR	27 (0.6%)
LCCC	NICOSIA FIR	193 (4.1%)	UGGG	TBILISI FIR	14 (0.3%)
OLBB	BEIRUT FIR	110 (2.3%)	LTBB	ISTANBUL FIR	5 (0.1%)
HECC	CAIRO FIR	99 (2.1%)	OOMM	MUSCAT FIR	4 (0.1%)
OIIX	TEHRAN FIR	93 (2.0%)	OMAE	EMIRATES FIR	3 (0.1%)
LLLL	TEL-AVIV FIR	66 (1.4%)	OKAC	KUWAIT FIR	2 (0.0%)
UDDD	YEREVAN FIR	50 (1.1%)	OYSC	SANAA FIR	1 (0.0%)
OJAC	AMMAN FIR	45 (1.0%)	DTTC	TUNIS FIR	1 (0.0%)

### Location of Reported GNSS/GPS Interference

By analyzing reported waypoints and coordinates, two major clusters were detected:

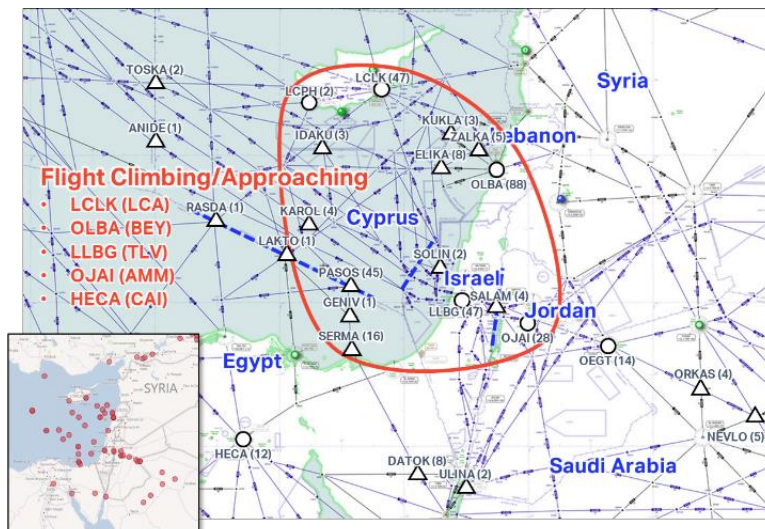
- Eastern Turkish airspace to Iraq, Iran and Armenia (extended to the border between Armenia and Azerbaijan).
- Eastern Mediterranean airspace to Cyprus, Egypt, Lebanon and Israel (extended to a corridor between Israel and Jordan)





Of the GNSS/GPS interference reports near Eastern Turkish airspace, 99.8% were reported during cruise.

Most of the reported waypoints were distributed near FIR borders, especially between Turkey (LTAA) and Iraq (ORBB). Numerous reports were concentrated over air route UM680 (Iraq to Turkey) and UM688 (Turkey to Iraq).



Of the GNSS/GPS interference reports near Eastern Mediterranean airspace, 64.6% were reported during approach, descent or climb. By contrast, flights on cruise represented only 29.2% of total reports.

Most of the reports were distributed near airports, such as Lebanon-OLBA (20.5%), Cyprus-LLCK (10.9%), Israel-LLBG (10.9%), Jordan-OJAI (6.5%) and Egypt-HECA (2.8%). However, some reports were collected at the border between Nicosia FIR (LCCC) and Cairo FIR (HECC).

## Recommendations

In 2019, IATA released a [briefing](#) on the issue of harmful interference to GNSS/GPS and presented a [working paper](#) at the 40th ICAO Assembly, urging states to adopt and implement measures to manage and reduce the causes and impacts of the interference. In the Middle East and North Africa (MENA) region, the Middle East Regional Aviation Safety Group (RASG-MID) released guidance material, related to GNSS vulnerabilities to mitigate safety and operational impacts of GNSS service disruptions. The guidance material recommends pilots to report GNSS interference and air navigation service providers (ANSP) to issue appropriate advisories and Notices to Airmen (NOTAMs).



To address the on-going risk of GNSS/GPS Interference in the Middle East region, IATA invites:

1. States and ANSPs to proactively identify GNSS/GPS interference and promptly notify airspace users with advisories, safety bulletins and NOTAMs;
2. States and ANSPs to analyze the risk level of harmful interference to GNSS and establish contingency procedures and infrastructure as appropriate;
3. Airlines to monitor NOTAMs and advisories and brief crews to be aware of potential GNSS/GPS interference, its impact and contingency procedures during GNSS capability loss; and
4. Airlines to encourage active reporting of GNSS/GPS interference to relevant national authorities and IATA.

## 8. As Aviation is to Freedom, so Conflict Zones are to Safety and Security

It is often said collaboration on key topics, like aviation safety and security, is the greatest control measure of identified risks itself. The collaboration between Governments and industry on conflict zones has strengthened since the tragic events of MH17 over Ukrainian skies in July 2014 and is further underscored by the downing of Ukrainian International Airlines flight PS752 in Tehran, Iran, January 2020. Both events are deeply unacceptable, still remain under judicial authority and/or ICAO Annex 13 investigations, highlighting why this topic overall remains a priority for governments, airlines and the traveling public.

Civil aviation has come a long way, largely owing to the tireless work of the International Civil Aviation Organisation (ICAO), a small number of States, with specific emphasis on work undertaken by the Dutch Safety Board (DSB) and United States Federal Aviation Administration (FAA), airlines who operate internationally, Air Navigation Service Providers (ANSPs), and geopolitical security risk service providers. It is arguable that the nature of hostilities and the number of active conflict zones, as defined by ICAO [Risk Assessment Manual for Civil Aircraft Operations Over or Near Conflict Zones \(Doc 10084\)](#), has dissipated in recent times. However, regulated operators still face many kinds of risks arising from conflict zones, but the collective management of identified risks has, no doubt, evolved. Despite the tragic events mentioned above, there are several recent examples where hostilities within a State and/or transnationally have resulted in significant civil airspace contingency operations, but successfully risk managed flight safety outcomes.

Key issues, such as timely information-sharing, military and civil airspace coordination, harmonization of NOTAM information and the ever-debated nexus between ICAO standards and the on-going reliable implementation of standards and recommended practices (SARP/s) persists. Both the European Commission and the US have established multilateral platforms for government and industry to share timely information on a need-to-know basis. However, the remaining regions of the world, which historically suffer from the effects of conflict zones, are yet to put in place a similar mechanism, or realize the opportunities and safety/security outcomes to be achieved from similar collaboration.

In March 2021, IATA hosted an online extraordinary information sharing briefing for airlines who operate into- and over- the Jeddah Flight Information Region (FIR), following a notable change in the intelligence paradigm. The briefing was simply about providing a baseline and factual understanding of the direct and indirect risks to airlines operating within the FIR.

Moreover, the nature of the call provided an opportunity for NOTAM issuing Governments to speak not only directly to the safety policies in reaction to significant events, but more so to the strategic considerations of the hostilities.

Through this unique exchange in an unclassified setting, airlines were able to learn insights in the way Governments perceive specific indicators and what that means for the policy responses thereafter. In a challenged international air travel operating environment for now, a degree of predictability within safety and security risk management, to the extent possible, provides useful relief for scheduled airline operations.

For more information please contact [aviationsecurity@iata.org](mailto:aviationsecurity@iata.org) and/or register for [the Global IATA Tactical Operations Portal](#).



Image provided by [Risk Advisory](#), an [IATA Strategic Partner](#).

## 9. Detection of Unstabilized Approach

By *Burhan Gemici & Serdar Şahin, Corendon Airlines*  
For further details on this study, please refer to Annex A of the Bulletin.

### Introduction

Unstabilized approach (UA) is a key figure for aviation industry and safe flight operations, and Flight Data Monitoring (FDM) programs are the most common tools to detect an unstabilized approach for all type of aircraft operators.

The expectation after an unstabilized approach is the same for the entire industry: execution of a go-around maneuver. However, as it has been stated in the Go-Around Safety Forum study in 2013 [1], one of every ten go-arounds contains a potential hazardous outcome, such as aircraft performance limit exceedance or fuel endurance. That is why, promoting go-around execution after any deviation in every circumstance, includes a paradox in it.

Additionally, the Go-Around Safety Forum study [1] suggests that the go-around policy of operators should be refined, subjectivity of decision-making should be minimized, and potential threats should be monitored actively to manage the state of safety at the highest possible level at all phases of flight.



Go-Around policy compliance statistics show us that only 3% of detected unstabilized approach comply with the go-around policy [2]. Although there are many reasons to have such low statistical results, here are a few listed below:

- *Even though go-around is a normal phase of flight, they are rare and when go-around occurs it is often performed poorly [1]*
- *Pilots do not believe that go-around policy is realistic enough [2]*
- *Industry accepts the non-compliance of go-around policy [2]*
- *Overall awareness about the impacts of unstabilized approach is low [2]*

## Current UA Detection Algorithm

Any approach, which does not meet with the stabilized approach criteria defined in an operator's SOP, is evaluated as an unstabilized approach.

To make the definition of stabilized approach as the industry standard, a common set of parameters defines the stabilization criteria [3]. Some of these parameters are as below:

- Target an approach speed only few knots faster than the desired touchdown speed
- Target a rate of descent which collaborates the approach angle and speed
- Target an altitude where the landing configuration completed
- Target an attitude of stability in all 3 axes
- Target a stable thrust above idle

To detect the deviation from the stabilized approach criteria, operators are generally looking for the triggered FDM events such as:

- Incorrect Landing Configuration
- More than 1/4 dot Localizer Deviation
- More than 1 dot Glide Slope Deviation
- IAS too high or too low relative to a reference speed
- Vertical Speed Higher than 1000 ft/min
- Pitch attitude too low or too high (fleet and SOP Specific)
- Bank angle greater than 7 degrees
- Thrust Power not stabilized or below idle

Therefore, when these events are triggered during an approach, the approach phase is evaluated as unstable and a go-around maneuver is expected.

However, looking at triggered events only is contradicting the approach phase integrity. When one looks at the triggered FDM events, it means that one is looking at the moments of an approach and disregards the pilot's decision, given control inputs and reaction of the aircraft [3].

As the result of this detection method, unstabilized the number of unstabilized approaches increases resulting in the following disadvantages:

- Insensitivity of flight crew about unstabilized approach detection [2]
- Accepting the continuation of unstabilized approach and low statistical go-around policy compliance results [4]
- Creates additional stress on flight crew [4]



## Searching for a New Model

To increase go-around policy compliance, sensitivity should be increased, and risk of go-around should be minimized, while keeping the stress factor as low as possible. Due to that, while evaluating an approach against stable approach criteria, effective control input and reaction of aircraft systems should be considered.

Once an analysis is conducted through the triggered FDM events, it can be seen that approach events generally trigger in groups. Most of the time, there is a direct relationship with the selected events.

To reach this aim, two principles can be added into the unstabilized approach detection method: Continuity and Event Score.

**Continuity** describes the non-presence of active monitoring and effective control conditions. When these conditions are not present in the cockpit, after the first FDM event, a chain reaction would start, and other FDM events would continue to occur.

**Event score** describes the differentiation between the triggered FDM events and flights with their existing level of severity and involved risk factors.

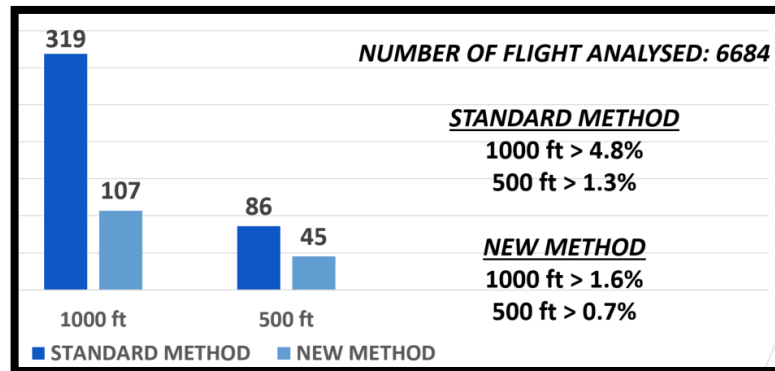
To implement these principles into the unstabilized approach detection method, score values of the triggered FDM events are summed together to calculate one total score for the whole approach phase of the flight. The tables below visualize this implementation.

Event Name	Event Score	Event Name	Event Score
Approach Speed High (1000-500 ft)	1	GPWS Warning	3
Approach Speed High (500-50 ft)	2	GPWS Terrain or Pull Up	5
Approach Speed Low (1000-500 ft)	2	Stall Warning	5
Approach Speed Low (500-50 ft)	3	Low Speed Selection	5
High Rate of Descent (1000-500 ft)	1	Late Landing Gear	2
High Rate of Descent (500-50 ft)	3	Excessive Bank on Approach	2
Flap movement (1000-500 ft)	3	Low Power On Short Final	2
Flap movement (500ft to TD)	5	Unstable at Low Altitude (Flap)	1
Speed brake deployed (1000-500ft)	2	Unstable at Low Altitude (Spd Hi)	1
Speed brake deployed (500ft to TD)	3	Unstable at Low Altitude (Spd Lo)	1
TOGA Engaged	5	Unstable at Low Altitude (VSI Hi)	1
		Unstable at Low Altitude (VSI Lo)	1

FLIGHT #	METEO.	IMC 1000 FT LIMIT		VMC 500 FT LIMIT		TOTAL SCORE
		EVENT NAME	Coef.	EVENT NAME	Coef.	
1	VMC	Approach Speed High	1	Approach Speed Low	3	4
				Unstable at Low Alt. (Spd Low)	1	
2	VMC	Flap Movement	3	Approach Speed High	2	2
		Approach Speed High	1			
3	VMC	-	-	High Rate of Descent	3	6
				GPWS Sink Rate	3	
4	IMC	Approach Speed High	1	High Rate of Descent	3	4

## Conclusion

Using a business intelligence tool, over 6600 flights have been analyzed with this new algorithm. Results of the unstabilized approach detection decreased drastically, as can be seen in the figure below.



As a result of the study, once the proposed above method is established in the FDM program of an operator, the following benefits may be achieved:

- Comparison of Standard Method and New Method can visualize how much noise is being generated by the FDM program algorithm
- Increase general flight analysis techniques of an FDM specialist
- Increase awareness of unstabilized approach for both operator's management and flight crew
- Convince flight crew about the realistic implementation of the go-around policy
- Help improve compliance with go-around policy
- Reduce the risk associated with unnecessary go-around execution
- Reduce the stress level on flight crew created over detection of an unstabilized approach
- Help investigate deeper the relationship between unstabilized approach and fatigue or environmental factors

## References

[1] - Go-around Safety Forum / 18 June 2013 / Brussels: Findings and Conclusions

[2] - Go-Around Decision-Making and Execution Project

[3] - Unstable Approaches: Risk Mitigation Policies, Procedures and Best Practices 2nd Edition

[4] - Human Factors Contributing to Unstabilized Approaches and Landings in Commercial Aviation Incidents: An Analysis of ASRS Reports

[5] - Guidance for FDM precursors (EOFDM WGB-RE25)

## 10. Review of an Airport Adverse Weather/Thunderstorm Definition and Criteria for Ground Operations

### Overview

The event took place last summer, and it prompted us to review the airport adverse weather/thunderstorm TS-3 (IATA RED Equivalent) criteria for ground operations. Two mechanics were working on a stepladder underneath a B787 while thunderstorms were approaching TYO international airport.

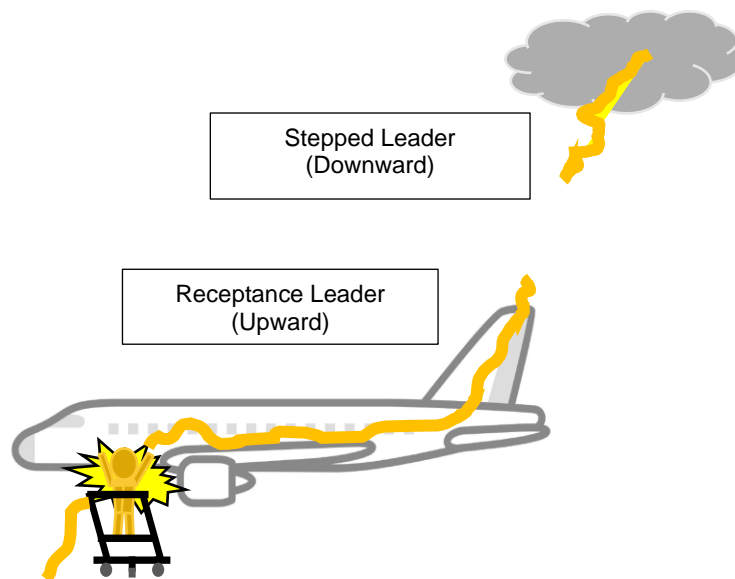
The approximate position of the thunderstorms was still far enough to activate the thunderstorm warning, while the airport weather at that time showed no sign of adverse weather impacting the working conditions on the ramp where the B787 was parked. It was absolutely safe to do the job.

Therefore, the two mechanics continued the work on the stepladder. Suddenly both of them fell to the ground without realizing what had happened to them. They were rushed to the hospital nearby and diagnosed with an electric shock injury of some kind.

During the investigation, we first needed to find out how the two mechanics received an electric shock. So, we made two hypotheses as to the probable causes.

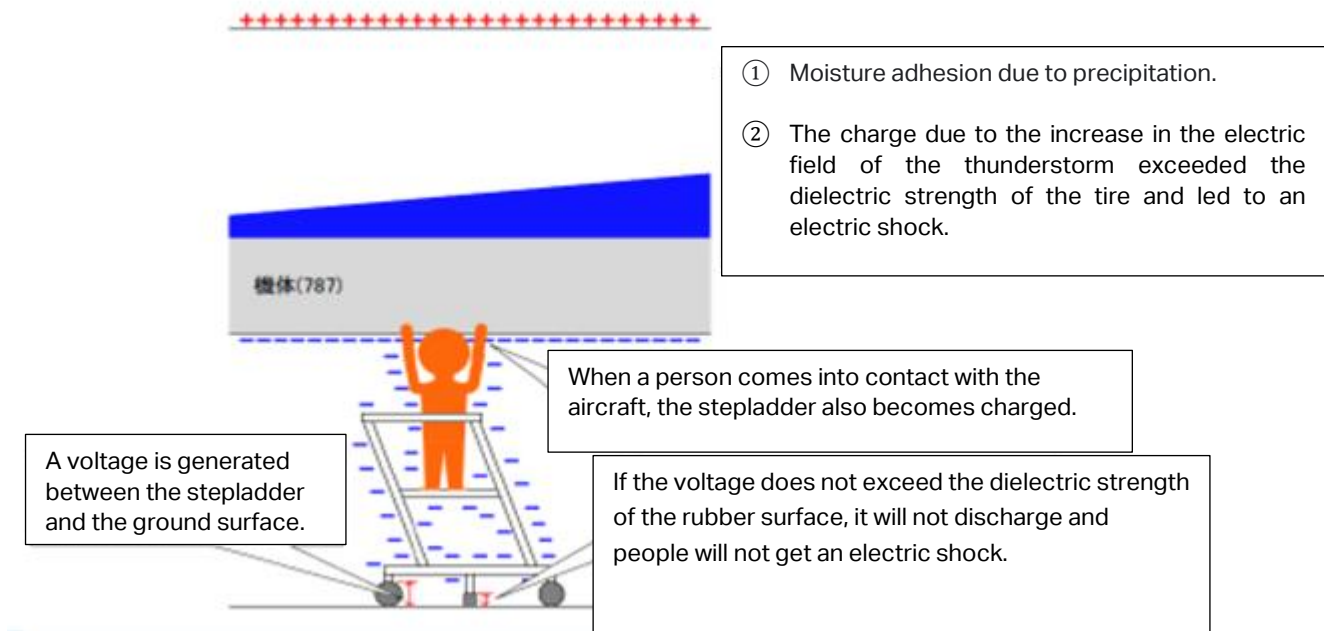
### Probable Cause

#### Case 1 – *Stepped Leader theory by approaching thunderstorm*





Case 2 – Electric shock due to contact with charged material (the charged airframe and the person become the ground)



After we consulted with an institution specialized in researching lightning rods, both hypotheses were identified as a hazard to ground operations during a thunderstorm that is approaching or is nearby the airport.

Therefore, we have revised the definition and criteria of the airport thunderstorm warning for ground operations.

## What is “Stepped Leader”

Stepped leaders develop within thunderstorm clouds when charge differences between the main region of negative charge in the middle of the thunderstorm, and the small region of positive charge near the base of the storm become large (**Figure 1, next page**).

Stepped leaders start to develop when charge differences in the cloud become too large. When this happens, the insulating capacity of the air breaks down and the negative charge starts moving downward (**Figure 2, next page**).

Typically, the small amount of positive charge at the base of the cloud, near the developing channel, is not sufficient to satisfy the negative charge that has accumulated along the conductive channel aloft. Consequently, the negatively charged channel emerges from the bottom of the cloud and continues to move toward the ground (**Figure 3, next page**).

It is worth noting that the tip of the stepped leader does not sense the actual charges on the ground as it emerges from the cloud. Rather, as it moves out of the cloud, the stepped leader only senses charges within about 50 meters of the leader tip. As a result, the stepped leader surges ahead in 50-meter segments, based solely on the charges in the air, immediately surrounding the tip (**Figure 4, next page**). Each surge of the leader produces a small flash of light, which can be detected by high-speed cameras.

As a result, the path of the leader from cloud to ground can be very jagged and indirect ( **Figure 4**). Consequently, **the leader does not take the path of least resistance from cloud to ground as it moves blindly toward the ground. In addition, the stepped leader generally branches outward as it seeks a connection to the ground.**

Depending on the electric field surrounding the step leader, individual branches of the leader may become more or less prominent, ( **Figure 5**).

While the stepped leader develops downward at a speed of 200,000 miles per hour, the leader would move much faster if it didn't pause between each of its steps downward.

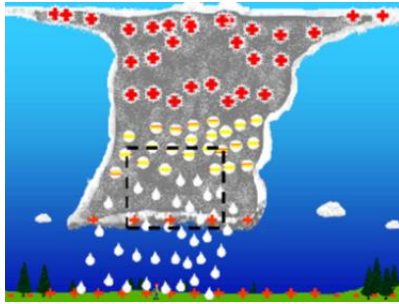


Figure 1

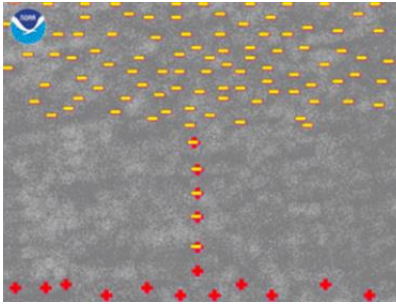


Figure 2

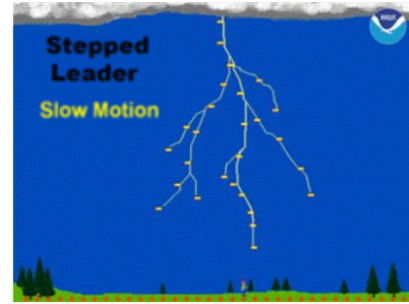


Figure 3

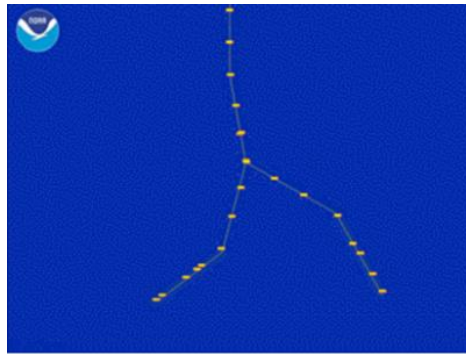


Figure 4



Figure 5

The definition for a thunderstorm countermeasure before the event was as follows:

**Thunderstorm Caution (TS CONDITION-1):**

- When a thunderstorm is observed within a 50 km (27.0 nm) radius from the airport and is expected to come close to the airport.
- Or, when a thunderstorm can no longer be observed within a 20 km (10.8 nm) radius but can be observed within a 50 km (27.0 nm) radius from the airport after TS-2 is issued.

**Thunderstorm Warning (TS CONDITION-2):**

- When a thunderstorm is observed within a 20 km (10.8 nm) radius from the airport and is expected to come close to the airport.
- Or, when a thunderstorm can no longer be observed **within a 5 km (2.7 nm) radius** but can be observed within a 20 km (10.8 nm) radius from the airport after TS-3 is issued.

**Thunderstorm Alarm (TS CONDITION-3):**

- When a thunderstorm is observed **within a 5 km (2.7 nm) radius** from the airport.



The definition for thunderstorm countermeasure after the event was as follows:

**Thunderstorm Caution (TS CONDITION-1):**

- When a thunderstorm is observed within a 50 km (27.0 nm) radius from the airport and is expected to come close to the airport.
- Or, when a thunderstorm can no longer be observed within a 20 km (10.8 nm) radius but can be observed within a 50 km (27.0 nm) radius from the airport after TS-2 is issued.

**Thunderstorm Warning (TSCONDITION-2):**

- When a thunderstorm is observed within a 20 km (10.8 nm) radius from the airport and is expected to come close to the airport.
- Or, when a thunderstorm can no longer be observed **within an 8 km (4.3 nm) radius** but can be observed within a 20 km (10.8 nm) radius from the airport after TS-3 is issued.

**Thunderstorm Alarm (TSCONDITION-3):**

- When a thunderstorm is observed **within an 8 km (4.3 nm) radius** from the airport.

## Other hazards that are considered

- A possibility of being injured by electric shock when the announcement is made at 5 km from the lightning strike position
- Current SOP that allows the work at the time of TS3 announcement
- The width (interpretation) of TS2 is too wide, and it is difficult for workers to judge whether or not the work can be continued
- There are variations in workers' knowledge and awareness of lightning response
- There is a range in the timing of TS issuance (skills and experience of the person who issue TS Alert/Warning, judgment is depended upon just by looking at the monitoring on the screen, consideration for the impact on operated flights, consideration for the situation of other airlines)
- SOP to share the information with flight crew in a timely manner is not clear
- Current GRD WIRE handling procedure may create electric shock risk

## Fundamental policy for a barrier to be implemented

- Considering the time to make a complete evacuation of all outside workers, evacuation shall be completed when the thunderstorm reaches 5km; TS-3 will be issued when the thunderstorm reaches 8km from the airport
- Reviewing educational material for thunderstorm and lightning
- Provide awareness regarding thunderstorm and lightning (Occupational Safety)
- Be more transparent as to the timing of TS alert warning issuance

# 11. Traffic Alert and Collision Avoidance System Resolution Advisory (TCAS RA) Compliance Study in European Airspace

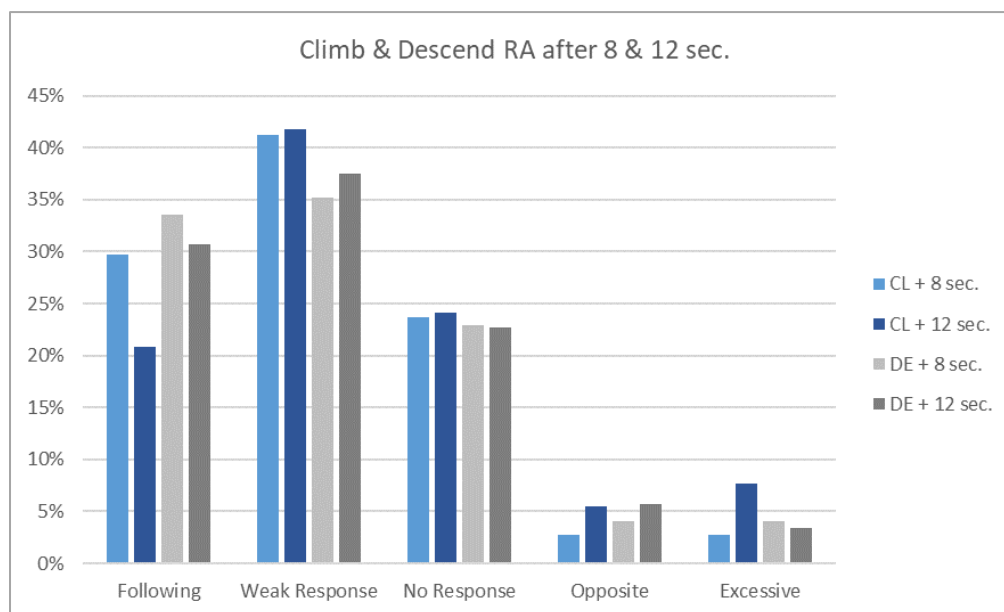
By Stan Drozdowski, EUROCONTROL

In 2019, IATA in cooperation with EUROCONTROL published a document, *Performance Assessment of pilot compliance with Traffic Alert and Collision Avoidance System (TCAS) using Flight Data Monitoring (FDM) – Guidance Material*. The Guidance Material (GM) was subsequently updated in November 2020.

## TCAS RA Compliance Study (European airspace)

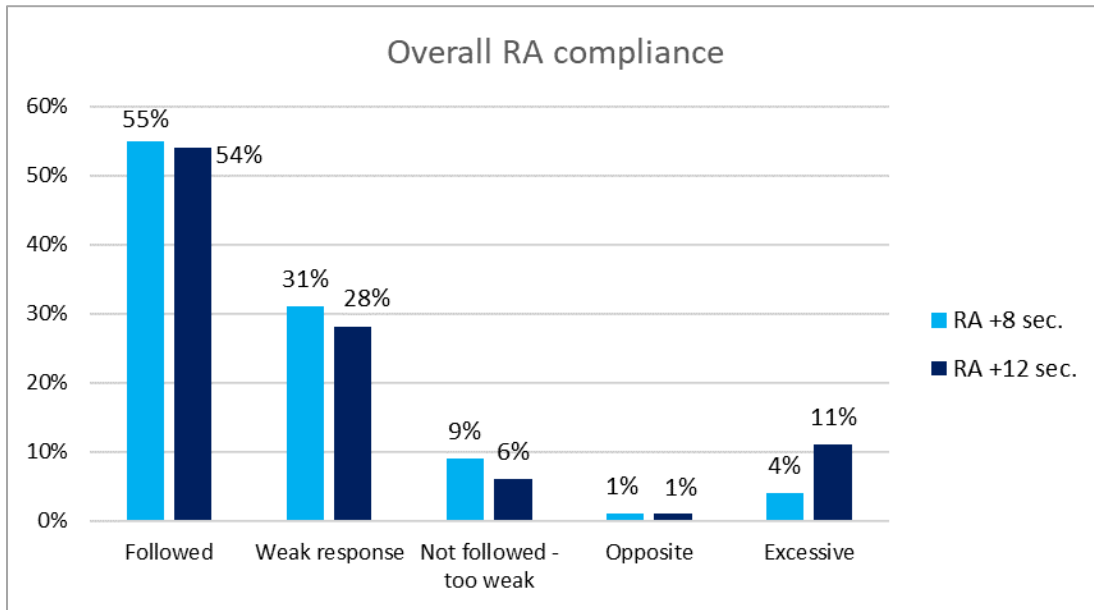
The TCAS RA compliance methodology described in the GM was used by EUROCONTROL in the 2020 study of pilot RA compliance. EUROCONTROL used surveillance data, which was gathered (before the COVID-19 crisis) in core European airspace over a period of 12 months, to assess how pilots complied with TCAS RAs. The study was expanded in 2021 to use an alternative – less rigid – assessment methodology, that gives credit to a pilot having to significantly change vertical rate (e.g. from climb to descent), even if the final required vertical rate has not yet been achieved. Furthermore, additional pilot compliance calculations were conducted to establish compliance by the type of operation and the aircraft type group or family. The full report is available on [SKYbrary](#).

Compliance varied, depending on RA type and duration. Using the method introduced in 2021, approximately a third of Climb and Descend RAs were classified as “Followed” at 8 seconds after the RA. At 12 seconds after the RA, the compliance was slightly lower. Just over 40% of Climb and Descend RAs were classified as “Weak response” and approximately 25% as “No response” (see figure below).





The figure below illustrates the overall RA compliance rates. For Level Off RAs two thirds of responses were classified as “Following”, which benefited the overall compliance picture.



The study found a number of cases where, in the absence of correct pilot response, vertical separation at the Closest Point of Approach was significantly reduced. However, the relative infrequency of these cases meant they could not be used to draw statistically significant conclusions. Moreover, the achieved vertical separation was affected by additional factors, including: pilot responses to modified RAs; maneuvers of the other aircraft in the encounter; and, in the case of Level Off RAs (which are typically issued when the aircraft are still separated) any erosion of separation is difficult to detect.

No significant performance differences were observed between different aircraft types.

The study did not look into the reasons for non-compliance as the examined data was just a snapshot of the event and no operational context was available.

## Assessment of TCAS RA – cooperation between aircraft operators and ANSPs

The development and implementation of the TCAS was driven by aviation accidents. In order to benefit from the protection offered by TCAS, pilots must respond to RAs promptly and accurately. Reasons behind any non-compliance must be understood and addressed. A *TCAS RA not followed* has been identified as one of IATA’s priorities and one of *EUROCONTROL’s Top 5 operational risk priorities*. It will become particularly more vital when traffic levels start to increase in a post-COVID environment.

The assessment of TCAS RA compliance using surveillance data (as in the above-mentioned study) is subject to some limitations. The airborne data will allow for the assessment of individual pilot responses, but it will not provide the operational context of the event. Therefore, cooperation between aircraft operators, ANSPs as well as other stakeholders, is needed to fully understand the RA event.



It is fully recognized that a detailed investigation of each RA is not practical; however, events in which a serious loss of separation has occurred, or pilot response was substandard, should be examined carefully using all possible data sources. This should contribute to the identification of reasons for noncompliance, and areas that should be addressed in training activities or awareness material.

Furthermore, IATA and EUROCONTROL would like to encourage aircraft operators to not only encourage reporting of RA events, but also to provide (as far as practical) their pilots with feedback regarding their performance during

RAs in real time, or shortly after the event. Pilots alone cannot reliably assess how the RA was flown, that can only be done using recorded data. The fact a collision was avoided, is not necessarily an indication that the RA was flown correctly.

## IATA/EUROCONTROL Guidance Material

Technical talks are taking place between IATA and EUROCONTROL to update the Guidance Material by incorporating the methodology used in the study quoted above, as well as to provide aircraft operators with a tool, allowing for precise pilot compliance assessments.

EUROCONTROL and IATA would welcome the opportunity to cooperate (on a confidential basis) with aircraft operators on the assessment of pilot compliance, and the validation of the Guidance Material.

### References

- [IATA/EUROCONTROL Guidance Material](#) on Performance assessment of pilot compliance with Traffic Alert and Collision Avoidance System (TCAS) using Flight Data Monitoring (FDM), 2nd edition, November 2020
- [Assessment of pilot compliance with TCAS RAs](#), TCAS mode selection and serviceability using ATC radar data, EUROCONTROL, April 2021
- [TCAS RA not Followed](#), Network Manager Operational Safety Study, EUROCONTROL, September 2017
- [EUROCONTROL: Traffic Alert and Collision Avoidance System \(TCAS\)](#) – Selected Statistical and Performance Data in Core European Space, February 2020
- [EUROCONTROL ACAS Guide](#), December 2017

# 12. Experience Bleed in Aviation and its Impact on Safety

## Introduction

As the aviation industry is slowly battling its way through the most severe crisis in its history, we are slowly starting to see light at the end of the tunnel. The availability and administration of vaccinations is progressing and in many parts of the world reaching levels which allow societies to return to pre-COVID ways of living. We have already seen in the Chinese domestic market that the demand for air travel will return as governmental restrictions are removed. Furthermore, the United States is a good example of both the effectiveness of vaccination campaigns and its positive impact on domestic air travel. Even though international air travel is still nowhere near pre-COVID levels, suggestions by President of the European Commission, Ursula von der Leyen, signal that from summer 2021 onwards, recovery should come to this segment too.

## Recovery by Geographic Region<sup>2</sup>

—2019 —2020 —2021



It is great to see the enhanced collaboration between airports, airlines and ground handlers which allows them to quickly react to these changes, restart their operations and start flying people across the world once again. However, the past year has been very tough for the industry. Extreme measures had to be taken by many companies in order to secure their survival throughout this crisis. In this article we will investigate the impact on safety of some of those measures. We will look into some challenges we have observed and propose potential mitigation strategies.

## Challenges

Many of the stakeholders in the aviation industry are characterized by business models that include a relatively high degree of fixed costs. So, when the COVID crisis struck, and practically all revenues disappeared, cashflow was the number one issue to manage. Across the board we saw initiatives to reduce costs. This could include terminal closures, selling or retiring of aircraft and, unfortunately, also the furlough or (even worse) laying off of employees. In particular labor-intensive ground handling companies had little choice other than to reduce their workforce to a minimum.

Even though these kinds of measures did have an almost immediate effect, they are short-term solutions, which automatically create other issues for the medium to long-term. Many of the employees that have been laid off have found new jobs. Especially the more skilled and experienced ones as they are more likely to have had a better position on the labor market than their relatively low skilled or inexperienced colleagues. Without any additional action, as the industry restarts, the demand for these people, who have been laid off and found jobs elsewhere, returns. Unfortunately, the qualified staff who used to do these jobs are now no longer available. The challenge is further magnified by the fact that human resources for ground handling jobs were already scarce pre-COVID.

## Consequences

In practice, this leads to a situation where the number of people for ground handling jobs relative to the workload has decreased. Furthermore, the experience of those that are still available has also decreased. More traffic and less (well-trained) resources lead to more pressure (stress) on the system. History has already shown that increased stress on the system leads to more failures and reduced safety. The reduced level of experience makes the situation more severe.

One use case for Assaia's Apron AI technology is to use cameras and computer vision technology to automatically detect unsafe situations (e.g. pre-arrival stand check is not performed). Looking at the total number of unsafe situations that we have detected, we can clearly see an increase in this number between the end of November 2020 and beginning of April 2021.

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<sup>2</sup> Source: FlightAware, <https://blog.flightaware.com/visualizing-the-impact-of-covid-19-on-the-aviation-industry>  
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Safety in itself is an existential requirement for air transport. Especially now, as people are rethinking the need for travel, it is more important than ever that the option to fly is a safe one. Confidence and trust will need to be rebuilt to some degree and safety is foundational to that.

## Mitigation Strategies

So, what can airports, airlines and ground handlers do to mitigate the problem described above? Below, we elaborate on two solutions that address the availability of human resources and the experience levels.

### Increasing productivity

One way to handle less human resource availability is to reduce your dependency on them. There are many possible digitization and automation initiatives, which can increase employee productivity and reduce the required number of staff. Investments in these kinds of innovations have often suffered during the crisis. However, now is the time to consider engaging in such projects, as they may solve a direct, short-term problem while at the same time creating a competitive advantage by lowering the cost base for the medium to long term.

Luckily many airports, airlines and ground handling companies have already started projects in this direction and therefore do not have to start from scratch. It is, however, important that these initiatives are revived and executed with increased focus and reduced delivery times.

### Increasing training and feedback loop

The other issue regarding a lack of experience in the workforce has to be addressed as well. Typically, people starting in new positions will receive job-related training. We believe that these training programs can, however, be more targeted through a better understanding of the root causes of unsafe behaviors. And in order to enhance this understanding, data is going to be crucial. Traditionally, safety data is manually collected through audits and safety reports. This way, however, can be cumbersome and subjective, making proper root-cause analysis more difficult to perform. Furthermore, the presence of auditors is typically known, which can also negatively influence the reliability of audit data.

We believe that existing camera systems at airports could be used in combination with computer vision software that can automatically detect unsafe behaviors. These systems work objectively, 24/7, without impacting the way work is executed. Another major benefit of such automated audit systems is that they enable continuous feedback loops, where employees can receive both positive and negative feedback on their performance.

It is good to note, however, that the objective is not to evaluate an individuals' performance but rather the operational processes in general.





# 13. COVID-19 Vaccine Distribution: The Role of Air Cargo Technology

*By Scott Sangster, VP, Global Logistics Service Providers at Descartes*

The global nature of the pharmaceutical manufacturing and distribution landscape, coupled with the regulatory requirements of individual countries, has always made pharmaceutical logistics a challenge. However, delivering the unprecedented volume of doses of COVID-19 vaccines to the world's population over the next three to five years is perhaps the largest single transportation challenge the air cargo industry will ever face, requiring a rigorous logistical approach.

Shipping via air cargo has always been best practice for moving high-velocity, high-value goods like pharmaceuticals, but cold chain logistics involves additional challenges that impact how pharma manufacturers and their logistics partners navigate the process.

## Pharma Cold Chain Logistics Challenges

### Strict Temperature Requirements

To ensure the integrity of the COVID-19 vaccines, air cargo logistics providers must ensure that Pfizer's vaccines are transported and stored at negative 70 degrees Celsius, while the Moderna, Astra Zeneca, and Janssen (Johnson & Johnson) vaccines will remain stable between two and eight degrees Celsius. Unfortunately, 25% of all vaccines are degraded when they reach their destination due to improper shipping, while 20% of temperature-sensitive products are damaged during transport due to a broken cold chain.

### Complex Chain of Custody

Air-based shipping is a multi-party process: before temperature-sensitive COVID-19 vaccines reach their final destinations, they will be subjected to multiple hand-offs, including the manufacturer, logistics service providers (LSPs), ground handling agents (GHAs), air carriers, and last mile distributors. Numerous touchpoints across disparate data collection systems complicate the safe and effective shipment of the vaccines.

### Shipment Visibility Gaps

Traditional tracking networks are expensive to deploy and provide limited coverage, leaving tracking gaps in the pharmaceutical logistics chain that can lead to theft, diversion, loss, counterfeiting, and product degradation. Plus, without an easy way to access critical shipment data, air cargo logistics providers and their end customers are left in the dark.

## Risk Mitigation: End-to-end Visibility

Recent Internet of Things (IoT) advancements enable the air cargo logistics community to monitor the status and location of shipments as they move through multiple hand-offs across the pharmaceutical supply chain, providing seamless end-to-end visibility. Using next-generation sensor-based Bluetooth-enabled tracking tags attached to cargo, LSPs can access a range of real-time data (e.g., location, temperature, humidity, light) to determine if product conditions are deteriorating and/or intervention is required.

Adding further resiliency to the tracking and data capture process, low-cost mesh networks across first/last mile carriers, freight forwarders, airports, GHAs, and air carriers automatically capture the movement and status of in-transit shipments. Using lower-cost, multi-path mesh networks, data is transmitted from multiple nodes to active gateways to provide overlapping coverage and close any visibility gaps.



To simplify the tracking process and ensure supply chain transparency, LSPs can access cargo data via mobile apps on their phones to provide a comprehensive door-to-door tracking process. Smartphones provide great flexibility for capturing data, receiving or delivering shipments, or interrogating shipment status on-demand across multiple touchpoints in the cargo journey. With advanced cloud-based tracking platforms and the open architecture of the tracking network, all participants in the pharmaceutical logistics chain can capture critical data effectively, eliminate data silos, and enable better decision-making.

## Lessons Learned

The air cargo logistics community needs to lead the way in creating a transparent end-to-end pharmaceutical supply chain. To create this transparency, the logistics community must adopt these five principles:

1. **Unify the tracking process across all parties in the supply chain:** Eliminate the gaps and standardize the data for a true end-to-end view
2. **Deploy common tracking technology and open network connectivity:** Ensure tracking across the entire logistics chain despite the numerous hand-offs
3. **Automate data capture:** Improve data accuracy and timeliness; reduce tracking labor
4. **Create a closed-loop process for reusing tracking tags:** Reduce tracking costs and improve sustainability of the logistics chain
5. **Proactively provide manufacturers and distributors with location and in-transit vaccine health status:** Prove the efficacy of the logistics chain and allow them to make more dynamic deployment decisions

Simplicity, resiliency, pervasiveness, and interoperability are the key requirements to establish true end-to-end pharmaceutical shipment visibility across the multi-party logistics chain. Advances in IoT capabilities, in parallel with advanced network strategies, make it possible for the air cargo logistics community to meet these requirements now. The result is a safer, more secure, and efficient logistics chain that is poised to meet the challenges of global COVID-19 vaccine distribution.

## 14. Aircraft Microbiological Contamination – What You Can't See, Can Hurt You!

*By Conidia Bioscience and ECHA Microbiology*

### Unwanted Microscopic Retribution

Further to the article entitled "The evaluation and risks associated with not using a fuel biocide" written in the 2020 - SIRM Special COVID-19 Bulletin October 2020, this article is meant to raise further awareness of consequences of microbiological activity in aircraft fuel systems during the pandemic.

Why are we talking about microbiological growth in aircraft fuel systems now? Microbial contamination is not a new problem for aircraft and the vast majority of airlines test for its presence in accordance with IATA Guidance and aircraft OEM maintenance recommendations. But the jet fuel that has been sitting in parked aircraft may well have changed significantly over the recent months. Whilst the pandemic has affected our lives so detrimentally, changes in the ecology within aircraft fuel tanks have benefited the lives of the unwanted microbes that can thrive in there.



Even if fuel was on-specification when delivered, minimal traces of microbial contamination can proliferate and, consequently, with prolonged parking, the fuel quality cannot be guaranteed when the aircraft is returned to service. Worse still, the aircraft may suffer the consequences of clogged fuel filters, damaged fuel system components and airframe corrosion.

Fungi and bacteria are nearly always present, even in clean fuel, due to contact with ambient air, and with pipeline and tank surfaces, from the time the fuel is produced and certified at the refinery, until it is delivered to your aircraft; it is the nature of life. And when and wherever these microbes come into contact with even tiny traces of water in the fuel tank, they will proliferate.

## Pandemic Conditions

Since March 2020, most aircraft have been parked, typically with 10-15 % fuel tank capacity. As a consequence, there is sufficient contact with ambient air to allow microbes to enter fuel tanks, and ample opportunity for water condensation to occur, particularly where aircraft are parked in humid climates or where there are significant diurnal temperature fluctuations. Further, whereas temperatures in fuel tanks of operational aircraft will drop below zero during flight cycles – too cold for microbial growth – temperatures in parked aircraft will be continuously in a range for optimal microbial proliferation. As stated in the Special Covid-19 SIRM Bulletin, microbes need water and food to multiply. The consensus is, keep fuel dry and you greatly reduce the chance of biodeterioration.

This is more easily achievable when aircraft are operational; fuel is consumed and replenished frequently while maintenance practices are performed at set frequency and aircraft engineered equipment such as water scavenging systems are playing their role in minimizing the presence of free water and other nutrients needed for microbes to grow. However, preventing water accumulation and consequent microbial growth may be more challenging during prolonged parking of aircraft.

## Recommended prevention practices and Airline Experience

Whilst OEMs and airline personnel have implemented special maintenance programs to minimize microbial growth in aircraft fuel systems during parking, there is little firm data to confirm whether these measures are fail safe. Are all environmental conditions the same around the globe where these aircraft are parked? The answer lies in the question.

In addition to regular removal of water, most aircraft manufacturers recommend that fuel in the tanks of aircraft which are parked long term, should be treated with a chemical biocide. Approved fuel biocides have been used effectively for many years, to prevent and kill microbial growth. When the aircraft returns to service, the biocide treated fuel can be burned in engines as normal. In recent years, misapplication of one of the approved biocides has been implicated in several potentially serious incidents of loss of thrust control and engine stalls. Investigations of two of these incidents, caused sufficient concern for some OEM's to withdraw their approval for that biocide's use and for the biocide manufacturer to suspend sales to the aviation industry.

The incidents highlighted the importance of using correct application procedures and well-trained competent staff when using fuel biocides, and IATA has worked with the Energy Institute to develop an industry standard, EI 1566 for biocide injection equipment. The withdrawal of one biocide left the airline industry with only one OEM approved biocide option. Initially, this biocide was not registered with relevant regulatory authorities in the EU until derogations were granted some months after the start of the pandemic. Consequently, many airlines had challenges sourcing an approved biocide at a time they most needed for treating large numbers of aircraft for parking.

Aircraft OEM's typically recommend that parked aircraft which have not been treated with biocide should have their fuel tanks sumped at least weekly to remove water. The frequency should be increased if the operator perceives a significant risk of microbial growth, for example due to high humidity conditions (e.g. above 70%), poor fuel source reliability, and operator in-service experience with incidents of fuel tank microbial growth. The frequency of sumping may be adjusted according to the amount of water recorded during the sump draining procedure.

A recent survey of operators in North America, Europe, Middle East, and Southeast Asia indicated that whilst 58% of operators sumped their aircraft (in service and parked) at least weekly, 28% sumped only monthly and 13% even less frequently. Perhaps this is concerning, given that 47% of operators said they occasionally found water when they sumped their tanks and 14% said they often found water. As evidenced by the photograph, we can attest that unless rigorous and effective water sumping is maintained, there is a significant increase in the chance of microbial growth and associated operational safety issues.



**Figure 2** - Microbial growth on a fuel tank surface – note the contamination is seen on ledges on the tank walls not just on the tank bottom



**Figure 1** - Pitting corrosion found under microbial growth on a tank surface

Another key OEM recommendation for both operational and parked aircraft is to perform regular microbial testing of fuel tank sump samples. OEM's recommend testing parked aircraft more frequently, for example, every 2 weeks if no biocide has been added, and monthly - if the tank has been biocide treated. The operator survey we conducted showed that 6% conducted testing on a monthly basis, 13% quarterly, 17% annually and 40 % less frequently. Encouragingly, most tested parked aircraft much more frequently; 18% fortnightly, 47% monthly although 33% tested less frequently.

## Lessons learned as we return to service

As aircraft operations start to return to pre-pandemic levels, operators should bear in mind that, even with scheduled sumping, some microbial growth may have occurred in their aircraft fuel tanks while parked. The risk is likely to have been significantly higher if a biocide treatment was not applied or where aircraft were stored in hot humid climates and where water condensation is an issue. Airlines should also bear in mind that airport storage tanks, hydrants, refuellers and filters, which have been underutilized during the pandemic, may have been subject to microbial growth. Fuel suppliers should adopt best practice recommended by industry organizations, such as JIG and the Energy Institute, before returning these to service.



Aircraft OEMs are working hard to update and harmonize their recommended practice and IATA is playing a key role by updating its [Guidance Material on Microbiological Contamination in Aircraft Fuel Tanks](#). The best way for the aircraft operator to assess whether significant microbial growth has occurred would be to inspect fuel tanks

internally, but as this is not always practical, at very least, data from microbiological testing should be assessed – any indications of microbial contamination should be considered seriously, and the OEM consulted for appropriate action.

## 15. Managing Passenger Non-Compliance in a COVID-19 Operating Environment

### Situation

In response to the COVID-19 pandemic, the Civil Aviation Authority mandated that all passengers, six years of age or older, must wear a mask on board the aircraft or provide an approved medical certificate to be exempt. This mandate created challenges for our frontline employees with the enforcement of these requirements and passengers who refused to comply. Our airline is committed to the highest safety standards in protecting our crew and guests by upholding this regulation.

### Action Taken

In September 2020, our airline group implemented a zero-tolerance mask policy, leading the industry in safety initiatives and ensuring the health of our guests and employees.

#### **Non-compliance is managed through a three-step process:**

1. Guests will first be asked to put the mask on in a discussion with cabin crew.
2. A warning (yellow card) that masks are required, and compliance is necessary
3. A note from the captain and notification that non-compliance will result in follow-up notification that non-compliant guests will be placed on a no-fly list for 12 months (red card)

The goal is to encourage compliance at the first or second step, without having to suspend travel. In each case, time is spent with our guests to thoroughly inform them of the requirements and of the possible repercussions. Cabin crew were also able to exercise "best judgement" for young children not able to wear mask in situations where parents were making an effort. This information was publicly shared via our airline's public website, through all media/social media platforms, as well as directly emailed to guests with a confirmed booking.

To avoid further escalation on board the aircraft, messaging regarding travel suspensions comes from the verbiage on the yellow/red cards. The yellow card stated that if the passenger continued to not comply to the yellow card request, a report will be filed against them and their future travel with our airline group would be suspended.

Finally, if they still do not comply, they are given a red card. This card is the final notice given to passengers after they still fail to comply to the request by crew members to wear a mask, in some cases this may be accompanied by a notice from the captain. This card states the passenger will be suspended for a minimum of 12 months from flying with our airline group. Each occurrence is reported to the Corporate Security Team who investigates and follows up with the non-compliant passenger.

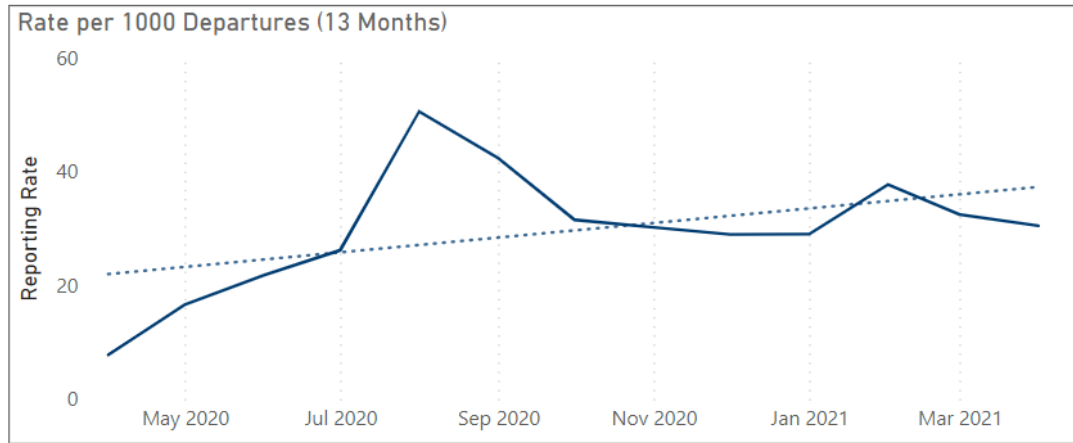


## Results

Mask violation reports include cases of verbal warnings, yellow cards, red cards (including Notice from the Captain) and some mask exemptions.

Approximately 13% of violations have resulted in some length of suspension from flying with any airline in our airline group. When there is a mask violation, in most cases, the passenger is given several warnings to keep their mask on or wear it properly. If they still fail to comply, they are given a yellow card, followed by a red card. All instances of non-compliance, which result in a red card, are forwarded to the Civil Aviation Authority for further review.

### Mask Violation Reports per 1000 Departures



## Conclusion

Program transparency to flying public and Executive support were key elements in the improved mask compliance amongst passengers. Frontline employees appreciated the tools to effectively do their jobs in a safe and compliant manner.

## 16. EASA – "BE READY and STAY SAFE" campaign

On 27 May, EASA launched its "[BE READY and STAY SAFE](#)" campaign. It was developed in partnership with IATA and a range of industry partners to support a coordinated and collaborative approach to ensure the industry can "BE READY and STAY SAFE" as aviation traffic ramps up again in the coming months.

The interconnected nature of aviation relies on organisations working together seamlessly. The more we can align our start-up strategies, the better we can ensure the safe delivery of services by focussing on the important actions and behaviors.

At the heart of the campaign are a set of key safety messages for organisations to consider during the ramp-up. There is a package for each of the operational domains; ATM/ANS Providers, Air Operators, Cabin Safety, Aerodromes and Maintenance that includes a concise summary of ramp-up resources and information on the most important safety issues for each domain as well as specific actions that organisations can take.

This package is provided with no branding, so that you can add your own logos and use it easily within your organisation - find out more and download the materials from the "BE READY and STAY SAFE" Campaign pages on the EASA Air Ops Community Site.

### Select Your Organisation

Ensure that you have the right tools, equipment and infrastructure in place.



**Air Operators**

Put your staff and their wellbeing at the heart of a people centred ramp-up.



**ATM/ANS Providers**

Have enough skilled, trained and qualified people who are operationally ready and fit for duty.



**Air Operators - Cabin**



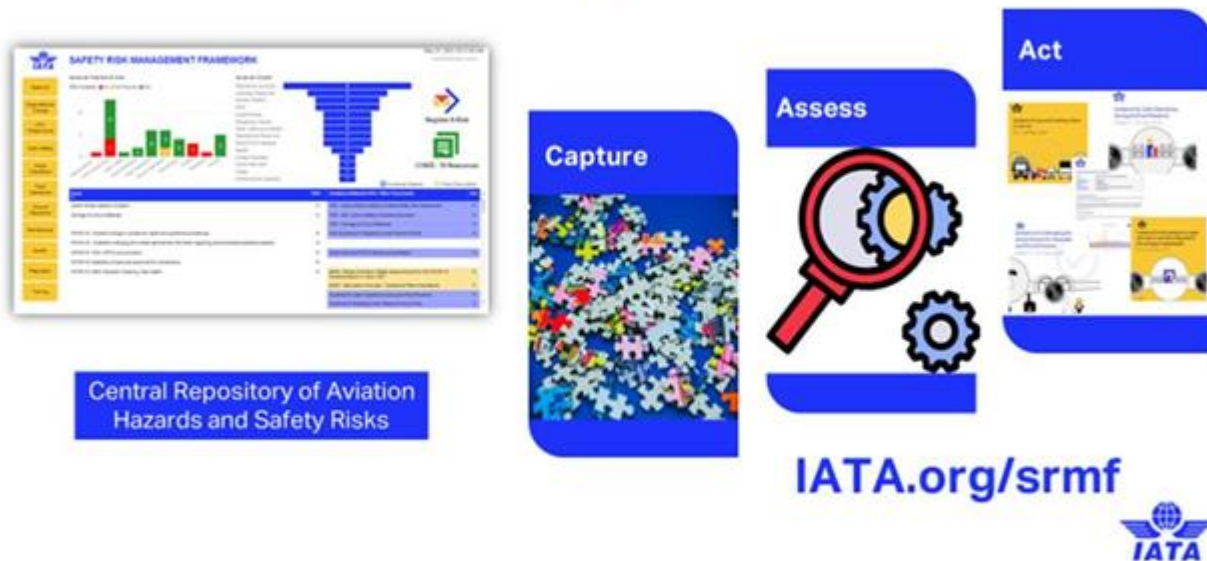
## 17. IATA Global Safety Risk Management Framework

The COVID-19 pandemic highlighted the need for a central repository of safety risks from Industry to effectively understand, and support IATA members, and the wider aviation community, to identify, prioritize and manage safety risks emerging from the crisis. A COVID-19 Safety Risk Management Framework was developed to meet this need and has demonstrated its value for collecting, assessing, and providing solutions for the mitigation of safety risks during these uncertain times.

The success of the COVID-19 Safety Risk Management Framework has evolved into the [Safety Risk Management Framework](#) and is expanding to collect not only COVID-19 specific risk, but Industry reported risks with associated reference and guidance materials for operator level mitigations.

We invite you to visit the SRMF site for further information and details.

### Safety Risk







# ANNEX A

## DETECTION OF UNSTABILIZED APPROACH

### **1- UA-GA Paradox**

Unstable approach is a key figure for aviation industry and safe flight operations. Aircraft operators are trying to manage this risk and mitigate it as low as possible. The best tool to detect an unstable approach might be a safety report, sent by flight crew, about the execution of go-around due to unstabilized approach. However, since this scenario does not appear during real life practices very often, Flight Data Monitoring (FDM) programs are the most common tools to detect an unstable approach for all type of aircraft operators.

Whichever way the unstabilized approach detected if there is an execution of go-around there are the risks relevant with the go-around maneuver. As it has been stated in Go-Around Safety Forum study in 2013 [1] one of every ten go-around contains potential hazardous outcome such as aircraft performance limit exceedance or fuel endurance. That is why, promoting go-around execution after any deviation in every circumstance, includes a paradox in it. While trying to prevent the unwanted outcome of unstabilized approach, conducting a go-around might not be the best thing to do always, to keep the flight safety at desired level.

Go-Around Safety Forum study [1] suggests that go-around policy of operators should be refined, subjectivity of decision-making should be minimized, and potential threats should be monitored actively to manage the state of safety at the highest possible level at all phases of the flight. Although go-around is a normal phase of the flight, in real operational environment they are rare, thus a well-balanced decision-making process should be carried out before commencing it.

Statistics tell us that only 3% of detected unstabilized approach comply with the go-around policy [2]. Although according to investigations about the accidents, between 2000-2016, 54% of all accidents could have been possible avoided by go-around execution [2], we know that when a go-around occurs it is often performed poorly, and go-around accidents are percentage wise more fatal [1].

When we bring these facts all together, the issue becomes a knife edge problem. None of the parties wants to compromise flight safety but, in fact, go-around policy compliance is unacceptably low and in real life experience go-arounds are rare thus introduces some extra risk factors. Additionally, to these counted facts, pilots who are in charge in the cockpit, do not believe that go-around policies are realistic enough [2].

### **2- Current Algorithm**

The general definition of Unstable Approach states that any approach which does not meet with the stabilized approach criteria, defined in operator's SOP, is evaluated as an unstable approach. Almost for every operator the criteria of stabilized approach is defined for a fixed altitude. Common practice might be observed for the stabilization altitude for airline operators as 1000 ft AGL for Instrumental Meteorological Conditions (IMC) and 500 ft AGL for Visual Meteorological Conditions (VMC). Of course, this altitude limit can vary for different type of operations.

To make the definition of stabilized approach as the industry standard, a common set of parameters defines the stabilization criteria [3]. Some of these parameters are as below.

- Target an approach speed only few knots faster than the desired touchdown speed,
- Target a rate of descent which collaborates the approach angle and speed,
- Target an altitude where the landing configuration completed,
- Target an attitude of stability in all 3 axes,
- Target a stable thrust above idle.



All the parameters above actually describe a state where aircraft energy conversion is well balanced, and deviations are damping. Through triggered FDM events deviations can be observed easily and comparison with SOP criteria can be made to evaluate an approach as stable or unstable.

## **2.1- Events**

According to Guidance for FDM precursors (EOFDM WGB-RE25) publication at the advised altitudes (1000 ft and 500 ft AGL) if an approach does meet with the conditions described below and triggers the relevant FDM event, approach can be evaluated as unstable.

These conditions,

- Incorrect Landing Configuration (fleet and SOP Specific)
  - Flap Movement
  - Late landing gear
  - Speed Brake Deployment
- More than 1/4 dot Localizer Deviation
- More than 1 dot Glide Slope Deviation
  - GPWS Warning
- IAS too high or too low relative to a reference speed. Lower than VAPP – 5Kts or higher than VAPP + 10Kts.
  - Approach Speed High
  - Approach Speed Low
- Vertical Speed Higher than 1000 ft/min
- Pitch attitude too low or too high (fleet and SOP Specific)
- Bank angle greater than 7 deg
  - Excessive Bank on Approach
- Thrust Power not stabilized or below idle.
  - Low Power on Short Final

So, when these events triggered during an approach, the approach phase is evaluated as unstable and thus after such deviations a go-around maneuver is expected.

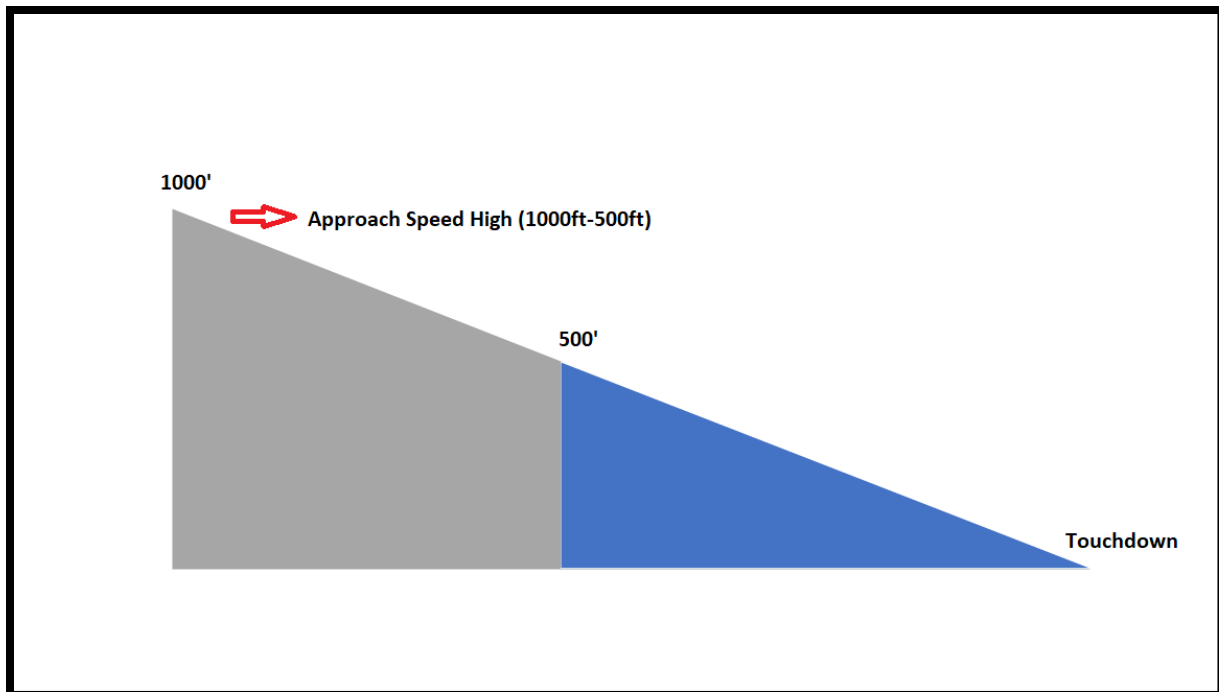
## **2.2- Duration**

Approach phase might be the most critical phase of a flight, along to that it is a phase, which starts at the final approach fix and finishes upon touchdown. Although there are many factors which have impacts on this most critical phase of flight; pilot's decision, given control inputs and reaction of aircraft systems can be count as dominant factors [3].

### **2.2.1- Time Dimension in Human Machine Relationship**

The figure below represents approach path with altitude limits and a triggered FDM event.

**Figure 1 – Approach Phase**



During this approach, Approach Speed is high, and it triggers an FDM Event. Afterwards necessary corrections made by the flight crew and without any other event landing completed. Pilot's awareness of high speed might have been started while aircraft was higher than 1000 ft AGL, but due to the human machine interactions, reaction of aircraft systems, correction of airspeed might have been delayed below 1000 ft AGL, thus it results an FDM event triggers, in any case according to SOP rules this approach should be defined as Unstabilized Approach.

### **2.3- Disadvantages of Unnecessary Unstable Approach Detection**

When the pilot's control input, and reaction times of aircraft systems have not considered in the unstable approach detection algorithm, triggered FDM events could result most of the approaches been evaluated as unstable. This situation involves some disadvantages.

#### **2.3.1- Insensitivity**

As previously mentioned, according to SOP rules, there should be a go-around execution after every unstabilized approach. However, statistics tells us that the compliance to this rule is very low. Both operators and pilots are underestimating the risks, involved in the continuing to landing after an unstabilized approach. [4]

According to a study conducted between 492 pilots, who has at least one or more unstable approach during the last 5 year period but did not execute go-around, the question of *"Anticipated company support for a GA decision"* scored 5.06 point over a scale between 1-6 points [2]. Which shows that even if the pilots believe that they are supported by their companies to conduct a go-around after an unstabilized approach, they do not follow the advice.

This study results can be used as an example of insensitivity resulted by the large number of unstable approach detection.



### **2.3.2- Stress on Flight Crew**

Factors which might have been contributing to unstable approach can be listed as below.

- Loss of situational awareness
- Poor visibility and visual illusions
- Inadequate recognition of the effect of wind conditions
- Lack of monitoring by the Pilot-Non-Flying / Pilot Monitoring
- Peer pressure
- Excessive altitude and/or airspeed too close to the threshold
- Late descent clearance due to traffic

Among these factors over detection of unstabilized approaches can create additional stress factor on the flight crew. Which may lead into inadequate threat and error management and result to execute go-around under improper conditions.

In the above-mentioned research study [4] the question "Who say their company reprimands for performing UAs" collected 43% of positive answer, which can be used as a support for stress related decisions.

### **3- Searching for a New Model**

To increase go-around policy compliance, insensitivity should be decreased, and risk of go-around should be minimized while keeping the stress factor as low as possible. Due to that while evaluating an approach against the stability criteria, effective control input and reaction of aircraft systems should be considered.

Once an analysis conducted through the triggered FDM events, it can be seen that approach events generally trigger in groups. Most of the time, there is a direct relationship with the selected events.

For simplicity, this relationship can be called as "*Chain Reaction*". During an approach when any of the selected flight parameter starts to deviate, active monitoring of flight crew can most of the time prevent the deviation triggers and FDM event. However demanding approach patterns, environmental conditions or operational pressure can result rapid changes in the parameter deviation and an FDM event might occur suddenly. Either before or after an FDM event triggers, deviation can be controlled by effective control inputs of the flight crew. Actually, this is the aim of the well-known concept of being mentally ahead of the aircraft.

If there is not active monitoring and effective control of the aircraft, either due to negligence or some other factors, after the first FDM event, chain reaction may occur.

Imagine such a scenario: Approach Speed High (continue with no correction) – Aircraft High on Glide Path (continue with path correction) – High Vertical Speed (due to path correction) – Below Glide Path (due to high vertical speed) – GPWS G/S Warning (due to deviation at low error margin area).

This hypothetical scenario may occur in many different FDM event combinations but in every case, there would be a relationship between the triggered FDM events.

### **3.1- Principles of New Unstable Approach**

The new algorithm should consider pilots control input, reaction times of aircraft systems, environmental conditions and respect the integrity of the whole approach phase.

Also, FDM events should be considered according to their level of severity which can be decided with different risk management methods.

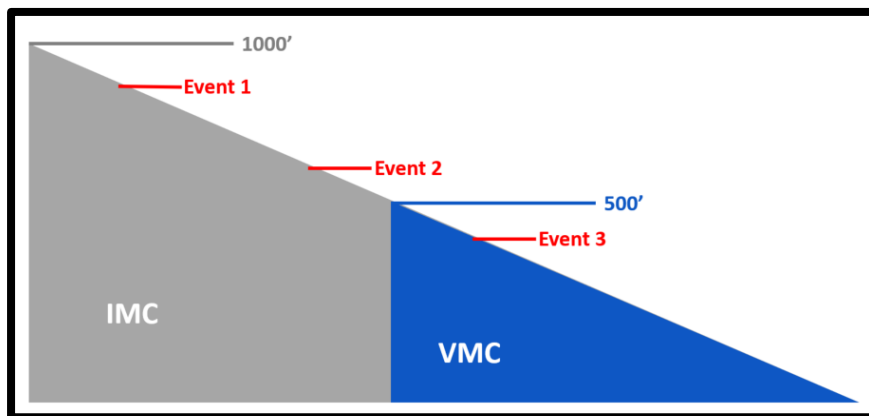
### 3.1.1- Continuity

Continuity describes the non-presence of active monitoring and effective control conditions. When these conditions are not present in the cockpit, after the first FDM event, chain reaction would be starting and other FDM events would continue to occur.

It can be said, when the unstabilized approach continues for landing without effective correction, deviation of the parameters will be oscillating more, and aircraft movement will generate more FDM events. Even if the approach completed with uneventful landing, it will not change the fact that the non-compliance with go-around policy had increased the operational risk, hence compromised from safety.

Continuity of unstabilized approach and triggered FDM events can be imagined as below in Figure-2.

**Figure 2 – Continuity of Unstabilized Approach**



### 3.1.2- FDM Event Score

Assigning different score values for different FDM events should be as natural as giving them different names. The main purpose of this implementation is to make some level of differentiation between the triggered FDM events and flights.

As an example, Approach Speed High FDM event can be assigned with different score values when it triggers below 1000 ft AGL or below 500 ft AGL. Also, GPWS Sink Rate warning and High Rate of Descent events can be assigned with different score values. Once it is analyzed, it can be seen that every GPWS Sink Rate event (excluding high terrain changes at low altitude) includes a High Rate of Descent event in it, but opposite relationship cannot be observed always.

For the implementation of the new algorithm into a detection formula the table below can be used as an example.

**Table 1 – Selection of Events and Score Values**

Event Name	Event Score	Event Name	Event Score
Approach Speed High (1000-500 ft)	1	GPWS Warning	3
Approach Speed High (500-50 ft)	2	GPWS Terrain or Pull Up	5
Approach Speed Low (1000-500 ft)	2	Stall Warning	5
Approach Speed Low (500-50 ft)	3	Low Speed Selection	5
High Rate of Descent (1000-500 ft)	1	Late Landing Gear	2
High Rate of Descent (500-50 ft)	3	Excessive Bank on Approach	2
Flap movement (1000-500 ft)	3	Low Power On Short Final	2
Flap movement (500ft to TD)	5	Unstable at Low Altitude (Flap)	1
Speed brake deployed (1000-500ft)	2	Unstable at Low Altitude (Spd Hi)	1
Speed brake deployed (500ft to TD)	3	Unstable at Low Altitude (Spd Lo)	1
TOGA Engaged	5	Unstable at Low Altitude (VSI Hi)	1
		Unstable at Low Altitude (VSI Lo)	1

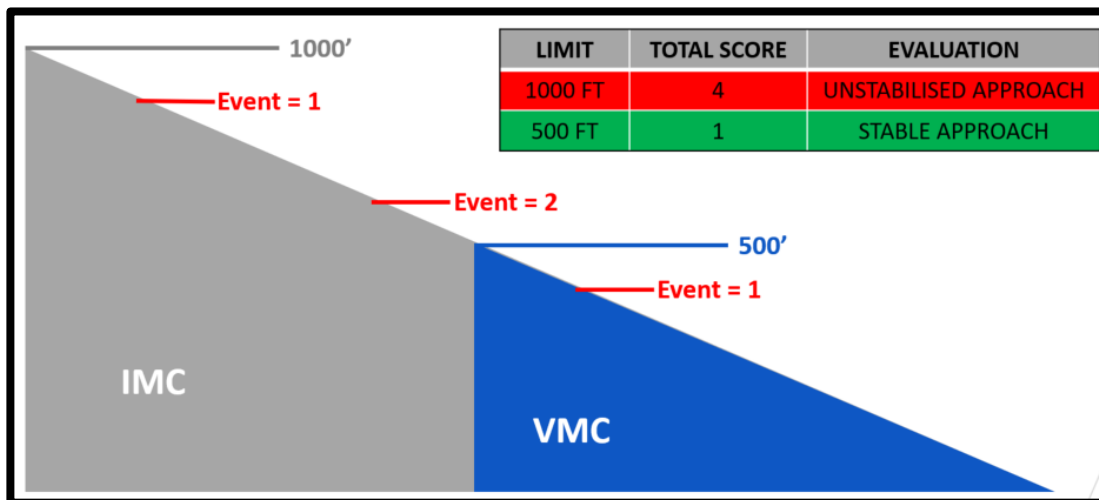
**3.1.3- Detection Formula**

While analyzing historic flights for the testing purposes of new algorithm, main goal was to detect all unstabilized approaches and decrease noise (or parasite) detections by evaluating those eventful but effectively controlled flights as Stable Approach.

To achieve this aim, Total FDM Event Score Limit for a flight set as 4. So, if the summation of the event score values is higher than 4, approach could be evaluated as Unstable, if not it could be evaluated as Stable.

Having two altitude limits in the SOP for the stabilized approach criteria might make things a bit complicated. The figure below represents one single flight without considering if the meteorological conditions is visual or instrumental. For such cases METAR records should be obtained and one of the total scores and the evaluation results should be dismissed according to the relevant visibility.

**Figure 3 – Sample Flight Total Event Score Calculation**





Some other sample flights with the triggered FDM events and the stabilization analysis results can be seen in the table below.

**Table 2 – Sample Flights and Total Event Scores**

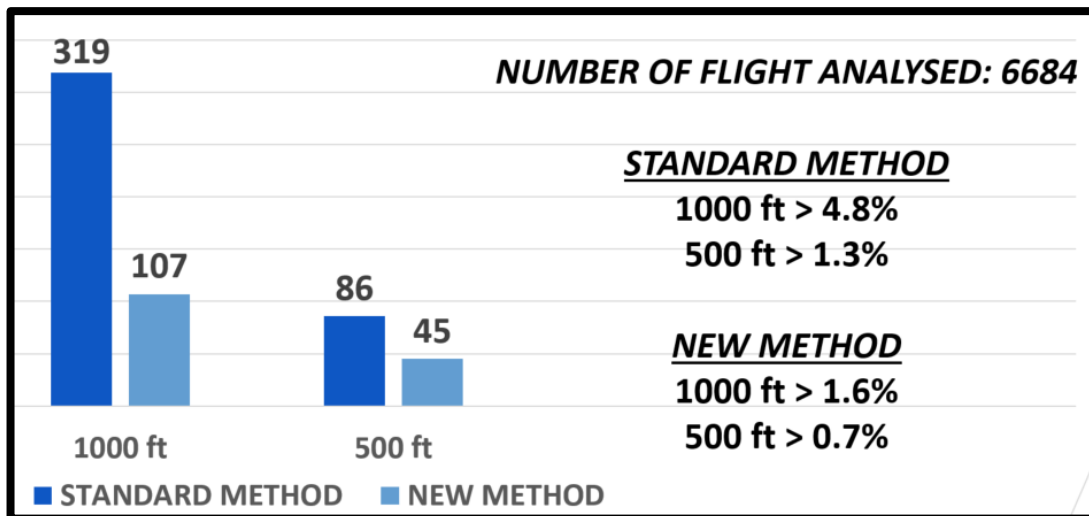
FLIGHT #	METEO.	IMC 1000 FT LIMIT		VMC 500 FT LIMIT		TOTAL SCORE
		EVENT NAME	Coef.	EVENT NAME	Coef.	
1	VMC	Approach Speed High	1	Approach Speed Low	3	4
				Unstable at Low Alt. (Spd Low)	1	
2	VMC	Flap Movement	3	Approach Speed High	2	2
		Approach Speed High	1			
3	VMC	-	-	High Rate of Descent	3	6
				GPWS Sink Rate	3	
4	IMC	Approach Speed High	1	High Rate of Descent	3	4

It is important to notice that at first meteorological conditions is being decisive about the stabilization altitude limit, then the presence of the effective control and energy management should be observable with the triggered FDM events. To increase the tolerance of the formula leading events, such as high speed, high rate of descent etc., assigned with lower score values compare to low altitude or high severity level events.

**4- Comparison of Algorithms**

Over 6600 flights have been analyzed with this new algorithm by using a business intelligence tool. Results of the unstabilized approach detection decreased drastically as it can be seen from the figure below.

**Figure 4 – Statistical Results**





## **5- Conclusion**

Throughout the literature research some findings have been prioritized against the others. It has been concluded that establishing a new, more effective method of detection of unstabilized approach, either like the one suggested in this article or a similar version, could have been beneficial for the whole industry.

Prioritized findings are listed as below:

- Unacceptable low rate of go-around policy compliance.
- UA-GA paradox in terms of safety assurance.
- Insensitivity against the detected Unstabilized Approaches.
- Flight crew's disbelief against the go-around criteria
- Increased number of Unstabilized Approach detection and resultant stress on flight crew.

As a result of the study, once such a proposed method established in the FDM program of an operator, the benefits written below may be achievable.

- Comparison of Standard Method and New Method can visualize how much noise is being generated by the FDM program algorithm.
- Increase general flight analysis techniques of an FDM specialist.
- Increase awareness of unstabilized approach for both operator's management and flight crew.
- Convince flight crew about the realistic implementation of the go-around policy.
- Helps to improve compliance of go-around policy.
- Reduce the risk associated with unnecessary go-around execution.
- Reduce the stress level on flight crew created over detection of unstabilized approach.
- Helps to investigate deeper about the relationship between unstabilized approach and fatigue or environmental factors.

## **References**

*[1] - Go-around Safety Forum / 18 June 2013 / Brussels: Findings and Conclusions*

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*[3] - Unstable Approaches: Risk Mitigation Policies, Procedures and Best Practices 2nd Edition*

*[4] - Human Factors Contributing to Unstabilized Approaches and Landings in Commercial Aviation Incidents: An Analysis of ASRS Reports*

*[5] - Guidance for FDM precursors (EOFDM WGB-RE25)*