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DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de la Mobilité
et des Travaux publics
Direction de l'aviation civile

Direction de l'Aviation civile

Annual Safety Review 2020

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Introduction

The year 2020 has been a most difficult year for the aviation sector due to the COVID-19 pandemic and its impact on travel. In some business sectors, the pandemic forced organisations to adapt their internal processes to the sanitary situation, in order to maintain a largely similar product or service output. Aviation organisations faced a far greater challenge as they had to adapt not only their processes but their products and services as well, as their entire market collapsed or shifted in unexpected ways.

This unprecedented situation created a number of new threats to aviation safety: Aircraft were moved into and out of storage, flight crew lacked opportunities to fly or access to flight simulators due to travel restrictions, etc. Not to forget that in addition to the new threats, the usual safety issues are still as present as ever.

In this new and fast-changing environment, aviation safety worldwide showed a remarkable resilience. The rate of fatal accidents per million flights remained in the same range as the previous years: The Aviation Safety Network¹ recorded 0.42 fatal accidents in 2020 per million flights versus 0.48 for the five previous years.

This report examines the safety performance of civil aviation in Luxembourg during 2020. First, the accidents and serious incidents are presented. In order to analyse the main safety issues of 2020, it is necessary to elaborate on the traffic situation first. The entire report, and especially comparisons to previous years, have to be interpreted in this context of significantly reduced traffic. The reporting of occurrences then leads to the main safety issues. Like the previous years, the ARMS methodology, as presented in Annex II, is used to identify the most important safety issues. To conclude, an attempt has been made to identify the impact of the COVID-19 pandemic by linking the reported occurrences to the COVID-19 Safety Risk Portfolio² elaborated by EASA.

1 www.aviation-safety.net

2 "Review of Aviation Safety Issues Arising from the COVID-19 Pandemic", EASA

Accidents and serious incidents

One accident and two serious incidents affecting aircraft registered in Luxembourg were notified in 2020. They did not lead to any injuries or fatalities.

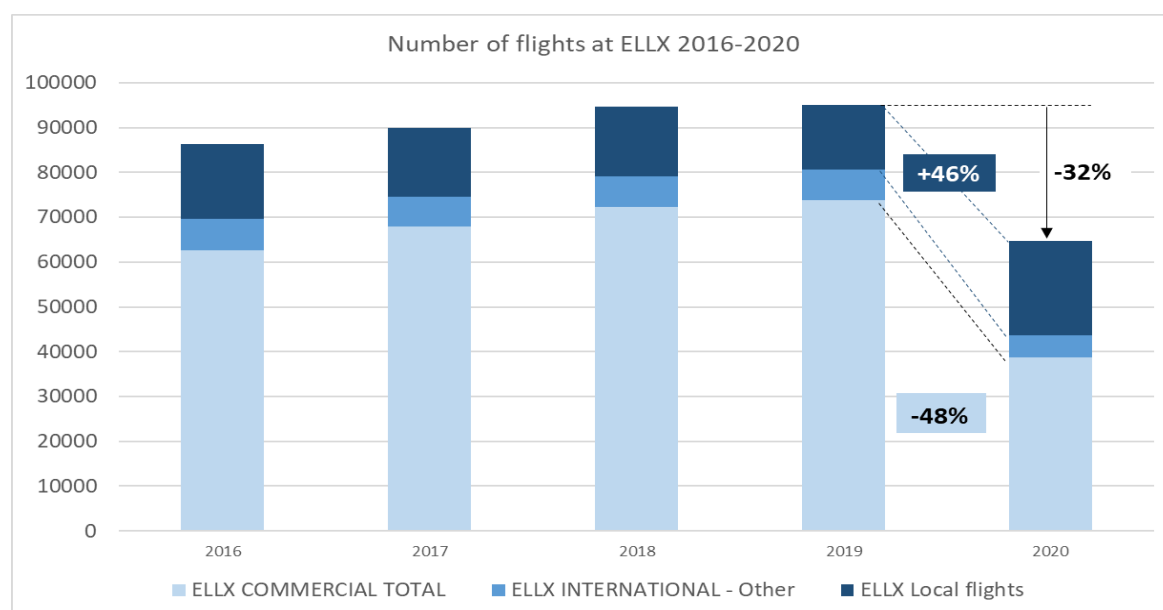
	Aircraft type	Date	Location	Event	Investigation
Accident	Pilatus PC12	30.3.	LFMN Nice	Lightning strike and wing damage	BEA (France) - closed
Serious incident	Piper Pa-28	19.7.	LSZR St. Gallen-Altenrhein	Loss of power after take-off	STSB (CH) - ongoing
Serious incident	Bombardier Global 5000	30.8.	LIPO Brescia-Montichiari	Wingtip strike during landing	ANSV (Italy) - ongoing

No accident or serious incident was reported in Luxembourg.

The serious incident involving a wingtip strike happened in the context of training activities during a positioning flight without passengers. As this flight did not operate as Commercial Air Transport (CAT), no accident or serious incident in CAT by operators from Luxembourg was recorded in 2020.

Impact of the COVID-19 pandemic on traffic

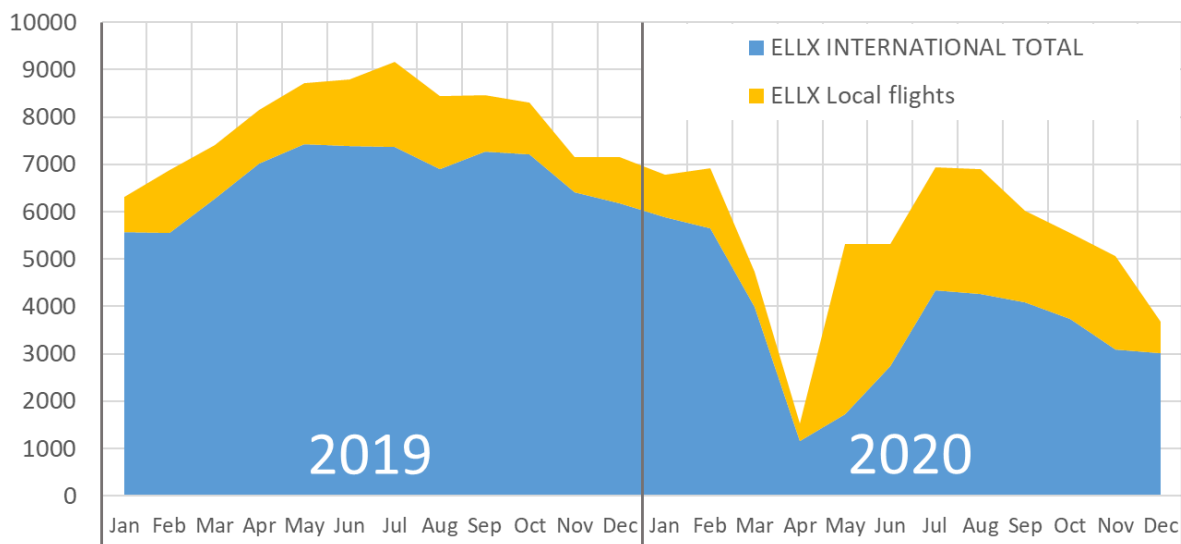
The overall traffic at Luxembourg airport decreased by 32% in 2020 compared to 2019. Commercial traffic decreased by almost 48% and other international traffic by almost 26%. However, local traffic at ELLX presented a different picture: after an initial drop during the first 2 months of the pandemic, the number of local flights increased to a higher level than previous years. Over the entire year 2020 compared to 2019, a 46% increase of local flights was noted.



Source data: Administration de la Navigation aérienne

When detailing the traffic per month, the impact of the pandemic is seen as a very steep drop of all types of flight starting in March and bottoming out in April. Starting in May, the number of local flights increases significantly and stays at a much higher level than 2019 for the rest of the year. The recovery of commercial and other international flights is not only slower, but starts to decline again after the summer season.

Traffic per month at ELLX 2019 and 2020



Source data: Administration de la Navigation aérienne

The total number of flights by Luxembourg AOC holders shows a similar decrease when compared to 2019: -29% overall. However, the total of flight hours decreased only by 15%. This difference is due to the cargo sector, which has mostly been spared by the pandemic: The cargo flights of Luxembourg AOC holders are on average of much longer duration than passenger flights. These long-haul cargo flights were not affected by cancellations like the shorter-duration passenger flights. The number of flights drops significantly in March-May 2020, but for the total of flight hours, the drop is barely apparent.

Reporting of occurrences

The DAC receives, classifies and analyses occurrence reports. The reports cover:

- Events in Luxembourg's airspace, at Luxembourg's airport and other landing sites
- Events occurring outside of the national territory reported by air operators from Luxembourg.

Both mandatory and voluntary reports (according Regulation (EU) 376/2014) are included in this analysis.

The number of reports per occurrence class is shown in the table below. In this table, two or more reports concerning the same event have been merged.

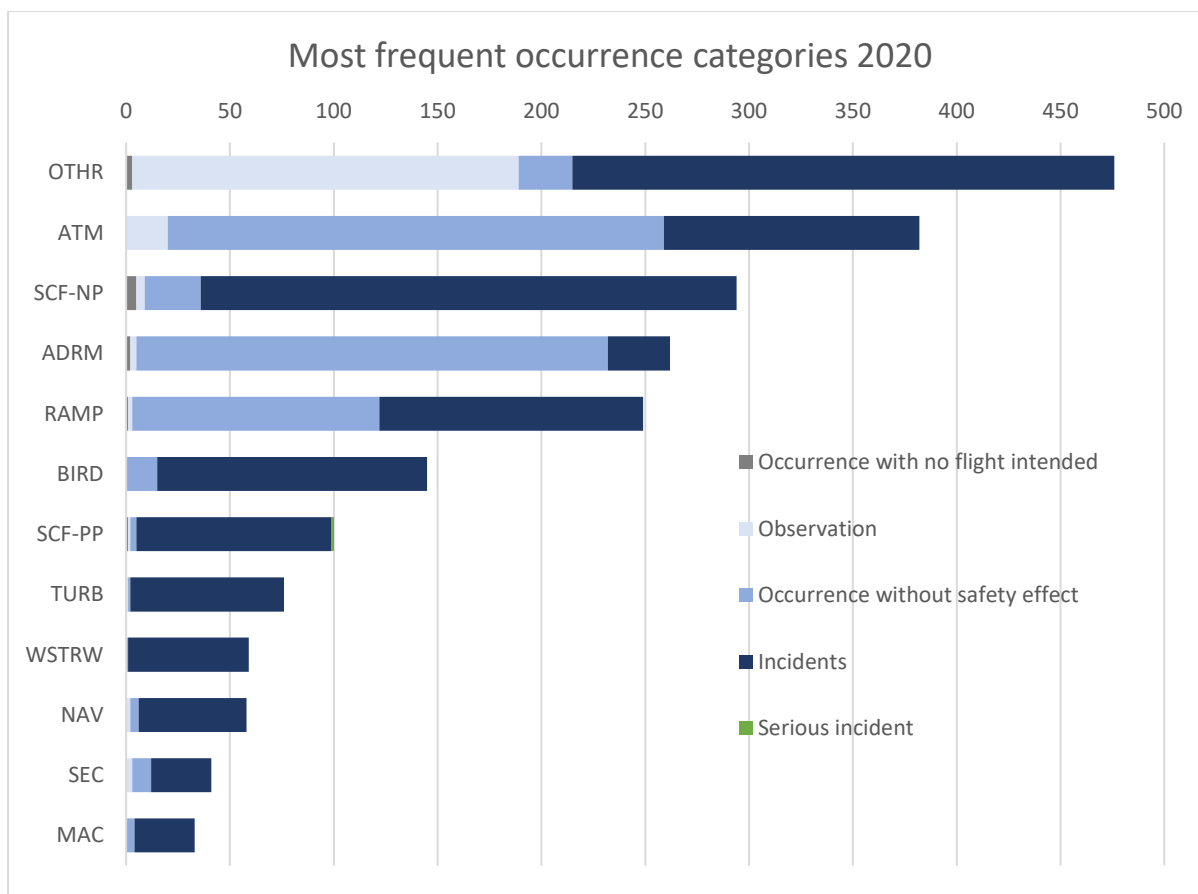
	2012	2013	2014	2015	2016	2017	2018	2019	2020	Variation 2019- 2020
Proactive report / Observation / Occ. with no flight intended	332	561	454	535	470	617	704	488	232	-52%
Occurrence Without Safety Effect	684	813	727	798	689	289	843	883	563	-36%
Incident	458	523	597	578	873	1229	1310	1473	1256	-15%
Serious Incident	3	1	1	3	0	2	0	0	2	-
Accident	2	9	5	3	2	3	3	0	1	-
Total	1479	1907	1784	1917	2034	2140	2860	2844	2054	-28%

The overall number of reported safety occurrences in 2020 was clearly influenced by the drop in traffic. In all occurrence classes except Serious Incident and Accident, the number of reported occurrences has decreased.

Occurrence categories

All occurrences have been attributed to one or more occurrence categories, as defined by the CICTT¹. The most frequent occurrence categories in 2019 are shown in the chart on next page.

¹ CAST/ICAO Common Taxonomy Team



Definition of categories:

OTHR:	<i>Any occurrence not covered under another category</i>
ATM:	<i>Occurrences involving Air traffic management (ATM) or communications, navigation, or surveillance (CNS) service issues</i>
SCF-NP:	<i>Failure or malfunction of an aircraft system or component - other than the powerplant</i>
ADRM:	<i>Occurrences involving aerodrome design, service, or functionality issues</i>
RAMP:	<i>Occurrences during (or as a result of) ground handling operations</i>
BIRD:	<i>Occurrences involving collisions / near collisions with bird(s)</i>
SCF-PP:	<i>Failure or malfunction of an aircraft system or component - related to the powerplant</i>
TURB:	<i>In-flight turbulence encounter</i>
WSTRW:	<i>Flight into windshear or thunderstorm</i>
NAV:	<i>Navigation errors - Occurrences involving the incorrect navigation of aircraft on the ground or in the air</i>
SEC:	<i>Criminal/Security acts which result in accidents or incidents</i>
MAC:	<i>Airprox, ACAS alerts, loss of separation as well as near collisions or collisions between aircraft in flight</i>

As in previous years, “OTHR” (other) is the most frequent occurrence category. The main change compared to previous years is the second position of the “ATM” category. Contrary to the trend of other categories, which decrease more or less in relation to the overall decrease in occurrences, this category has even seen an increase. The increase reflects the number of reports about issues related to the surveillance chain upgrade at Luxembourg airport.

Surveillance chain issues at ELLX

The DAC Annual Safety Review of 2019 already identified surveillance chain issues at Luxembourg airport as a latent condition that could endanger aircraft and contribute to incidents and accidents. A technical upgrade of the surveillance radar in June 2019 introduced several issues that were unfortunately not resolved during 2019 nor during 2020. During 2020, 28% of all occurrences reported in Luxembourg were related to these issues, compared to 8% before the technical upgrade (Jan-Mai 2019). The reports demonstrate continuing shortcomings in two main areas: Radar issues and Flight Data Processing issues.

Radar issues include aircraft disappearing from radar, ghost targets (aircraft shown where there is no aircraft) and wrong correlations (aircraft shown, but with a wrong identity). All of these issues are recurrent, indicating that the root cause has not yet been addressed. These issues also did not disappear when the traffic was largely diminished during the months most affected by the pandemic.

The purpose of Flight data processing is to provide information about flights to Air Traffic Controllers. Occurrence reports for problems affecting this system are more frequent than for radar issues, but are generally assessed as involving a lower risk.

DAC will continue to monitor the risks involved in this issue and ensure supervision of the efforts to resolve it.

Main Safety Issues

In order to perform a detailed analysis of specific issues, DAC has defined and is monitoring more than 120 potential safety issues based on reported occurrences. All occurrences are assigned to one or more of these Safety Issues. This allows a customized and more detailed overview of specific issues. Notably, the very high number of occurrences in the CICTT category “OTHR”, which does not permit any further analysis, could be distributed to meaningful Safety Issues.

It is also desirable to take into account the severity of occurrences, to assess if an occurrence had a high risk or a low risk of resulting in an accident. DAC applies the ARMS methodology where an ERC Risk Index (Event Risk Classification, cf. Annex II) is assigned to each occurrence. As the ERC Risk Index is expressed as a number, a relative comparison between the Safety Issues can be made by looking at the sum of the ERC Risk indexes of the related occurrences. This will result in a better overall risk picture than counting only the number of occurrences related to a Safety Issue. Where the risk classification methodologies are compatible, the risk classification of the reporting organisations have been considered. Where the risk classification methodologies are not directly compatible, follow-up reports from the reporting organisations are crucial to enable DAC to understand the risks and to reproduce the operator’s own evaluation.

The ten most important Safety Issues for 2020 have been identified by the highest sum of ERC Risk Index of the related occurrences. They are shown in the table on next page.

Top 10 Safety issues 2020	
1	Risk of Mid-Air Collision
2	Fatigue
3	Windshear
4	Engine failure or problems - multi-engine aircraft
5	Unstabilized approach
6	FOD (Foreign object / debris)
7	Technical - Landing gear
8	Improper installation of parts
9	Incorrect aircraft setup by crew
10	Aircraft released with incomplete maintenance tasks

Risk of Mid-air collision

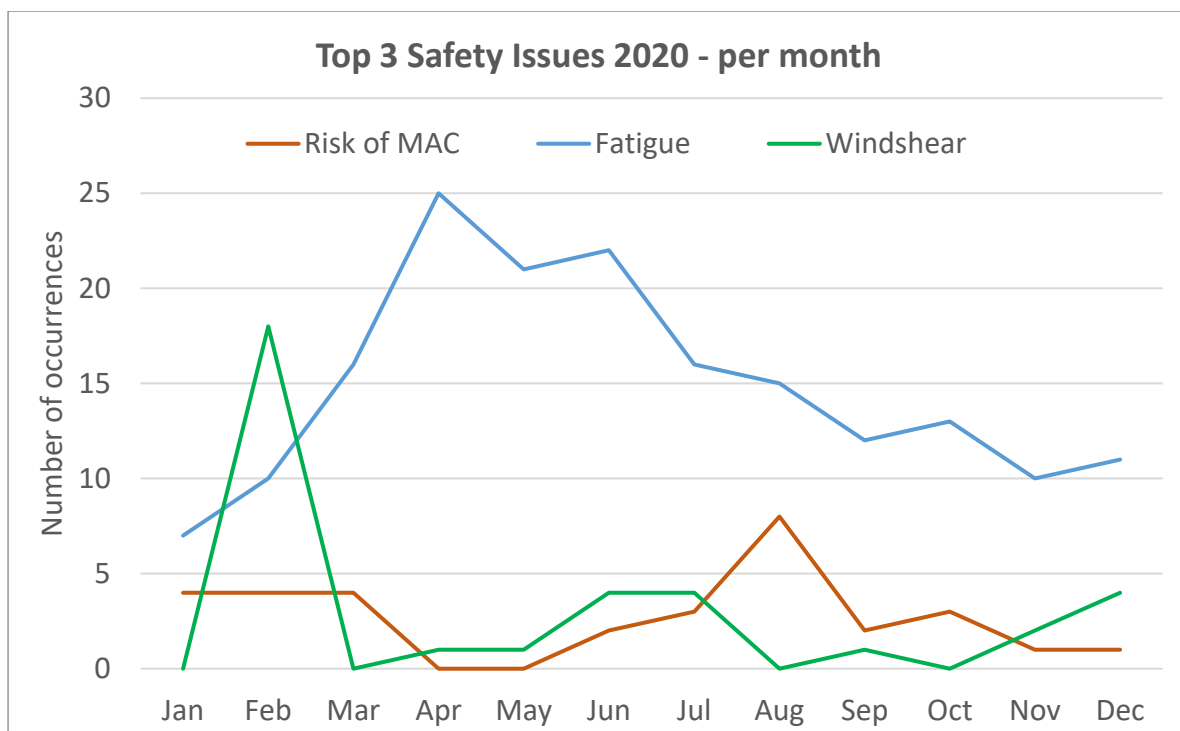
According to the methodology used for risk assessment, the risk score of a safety issue depends on the frequency and severity of related occurrences. Consequently, a high risk score can be the result of a high number of relatively low risk events, or of a low number of relatively high-risk events. The risk of mid-air collision follows the latter scheme because the potential outcome is always assessed as “catastrophic”. As is the case for most Safety Issues, the number of occurrences and the sum of their Risk index did decrease compared to previous years. The distribution across the year 2020 shows that no events occurred in April and May, a drop that is consistent with the significantly lower traffic.

Fatigue

The risk of crew fatigue results from a high number of reported occurrences of a relatively low risk. First, it should be noted that the number of recorded fatigue events is only about half of the number of 2019, which shows a significant improvement even when compensating for the reduction in traffic. This explains the large drop of 52% in the “Proactive report / Observation” occurrence class in the table of page 6, as almost all fatigue reports are in this occurrence class. The distribution of fatigue events across the year also demonstrates a clear impact of the pandemic, with a significant peak of related reports from April to June. This shows that the main driver of the fatigue events were the factors related to the pandemic, like extended duty times and difficulties to obtain rest due to quarantine requirements, room confinement during layovers, etc. The data validates the related safety issue identified by the EASA COVID-19 Risk portfolio: *“Flight crew fatigue due to unavailability of rest facilities at destination or extended duty period”*.

Windshear

The “Windshear” Safety Issue rose to 3rd place, in part due to exceptionally high winds in Luxembourg in February 2020 which led to a peak in the number of reported occurrences.



The DAC Annual Safety Review for 2019 included a longer-term analysis covering the timeframe from January 2015 to February 2020, including the Top10 Safety issues. Even with traffic situations that are not comparable, the comparison to the Top10 of 2020 can still provide some conclusions.

TOP 10 SAFETY ISSUES 2020	TOP 10 SAFETY ISSUES Jan 2015 – Feb 2020
Risk of Mid-Air Collision	Risk of Mid-Air Collision
Fatigue	Fatigue
Windshear	Cargo moving/shifting during flight
Engine failure or problems - multi-engine aircraft	Engine failure or problems - multi-engine aircraft
Unstabilized approach	Dangerous Goods handling (DGR)
FOD	Windshear
Technical - Landing gear	Runway incursion by aircraft
Improper installation of parts	FOD
Incorrect aircraft setup by crew	Technical - flight controls
Aircraft released with incomplete maintenance tasks	Weight & Balance issues due to wrong loading

Five of the Safety issues, highlighted in yellow, are present in both tables, in particular the Risk of Mid-Air collision in first place and Fatigue in second place. For windshear, it was already noted in the longer-term analysis of last year's report that high winds or storms at Luxembourg airport can result in a peak of windshear events, mostly between the months of January and March.

It is also interesting to note which Safety Issues were in the Top Ten for the longer-term analysis, but did drop out for 2020:

- Runway incursion by aircraft
This is possibly a consequence of the reduced traffic.
- Cargo moving/shifting during flight,
Weight and balance issues:
These are two cargo-related safety issues that are not in the Top Ten for 2020, despite the much higher proportion of cargo flights to overall flights when compared to the longer-term analysis. This confirms that the previously existing positive trend for these two safety issues has continued.
- Dangerous goods handling
This is another cargo-related safety issue that dropped out of the Top Ten in 2020. In previous years, its overall Risk index has typically been influenced by a few high-risk occurrences. No high-risk occurrence involving dangerous goods was encountered during 2020.

Impact of the COVID-19 pandemic on safety

The COVID-19 pandemic has disrupted a stable situation in the aviation industry and has necessarily impacted aviation safety. Safety is affected in many ways, for example by impacting the training, skills and knowledge of aviation personnel, their wellbeing, by potential airworthiness issues due to storage of aircraft and by changing traffic patterns.

EASA has published a specific Risk Portfolio of Safety issues related to COVID-19¹. Among the more than 50 identified risks, only few can be put in direct relation to an occurrence. For the more important ones among these, an analysis to identify them in the national occurrence database has been performed. Not all of them could be confirmed as applicable for the aviation sector of Luxembourg.

- *Flight crew fatigue due to unavailability of rest facilities at destination or extended duty period*
As already demonstrated, the occurrence data confirms that this safety issue had an impact during the pandemic.
- *Increased presence of wildlife on aerodromes*
The rate of birdstrikes per 1000 movements at Luxembourg airport has been analysed. A higher rate of birdstrikes has been confirmed, but only during the 2 months of very low traffic, March and April 2020.

1 "Review of Aviation Safety Issues Arising from the COVID-19 Pandemic", EASA

- *The rapid storage and de-storage of aircraft may lead to technical failures*
The number of related occurrences is very low, so that this is not considered a significant safety issue for the Luxembourg aviation sector.
- *Unusual approach profiles in the pandemic circumstances (Unstable approaches)*
The reported number of unstabilized approaches has been analysed in conjunction with the number of flights. No significant correlation was detected.

Other COVID-19 related Safety Issues of the EASA Risk portfolio are difficult or impossible to assign with certainty to individual occurrences. Especially for the human factor elements, it may at best be possible to detect a trend in the overall number of occurrences or in the rate of occurrences in relation to the number of flights. Among the Safety issues that could have a potential link to skills and knowledge degradation of personnel, only a few show an increase while most show a decrease. Consequently, no overall conclusion is possible on this topic.

Conclusion

In January 2020, DAC published the first National Aviation Safety Program¹. It will be complemented by the National Plan for Aviation Safety (NPAS) which defines the actions to address the main safety risks. As a base for elaboration of the NPAS, the DAC Annual Safety Review for 2019 included a longer-term analysis covering the timeframe from January 2015 to February 2020, before the COVID-19 pandemic created a major disruption. After consultation with the stakeholders, the first edition of the NPAS based on this longer-term analysis will be published soon. It will also include specific actions to address the most important COVID-19 related safety issues. The present Annual Safety Review confirms that despite the significant disruption caused by the COVID-19 pandemic and the still evolving situation, the aviation sector of Luxembourg has delivered a similar high level of safety as the previous years.

1 [Programme-national-de-securite-aerienne-002-.pdf \(gouvernement.lu\)](#)

ANNEX I: Definitions

Source:

Regulation (EU) No.996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC

- **Accident** means an occurrence associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down, in which:
 - (a) a person is fatally or seriously injured as a result of:
 - being in the aircraft, or,
 - direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or,
 - direct exposure to jet blast,except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or
 - (b) the aircraft sustains damage or structural failure which adversely affects the structural strength, performance or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component, except for engine failure or damage, when the damage is limited to a single engine, (including its cowlings or accessories), to propellers, wing tips, antennas, probes, vanes, tires, brakes, wheels, fairings, panels, landing gear doors, windscreens, the aircraft skin (such as small dents or puncture holes) or minor damages to main rotor blades, tail rotor blades, landing gear, and those resulting from hail or bird strike, (including holes in the radome); or
 - (c) the aircraft is missing or is completely inaccessible.
- **Incident** means an occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.
- **Serious incident** means an incident involving circumstances indicating that there was a high probability of an accident and is associated with the operation of an aircraft, which in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down.

ANNEX II: ARMS Methodology

DAC has adopted the ARMS – Aviation Risk Management Solutions methodology for the assessment of risks related to reported safety occurrences. The ARMS methodology was developed by a voluntary collaboration of aviation authorities, operators and air navigation service providers. It consists of two parts:

a. Risk classification of occurrences

A risk classification (“ERC- Event Risk classification”) has been applied to each occurrence, according to the ARMS methodology. The “ERC Risk Index” is expressed as a number from 1 to 2500, with associated green (1-10), yellow (20-102) and red bands (≥500).

Question 2

What was the effectiveness of the remaining barriers between this event and the most credible accident scenario?			
Effective	Limited	Minimal	Not effective
50	102	502	2500
10	21	101	500
2	4	20	100
1			

Question 1

If this event had escalated into an accident outcome, what would have been the most credible outcome?	
Catastrophic Accident	Loss of aircraft or multiple fatalities (3 or more)
Major Accident	1 or 2 fatalities, multiple serious injuries, major damage to the aircraft
Minor Injuries or damage	Minor injuries, minor damage to aircraft
No accident outcome	No potential damage or injury could occur

Typical accident scenarios
Loss of control, mid air collision, uncontrollable fire on board, explosions, total structural failure of the aircraft, collision with terrain
High speed taxiway collision, major turbulence injuries
Pushback accident, minor weather damage
Any event which could not escalate into an accident, even if it may have operational consequences (e.g. diversion, delay, individual sickness)

ERC – Event risk classification (ERC) according ARMS.

Source: *The ARMS Methodology for Operational Risk Assessment in Aviation Organisations.*

Developed by the ARMS Working Group, 2007-2010

b. Safety issues

Every occurrence reported to DAC is linked to a “potential safety issue”. If an occurrence with an ERC risk index higher than 10 (i.e. in the yellow or red band) does not fit with any existing “potential safety issue”, a new potential safety issue is created, in order to be able to identify future recurring events.

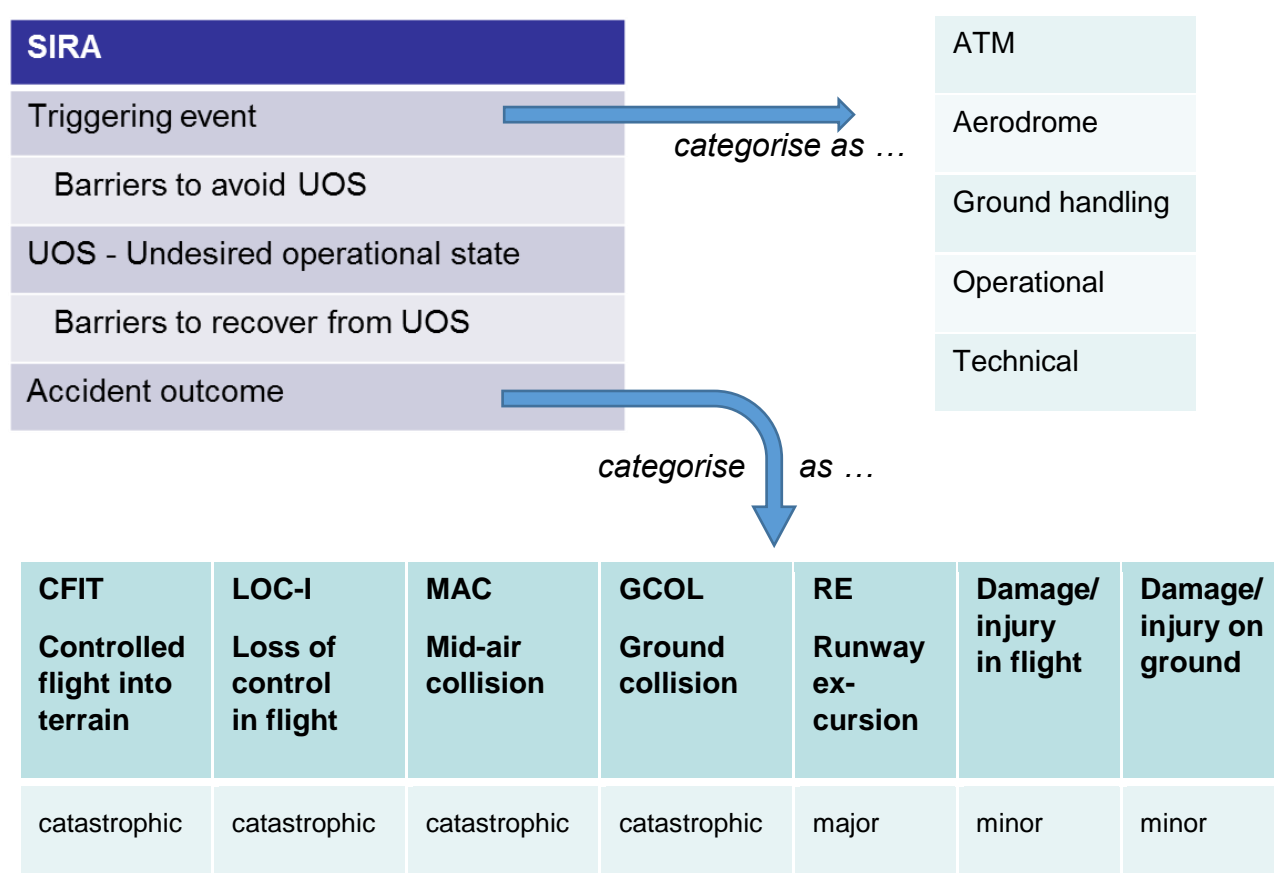
The risk assessment (“SIRA – Safety Issue Risk Assessment”) according to the ARMS methodology, allows to identify:

- the triggering event(s)
- the Undesired Operational State UOS
- the potential accident outcome(s)
- the safety barriers to avoid the UOS as well as the safety barriers to recover from the UOS.

In total, DAC is currently tracking more than 120 potential safety issues. To maintain an overview it is necessary to apply a classification. Two criteria have been applied by DAC:

- the domain of the triggering event:
 - ATM (Air traffic management)
 - Aerodrome
 - Ground handling
 - Operational
 - Airworthiness (technical)
- The type of potential accident outcome:

7 types of potential accident outcome have been defined, corresponding to the “feared consequences” of the risk portfolio of DGAC France¹.



¹ “Strategic action plan to improve aviation safety – the 2018 agenda”, DGAC France