

ANNUAL SAFETY REPORT 2021



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Abbreviations used

A/C	aircraft	GPS	Global Positioning System
AAB	Airprox Analysis Board	ICAO	International Civil Aviation Organization
ADR	aerodrome	IFR	Instrumental Flight Rules
AIB	Accident Investigation Board	ISMS	Information System Management System
AMC	Acceptable Means of Compliance	LFN	Low Flight Network
ANSP	air navigation service provider	LOC-I	Loss of control inflight
APU	auxiliary power unit	MAC	Mid-air collision
ASR	Annual Safety Report	NAA	national aviation authority
ATC	air traffic control	NLR	Netherlands Aerospace Centre
ATM	Air Traffic Management	NoCA	Network of Cyber Analysts
AVISTRAT	National Airspace and Aviation Infrastructure Strategy	OSITI	Ordinance on the Safety Investigation of Transport Incidents
CAT	commercial air transport	RWY	runway
CFIT	Controlled flight into terrain	SASP	Swiss Aviation Safety Plan
CYSECP	Cybersecurity Panel	SPO	specialized operations
DETEC	Federal Department of the Environment, Transport, Energy and Communications	SR	Safety Recommendation
	Energy and Communications	SRM	Safety Risk Management
EASA	European Union Aviation Safety Agency	SSN	Swiss Security Network
EGT	exhaust gas temperature	STSB	Swiss Transportation Safety Investigation Board
EPAS	European Plan for Aviation Safety	SUSI	Swiss U-Space Implementation
ESCP	European Strategic Coordination Platform	TMZ	transponder mandatory zone
EU	European Union	UAS	unmanned aerial system
FOCA	Federal Office of Civil Aviation	UAV	unmanned aerial vehicle
GA	general aviation	VFR	Visual Flight Rules
GM	Guidance Material		

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Foreword by the Director General

Civil aviation continued to feel the substantial impact of the worldwide coronavirus pandemic in 2021. After an extremely difficult 2020, some signs of industry recovery were seen; but the situation remained fraught with sizeable instabilities. For the FOCA as a supervisory authority, this meant accompanying the sector through this phase of constant uncertainties, and ensuring that civil aviation continues to consistently abide by its extremely high safety and security standards.

The crash of a historic Junkers Ju 52 passenger aircraft in 2018 prompted an external audit of our supervisory activities by Royal NLR, the Netherlands Aerospace Centre. The audit was conducted after the accident investigation report by the Swiss Transportation Safety Investigation Board (STSB) had also identified inadequacies in the FOCA's oversight of Ju-Air, the aircraft's operator. Royal NLR's specialists concluded that there were no systemic shortcomings or even risks in our oversight which would require immediate action.

It is, however, our concern and our duty to constantly further enhance the FOCA's supervisory activities. This includes improving the coordination of our technical and our operational oversight, along with paying due and full regard to 'soft' factors such as the safety culture of the enterprise overseen. We have already acted upon many of the recommendations made by the STSB and Royal NLR; and we will continue to pursue this issue throughout the present year.

The safety record of Swiss commercial aviation was favourable for 2021, too. On the non-commercial front, the safety performance was broadly in line with those of previous years, although a tangible increase was seen in the number of helicopter accidents. Overall accident numbers have stabilized since 2017, however, at substantially lower levels.

If we are talking about safety in aviation, we must also mention a new kind of threat in the form of cyberattacks. We have established new FOCA competencies and strong international interlinks to address this risk. But the issue of cybersecurity is sure to remain with us in the years ahead – not least in view of the further development of U-Space and the use of larger unmanned aerial vehicles.

Christian Hegner

Director General
Federal Office of Civil Aviation

Executive summary

This Annual Safety Report (ASR) 2021 provides an overview of the safety projects and challenges of the FOCA as well as the most important findings and developments from the data analyses of the occurrence reports received last year.

As a new feature, Chapter 5 provides an overview of the safety recommendations issued by the Swiss Transportation Safety Board (STSB) in 2021 and their current implementation status from the perspective of the FOCA. Ten safety recommendations were addressed to the FOCA, three of which have already been implemented.

In the 2021 reporting year, the FOCA registered 5 306 incidents, consolidated from over 8 100 incident reports. This corresponds to an increase of around 42 % compared to the previous year and a decrease of 6 % compared to 2019. In order to achieve better comparability, the number of incident reports is increasingly normalised, i.e. set in relation to flight movements. Unfortunately, this is not possible in the helicopter sector due to a lack of data.

The 32 accidents recorded (2020: 29) represent an increase over the previous year. With ten fatalities, the number remained the same compared to the previous year, with the collision at Piz Neir/GR being the most serious with five fatally injured people.

From the reports received, the most important safety problems were identified for each risk area and assessed according to severity. In order to take account of the increase in incident reports, the safety issue "wrong aircraft towing/pushback or marshalling operation" has been newly identified in the area of aerodromes. In the area of air traffic management, the increasing number of incidents concerning mixed IFR and VFR traffic since 2019 is notable. A negative trend can be observed in the technical area with regard to failure of landing gear, brakes and wheels in general aviation. Four accidents can be attributed to this safety issue.

Both, incidents involving drones and sightings by aircraft crews declined in 2021. This can possibly be attributed to the COVID-19 pandemic. In order to obtain an overall picture, an open reporting culture and data over a longer period of time are required.

In Swiss civil aviation, the principle of non-punitive reporting (Just Culture) applies. This principle has come into focus in recent years as a result of proceedings by the federal judiciary. Fears that reporting persons will be fined by the FOCA for incidents are unfounded - except in the case of grossly negligent or intentional acts.

Cyber security is becoming an increasingly important topic in aviation. In order to better manage the risks, the EASA Part-IS (Information Security) regulation has been drafted. The regulation will also be applied in Switzerland in due course.

In order to reach the target groups even better, the "Safety Promotion" working group was reorganised within the FOCA. Current, safety-relevant topics are addressed to the GA community via social media.

Looking to the near future, the safety risk areas "airborne collision" and "aircraft upset" are given the highest priority.

Zusammenfassung

Der vorliegende Annual Safety Report (ASR) 2021 bietet einen Überblick auf die Sicherheitsprojekte und Herausforderungen für das Bundesamt für Zivilluftfahrt (BAZL) sowie die wichtigsten Erkenntnisse und Entwicklungen aus den Datenanalysen der eingegangenen Vorfalle Meldungen im letzten Jahr.

Als Neuerung gibt das Kapitel 5 einen Überblick über die im Jahr 2021 von der Schweizerischen Sicherheitsuntersuchungsstelle (SUST) ausgesprochenen Sicherheitsempfehlungen und deren aktuellen Umsetzungsstand aus Sicht des BAZL. So wurden an die Adresse des BAZL zehn Sicherheitsempfehlungen ausgesprochen, wovon drei bereits umgesetzt wurden.

Im Berichtsjahr 2021 registrierte das BAZL 5'306 Vorfälle, konsolidiert aus über 8'100 Vorfalle Meldungen. Dies entspricht einer Zunahme von rund 42% gegenüber dem Vorjahr und einem Rückgang von 6% gegenüber dem Jahr 2019. Um eine bessere Vergleichbarkeit zu erzielen, wird die Anzahl der Vorfalle Meldungen vermehrt normalisiert, d. h. in Relation zu den Flugbewegungen gesetzt. Im Bereich Helikopter ist dies aufgrund fehlender Daten leider nicht möglich.

Die verzeichneten 32 Unfälle (2020: 29) bedeuten eine Zunahme gegenüber dem Vorjahr. Mit zehn Todesopfern ist die Zahl gegenüber Vorjahr gleichgeblieben, wobei die Kollision beim Piz Neir/GR mit fünf Todesopfern am schwersten wiegt.

Aus den eingegangenen Meldungen wurden für jeden Risikobereich die wichtigsten Sicherheitsprobleme identifiziert und nach Schweregrad beurteilt. Um dem Anstieg der Vorfalle Meldungen Rechnung zu tragen, wird im Bereich Flugplätze das *Safety Issue* «*Wrong aircraft towing/pushback or marshalling operation*» neu ausgewiesen. Auffällig im Bereich Air Traffic Management ist die seit 2019 steigende Anzahl von Vorfällen betreffend IFR und VFR Mischverkehr. Ein negativer Trend kann im Bereich Technik bezüglich Versagen von Fahrwerken, Bremsen und Rädern in der Leichtaviatik festgestellt werden. Vier Unfälle können diesem Safety Issue zugeordnet werden.

Sowohl Vorfälle mit Drohnen sowie Sichtungen durch Flugzeugbesatzungen waren im Jahr 2021 rückläufig. Möglicherweise kann dies der COVID-19 Pandemie zugeschrieben werden. Um ein gesamtheitliches Bild zu erhalten, bedarf es einer offenen Meldekultur und Daten über einen längeren Zeitraum.

In der Schweizer Zivilluftfahrt gilt das Prinzip des straflosen Meldewesens (Just Culture). Dieses Prinzip ist in den letzten Jahren durch Verfahren der Strafbehörden (Bundes-, Staatsanwaltschaft) in den Fokus gerückt. Befürchtungen, dass meldende Personen vom BAZL für Vorfälle gebüsst werden, sind – ausser bei grobfahrlässigen, bzw. vorsätzlichen Handlungen – unbegründet.

Cyber Security wird auch in der Aviatik ein immer wichtigeres Thema. Damit die Risiken besser bewältigt werden können, wurde die Verordnung EASA Part-IS (Information Security) entworfen. Die Verordnung wird zu gegebenem Zeitpunkt auch in der Schweiz zur Anwendung kommen.

Um die Zielgruppen noch besser erreichen zu können, wurde innerhalb des BAZL die Arbeitsgruppe zur Förderung der Sicherheit («*Safety Promotion*») neu aufgestellt. Über soziale Medien werden aktuelle, sicherheitsrelevante Themen an die «*GA Community*» gerichtet.

In die nahe Zukunft blickend, wird den Sicherheitsbereichen (safety risk areas) «*Airborne collision*» und «*Aircraft upset*» höchste Priorität eingeräumt.

Sommaire

Le présent rapport annuel sur la sécurité aérienne 2021 (RSA) passe en revue les projets et défis de l'Office fédéral de l'aviation civile (OFAC) en matière de sécurité de même que les principaux enseignements et tendances qui se dégagent de l'analyse des comptes rendus d'incidents notifiés l'année dernière.

Nouvellement cette année, le chapitre 5 présente un aperçu des recommandations de sécurité émises en 2021 par le Service suisse d'enquête de sécurité (SESE). L'état actuel de mise en œuvre de ces dernières du point de vue de l'OFAC y est également abordé. Ainsi, dix recommandations de sécurité ont été formulées à l'attention de l'OFAC, dont trois ont déjà été mises en œuvre.

Dans son rapport de 2021, l'OFAC a enregistré 5306 incidents basés sur plus de 8100 comptes rendus d'événements. Cela correspond à une augmentation de près de 42% par rapport à 2020 et à une diminution de 6% par rapport à l'année 2019. Afin de permettre une meilleure comparaison, le nombre d'incidents est dans la majorité de cas normalisé, ce qui signifie qu'ils sont mis en relation avec le nombre de mouvements aériens. Malheureusement, une normalisation des données n'est pas possible pour le chapitre traitant des opérations hélicoptère par manque de données.

Les 32 accidents recensés en 2021 représentent une augmentation par rapport à l'année précédente (2020 : 29). Avec un total de dix décès, le bilan est identique à celui de l'année dernière, l'événement le plus meurtrier étant la collision survenue près du Piz Neir/GR avec cinq personnes mortellement blessées.

Les principaux problèmes de sécurité ont été identifiés et leur degré de gravité évalué pour chaque type de risque à partir des comptes rendus reçus. Dans le domaine des aérodromes, la *Safety Issue* « *Wrong aircraft towing/pushback or marshalling operation* » a été ajoutée afin de tenir compte de l'augmentation des rapports d'incident y relatifs. On remarque également, dans le domaine *Air Traffic Management*, une augmentation du nombre d'incidents liés au trafic mixte IFR et VFR depuis 2019. Une tendance également négative peut être constatée dans le domaine technique de l'aviation générale en matière de défaillance des trains d'atterrissage, des freins et des roues. Quatre accidents peuvent être attribués à cette *Safety Issue*.

Tant les incidents impliquant des drones que les observations de drones par les équipages d'avions ont diminué en 2021 par rapport aux années précédentes. Cette diminution peut être attribuée à la pandémie de COVID-19. Afin de disposer d'une vue d'ensemble, il est nécessaire de mettre en place une culture d'annonce transparente et de collecter des données sur une plus longue période.

Dans l'aviation civile suisse, le principe de la culture juste prévaut, c'est-à-dire un système d'annonce d'événements non-punitif. Ce principe a été mis en avant ces dernières années dans le cadre de procédures de la justice fédérale. Les craintes de voir l'OFAC infliger des amendes aux personnes qui signalent des incidents sont donc, sauf en cas de négligence grave ou d'actes intentionnels, totalement infondées.

La cyber sécurité devient également un thème toujours plus important dans l'aviation. Afin de gérer au mieux les risques liés à la sûreté de l'information, l'AESA a élaboré le règlement *Part-IS (Information Security)*. Cette réglementation s'appliquera également en Suisse le moment venu.

Pour atteindre au mieux ses différents groupes cibles, l'OFAC a mis en place un nouveau groupe de travail chargé de la promotion de la sécurité (*Safety Promotion*). Par le biais des médias sociaux, des sujets d'actualité liés à la sécurité sont adressés à la « communauté de l'aviation générale ».

En ce qui concerne le futur proche, les domaines de sécurité « *Airborne collision* » et « *Aircraft upset* » sont considérés comme étant hautement prioritaires.

Sintesi

[La traduzione in italiano della sintesi seguirà a breve]

1 Introduction

Thanks to continuous and systematic efforts, high levels of safety have been achieved to date in the civil aviation field. In view of the dynamic nature of its operating environment, the aviation system must be able to identify complex system risks and, above all, be able to anticipate the ramifications of change.

Switzerland strives to maintain a high level of safety, and annually updates the Swiss Aviation Safety Plan (SASP), a master planning document describing the country's strategic thrust and direction for the management of aviation safety. The SASP outlines the key aviation safety issues that are current in Switzerland and defines state actions to improve safety performance in connection therewith. The SASP also specifies the Safety Performance Indicators used for monitoring the safety issues outlined. The Annual Safety Report (ASR) documents the development of these safety issues over the last few years, and thus serves as a reporting tool.

The present 2021 Annual Safety Report (ASR 2021) describes what projects the Federal Office of Civil Aviation (FOCA) pursued in 2021 in the safety field, what occurrences were reported in Swiss aviation in 2021 in the categories defined, how appropriate action was taken and what further actions are currently being planned. The report is primarily aimed at aviation professionals, but is also publicly available.

The publication of ASR 2021 is primarily intended to:

- 1) provide data and further information deriving from occurrence reporting requirements to serve as benchmarks for Swiss civil aviation;
- 2) determine key safety parameters and the degree of achievement of the safety targets set by the Federal Department of the Environment, Transport, Energy and Communications (DETEC);
- 3) assess the risks present and inherent in selected issues and illustrate developments therein;
- 4) outline actions based on occurrence data and the findings obtained.

ASR 2021 focuses on the areas of the FOCA's direct supervisory responsibility (Swiss airspace, Swiss aerodromes, HB-registered aircraft and Swiss-certificated air transport operators). On the basis of this, and in line with the SASP and the European Plan for Aviation Safety (EPAS), ASR 2021 provides data for the categories of Commercial Air Transport (CAT), Non-Commercial Air Transport (NON-CAT, NC or GA) and Specialized Operations (SPO) and addresses, wherever possible, any differences between them.

In 2021 the focus of such data analyses was on those safety issues which had been identified by the FOCA's Safety Risk Management (SRM) division and which can be assigned to certain 'safety risk areas'. This approach is intended to provide more transparency on those issues that require greater attention on the FOCA's part.

After the first chapters (the foreword by the Director General and the present introduction), Chapter 2 of this report offers a brief review of the FOCA's prime projects in 2021. Chapter 3 is devoted to the number of accidents and serious incidents within Switzerland. Chapter 4 focuses on the systemic issues of safety promotion and reporting culture. Chapter 5, the report's main element, presents all the relevant operational safety issues and their corresponding occurrence data for 2021, all in accessible chart form. Chapter 6 provides the latest information on the issues of unmanned aerial vehicles (drones) and cybersecurity. The concluding Chapter 7 offers an appraisal of the year's progress and results and draws conclusions from the same, while also providing a corresponding outlook on coming activities to maintain and further enhance safety in Swiss civil aviation.

2 FOCA-related projects

2.1 Low Flight Network

The Low Flight Network (LFN) is a Switzerland-wide network of low-level IFR flight routes for helicopters which was originally launched by Swiss Air-Rescue (Rega) and the Swiss Air Force. After the first steps had been taken in the network's creation, the present implementation phase, which is known as 'National LFN', began in April 2021 following a corresponding resolution by the Swiss Parliament.

The LFN consists of a distance flight network and subsequent IFR approach and departure procedures (points in space or PinS) at landing places such as hospitals or military facilities. The network is intended to serve solely public interests. Needless to say, establishing new low-level IFR routes in Switzerland's already very busy airspace is a complex undertaking. And in view of this, the FOCA has set up a coordination project involving the main national stakeholders.

The mandate issued to the FOCA in this regard is to devise the financial and legal concept for submission to the Swiss Federal Council, with the aim of laying a sustainable foundation for the LFN's future development. In particular, the new network's creation should guarantee nationwide connectivity among the points in space in the healthcare, security and disaster response fields. New civil and military accessibilities will also further extend the LFN to deliver an enhanced network performance.

A working group co-led by the Swiss Security Network (SSN)¹ and the FOCA and including representatives of federal and cantonal authorities and services as well as other key players (such as H+ Swiss hospitals and Skyguide) is currently formulating the requirements and defining the criteria for shaping the future network of a performant domestic infrastructure. The LFN project adheres to the highest safety standards, which will enable operators using it to accomplish their missions even in adverse weather conditions.

2.2 Just Culture

An effective safety culture must include the three components of a *Learning Culture*, a *Reporting Culture* and a *Just Culture*. The Just Culture element has become particularly topical in the last three years, in view of the recent legal judgments against Skyguide air traffic controllers.

The relevant studies under the auspices of the Swiss Federal Office of Justice are now nearing their conclusion. The Swiss Federal Council will then act upon these studies' findings and recommendations to compose a response in summer 2022 to the corresponding motion from the Council of States. But any resulting amendments to existing legislation will still take several years.

Parallel to the above, the industry has continued its own work in the Just Culture field, and has produced a position paper thereon which was published by Aerosuisse in March 2022. On the whistleblowing issue, St. Gallen University is currently working to establish a corresponding reporting channel for the aviation sector.

The fears over the impact that the threat of criminal proceedings might have on Just Culture aspirations – in the form of fewer issues or incidents being reported to the FOCA – have proven unfounded to date from the FOCA's perspective, though the quality of the content of such reports may have declined in some isolated cases.

Some two-thirds of the incidents being reported today occur in commercial flight operations. The proportions of high-severity and low-severity cases have remained virtually unchanged over the past four years. It is still the case that the commercial aviation sector has a better reporting culture than the general aviation sector. The FOCA remains alert to this, and makes regular 'stay safe' contributions to

¹ The heads of the Federal Department of Justice and Police (FDJP) and the Federal Department of Defence, Civil Protection and Sport (DDPS) as well as the presidents of the Conference of Cantonal Justice and Police Directors (CCJPD) and the Intergovernmental Conference on Military Affairs, Civil Protection and Fire Services (IG MZF) are represented in the Political Platform of the Swiss Security Network.

encourage more incident reporting to it from GA pilots. In our view, however, it is not the fear of possible administrative or criminal investigations that is the prime deterrent here.

Statistics show that a very small proportion of cases arising from an incident report – a mere 0.5 per cent – are pursued in the form of administrative or administrative penal proceedings. And only some 5 per cent of incidents which are investigated more closely by line authorities result in a FOCA fine. (In the technical and the aerodrome/ATM fields, not a single fine was levied in 2021 as a result of 376/2014 reporting.)

From the FOCA's perspective, such cases were rightly punished, because the conduct concerned was grossly negligent or (in some cases) even wilful. So in Just Culture terms, these cases were beyond the 'red line' (i.e. they were not honest mistakes, but were cases of gross negligence or wilful intent). The resulting retraining ordered should not, in our view, be regarded as a punishment: such actions are a proactive component that should be viewed as a preventive measure.

Various safety culture-related workshops were held within the FOCA in the course of 2021. These were all intended to help bring the key aspects of a safety culture more centrestage in the FOCA's supervisory activities. The FOCA has also made appropriate modifications to its oversight – not least in the light of the Ju-Air accident and the Royal NLR's monitoring report. The issue was also a prime focus at this year's Swiss Aviation Safety & Operations Conference (SASOC) on 6 May 2022.

2.3 Resumption of civil aviation activities after COVID-19

No sector was hit harder than aviation by the coronavirus pandemic. While flight bans are relatively easy to handle, gradually ramping civil aviation up again is proving a highly complex affair. With the constant background possibility of a relapse into a further lockdown and associated reimposed restrictions, countless technical, economic and legal considerations must be carefully weighed and appraised.

3 Safety level

3.1 Accidents and Serious Incidents

With 32 accidents recorded in 2021, the number has increased slightly compared to the previous year (2020: 29), although the number of fatal accidents (2021: 5 versus 2020: 6) has decreased with one accident less. The number of fatalities (2021: 10) is at the previous year's level (2020: 10).

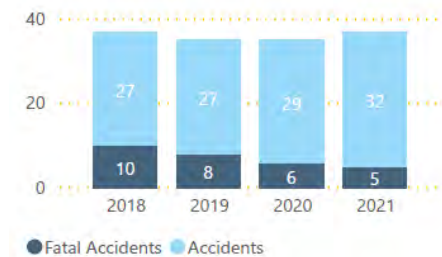


Figure 1: number of (fatal) accidents 2018-2021

The number of serious incidents (2021: 33) has decreased in comparison to the previous year (2020: 36).

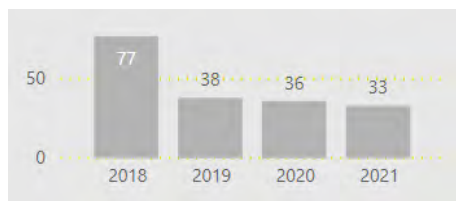


Figure 2: Number of serious incidents 2018-2021

3.2 Fatal Accidents

One of the main goals of the FOCA – to protect the citizens of and the travellers into and from Switzerland – was achieved last year, as there were no fatalities involving commercial air transport affecting Swiss territory or a HB-registered aircraft. Unfortunately, a mid-air collision at Piz Neir/GR with five fatalities had to be recorded in 2021.

Table 1: fatal accidents 2021

Date	Registration(s)	Place	AC Type	SRA	No of fat.
08.05.2021	HB-YMS	Oberramsern/SO	fixed wing aeroplane	LOC-I/CFIT	2
12.06.2021	HB-KLB/HB-3412	Piz Neir/GR	fixed wing aeroplane/fixed wing sail plane	MAC	5
18.07.2021	D-EMPE	Gloggentürmli-Gotthard/UR	fixed wing aeroplane	(tba)	1
20.07.2021	HB-UVC	Subingen/SO	fixed wing aeroplane	CFIT	1
22.07.2021	D-MANS	Conthey/VS	fixed wing sail plane (paramotor)	CFIT	1
TOTAL					10

Important note: the fatal accident with HB-XVY (08.11.2021, Soazza/TI) is not under investigation by the STSB and is therefore not listed in this table.

4 Systemic issues

4.1 Safety promotion

The FOCA was able to hold the majority of its events in person once more in 2021, enabling their various participants to meet up ‘live’ again after a year of largely online meetings. This was the case for meetings such as the Swiss Safety Committee and the Chief of Aerodrome Meeting. In this way, the latest information on projects and innovations relating to aviation safety could be passed on to the various Swiss aviation stakeholders. The FOCA also participated in several events and seminars to engage in dialogue with the various key players within the aviation safety domain.

Great efforts are continuously made to reach the target group of the general aviation community via the ‘Stay Safe’ social media channel, which broadcasts on safety-related topics. Stories or lessons learned are also an integral part of safety promotion via this channel. A greater number of people can be reached through the numerous articles published on the channel, thanks to its presence on new social networking platforms. In view of this, a new Safety Promotion Group has been formed within the FOCA to ensure such targeted promotion. The FOCA has thus been able to promote safety at all times, even in the recent exceptional circumstances.

4.2 Reporting culture

A total of 5 306 incidents were registered in 2021, an increase of 42% on the previous year in absolute terms. Relative to movements, the number of occurrences reported in 2021 was a 25% increase on the previous year. Compared to (pre-pandemic) 2019, the FOCA received 6% fewer incident reports in 2021.

The FOCA processed over 8 100 reports (initial reports from multiple parties involved, interim reports and final reports) in 2021.

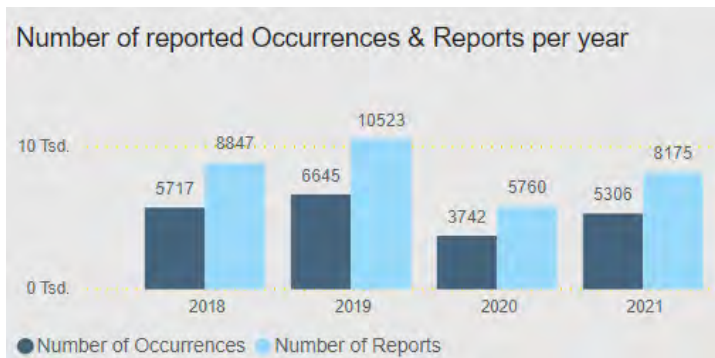


Figure 3: absolute number of occurrences vs reports received 2018-2021



Figure 4: ratio of reported high and low severity occurrences 2018-2021, all domains

5 Safety recommendations (SRs)

5.1 General remarks

The Swiss Transportation Safety Investigation Board (STSB) is the state authority of the Swiss Confederation which is mandated to investigate accidents and dangerous incidents involving trains, aircraft, inland navigation ships and seagoing vessels. The aim of such investigations is to determine not only the direct causes of such events but also any more deep-rooted reasons and other risks associated with them. The sole purpose of this form of investigation is to acquire insights by means of which future accidents and hazardous situations can be prevented and safety can be improved. The results of such safety investigations are **not** intended to clarify questions of blame or liability.²

If a safety deficit is identified in the course of the detailed investigation of an accident or serious incident, the STSB can issue a safety recommendation (SR), the implementation of which is intended to prevent future accidents and dangerous situations. It is then up to the competent supervisory authority, together with the transport circles involved, to decide whether and (if so) how such a safety recommendation should be implemented.³

Since the [Ordinance on the Safety Investigation of Transport Incidents \(OSITI\)](#) came into force (on 1 February 2015) in implementation of [REGULATION \(EU\) No 996/2010 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 October 2010](#), such safety recommendations are addressed directly to the competent supervisory authority. The supervisory authority will then inform the STSB of the measures it intends to take to address the safety deficit concerned, and of the timetable for their implementation.

Based on the feedback from the supervisory authority, these safety recommendations are classified by the STSB as follows:

- **Implemented:** Measures have been taken that are very likely to eliminate or significantly reduce the safety deficit identified.
- **Partially implemented:** Measures have been taken that are very likely to partially eliminate or somewhat reduce the safety deficit identified, or a binding and time-defined implementation plan is in place and has been started that is very likely to lead to a significant reduction in the safety deficit identified.
- **Not implemented:** No measures have been taken that have led to or will lead to a significant reduction in the safety deficit identified.

The STSB's assessments of such implementation status are available on their website.

² [SUST Startseite - Schweizerische Sicherheitsuntersuchungsstelle SUST \(admin.ch\)](#) [Stand: 03.05.2022]

³ SUST Jahresbericht 2020, Seite 15: [SUST_JB_2020_DE.pdf \(admin.ch\)](#) [Stand: 03.05.2022]

5.2 Safety recommendations in 2021

The STSB addressed 10 safety recommendations to the FOCA in 2021. The FOCA already fully implemented and closed three such safety recommendations in the course of the year.



Figure 5: These safety recommendations derive from the three accidents described below.

Final Report No. 2370 on the accident to Junkers Ju52e HB-HOT at Piz Segnas / GR on 4 August 2018

Safety recommendation number and recommendation	FOCA status
SR 561 The Federal Office of Civil Aviation should ensure that adapted rules are established for operations with passengers using aircraft listed in Annex I to European Regulation 2018/1139 that effectively take into account the risks specific to these operations.	
SR 562 Pending the implementation of Safety Recommendation No. 561, the Federal Office of Civil Aviation should ensure that in flight operations with passengers using aircraft in accordance with Annex I of European Regulation 2018/1139, the risks specific to these operations are recorded and effectively reduced with an effort adapted to the complexity and size of the respective flight operation.	
SR 563 The Federal Office of Civil Aviation should take into account the risks specific to this operation when certifying aircraft in accordance with Annex I of European Regulation 2018/1139 for the granting of exemptions and periodically review the exemption licences.	
SR 564 The Federal Office of Civil Aviation, together with the organisations that operate historic aircraft primarily for the transport of passengers, should define risk-based and effective management and monitoring measures that are capable of detecting and correcting the specific problems for this type of operation at an early stage.	
SR 565 The Federal Office of Civil Aviation should improve its organisation for carrying out audits and inspections so that a better exchange of information within the authority, a critical analysis of the company in question and identification of the relevant problem areas become more effectively possible.	

Safety recommendation number and recommendation	FOCA status
SR 566 The Federal Office of Civil Aviation should acquire the necessary technical and methodological expertise for the supervision of historic aviation or make it available from independent sources. It should further ensure that oversight is exercised in an effective manner.	
SR 567 Before the regular entry into service of the overhauled Ju 52/3m g4e aircraft, the Federal Office of Civil Aviation should require the flight operation company to determine the essential performance data and adapt the corresponding documents. (This concern is taken into account by the content of SR 566)	

Final Report No. 2369 on the accident to HB-SPO 1 km south of Gossau/ZH on 30 November 2019

Safety recommendation number and recommendation	FOCA status
SR 568 The Federal Office of Civil Aviation (FOCA) should take appropriate measures to ensure that unrestricted access to information on the technical condition of the aircraft is guaranteed to the authorised groups of persons from the start of the changeover to electronic logbook systems.	

Final Report No. 2368 on the accident to HB-SAA in Corpataux-Magnedens, Gubloux / FR on 3 January 2019

Safety recommendation number and recommendation	FOCA status
SR 571 The FOCA should supplement the aircraft register with an entry for electrically powered aircraft.	
SR 572 The FOCA, in cooperation with aerodrome operators and emergency personnel who usually respond to accidents involving aircraft, should take measures to increase awareness of the hazards posed by electrically powered aircraft involved in accidents and how they can be countered.	

6 Operational issues

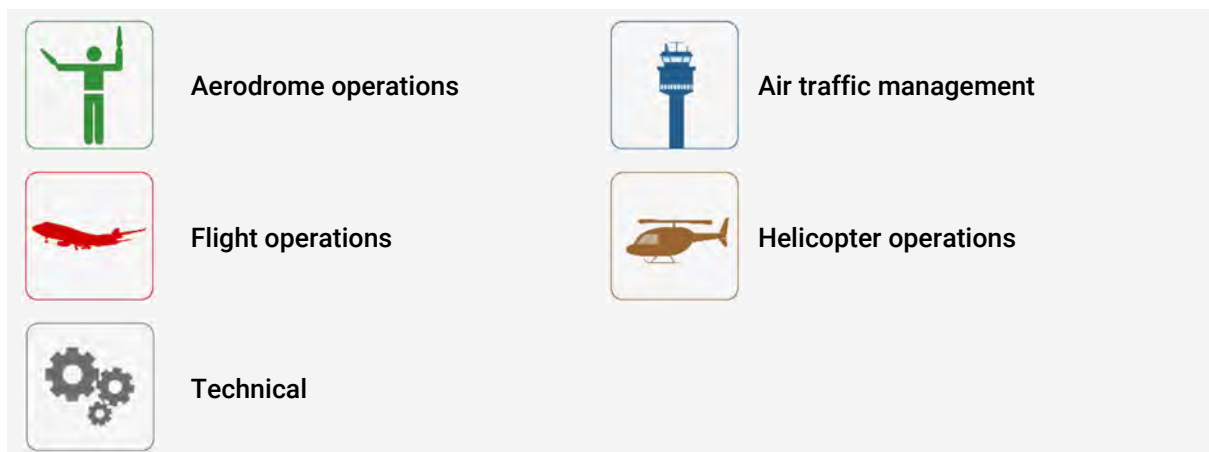
This chapter takes a closer look at the operational issues that are currently of most relevance to Swiss civil aviation in safety terms. These extend throughout the safety risk areas defined for civil aviation (see chapter 6.2 below), and may have an impact on the safety of flight operations.

As part of its data analyses, and with due regard to the numbers of occurrences reported and the severity classifications thereof, the FOCA identified safety-relevant issues in various operational areas in 2021 which were subjected to extensive analysis since they could lead to accidents in the safety risk areas mentioned above.

To monitor these safety risk areas, the FOCA has developed a number of safety indicators that enable it to continuously track their general development and also conduct any more extensive analyses or risk assessments which may be required. The data studied derive from both commercial and non-commercial aviation and also from specialized operations.

The safety issues identified may vary over the next few years, depending on corresponding developments in the associated trends.



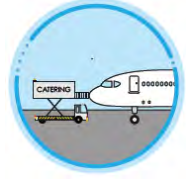




These safety issues have been assigned to the following operational categories, each of which is individually elaborated on in the subchapters below:



6.1 Structure of sub-chapters

Each operational category features an overview of the corresponding safety issues including their definition and their assignment to a particular safety risk area. Following this, the safety issues are presented in chart form according to the number of occurrences assignable to them in 2020 and with due regard to the average severity thereof. A further chart shows the number of such occurrences, divided into high and low severity for each safety issue. A multi-year comparison showing the occurrence trends over the past four years is provided as well. Each subchapter concludes with a brief discussion of the current situation and trends for each safety issue, whenever possible together with comments on their potential causes.

6.2 Safety risk areas in aviation

	Aircraft upset	<p>This safety risk area includes uncontrolled collisions with the ground/open terrain, as well as occurrences in which the aircraft deviates from the planned flight path or planned flight parameters, regardless of whether the aircraft crew notices the deviation or not. The causes can be of a technical, handling and/or operational nature.</p>
	Runway excursion	<p>These occurrences are usually caused by weather conditions (strong tail wind, slippery runways), technical defects or human error.</p>
	Injuries and damages	<p>This safety risk area includes occurrences that cannot be allocated to the other safety risk areas but have caused damage or injury.</p>
	Runway collision	<p>(Near)Collision between two aircraft on the runway and occurrences where runways, including the protected area, are entered or used without permission by an aircraft, vehicle or person.</p>
	Airborne collision	<p>Mid-air collision between aircraft.</p>
	Ground collision (off runway)	<p>A taxiing aircraft is involved in a (near) collision with another aircraft, vehicle, person or other obstacle in its path.</p>
	Terrain & obstacle collision	<p>The aircraft is unintentionally flown into the ground or an obstacle under control. Typically, the crew notices the impending crash too late.</p>

Your guide to the following sub-chapters

Definition: Safety Risk Areas

These categories used to be called accident categories. The FOCA has expanded this term in line with EASA's terminology and it now means safety-relevant risk areas at an operational level.

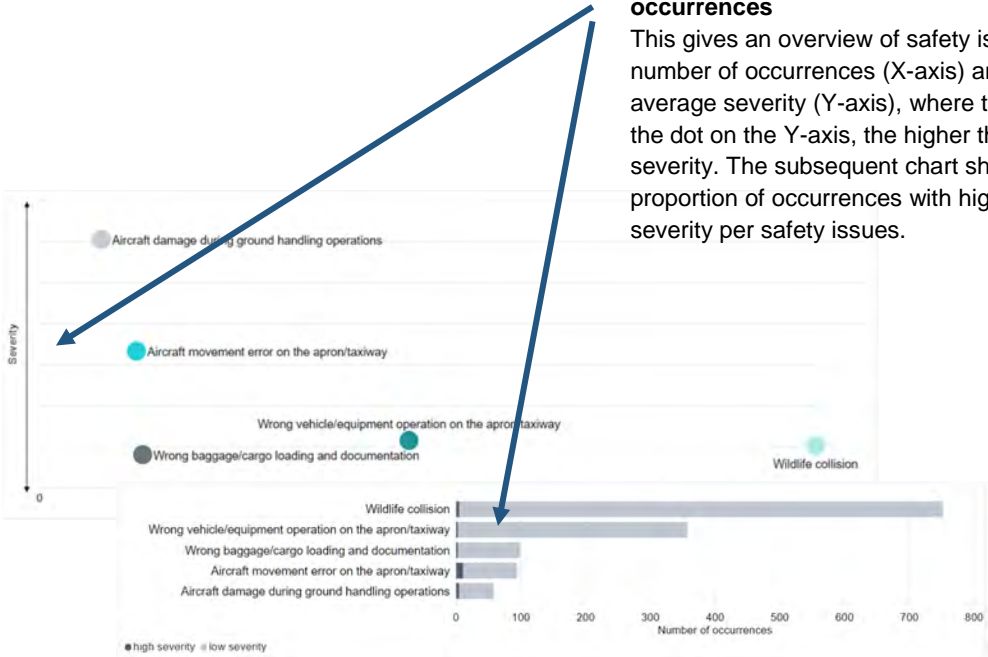
Safety issues Aerodrome operations	Safety Risk Areas			
	Aircraft upset	Runway excursion	Injuries/damages	Ground collision (off runway)
Aircraft damage during ground handling operations	•			
Wrong baggage/cargo loading and documentation	•	•		
Wildlife collision	•	•		
Aircraft movement error on the apron/taxiway (own power)			•	•
Wrong vehicle/equipment operations on the apron/taxiway			•	•

Definition: Safety Issues

Group of occurrences in a given area – in this example “Aerodrome operations”. A safety issue, depending on its impact, can lead to an accident in one of the identified safety risk areas – the potential accident is marked in the table with a dot per safety issue and allocated to the appropriate safety risk area. Safety issues are defined based on the number of occurrences and their severity.

Chart: Number and severity of occurrences

This gives an overview of safety issues by number of occurrences (X-axis) and average severity (Y-axis), where the higher the dot on the Y-axis, the higher the severity. The subsequent chart shows the proportion of occurrences with high/low severity per safety issues.




Definition: Severity

The FOCA analyses each individual occurrence and assesses its severity based on the available information.
 High severity: Accident, serious or major incident
 Low severity: Occurrences classified as significant/no safety impact/not determined.

6.3 Aerodrome operations

Safety issues in aerodrome operations

<p>Aircraft damage during ground handling operation</p> <p>A stationary aircraft is damaged during ground handling: collision with equipment/vehicle, incorrect manipulation (e.g. incorrect opening of cargo hold doors). The damage may compromise operational safety in flight. This does not include damage caused by foreign object debris (FOD).</p> <p>Aircraft movement error on the apron/taxiway (own power)</p> <p>The crew deviates from the taxiing rules, procedures and/or clearances when taxiing on the apron, which results in an unintentional near-ground collision or a ground collision with another aircraft, a vehicle or an obstacle. This does not include movement errors or collisions on the runway.</p> <p>Wildlife collision</p> <p>Bird strike or collision with an animal during approach or takeoff. The collision may cause damage and/or compromise flight safety. Animal sightings and carcass finds that cannot be clearly attributed to a collision are not included.</p> <p>Wrong aircraft towing/pushback or marshalling operation</p> <p>A deviation from the towing/pushback procedures and/or clearances on the apron or incorrect marshalling signs to or communication with crew, which results in an unintentional near-ground collision or a ground collision with another aircraft, a vehicle or an obstacle. This also includes aircraft parking procedures and issues (not suitable owing to size etc.) which could lead to a collision.</p> <p>Wrong baggage/cargo loading and documentation</p> <p>An aircraft is not loaded by the ground handling staff in accordance with the instructions, or is loaded based on incorrect rules. The loading plan may be incorrect (wrong takeoff weight, balance calculation, flight parameters); or the aircraft may be loaded incorrectly, so that cargo may shift in flight. Loading errors can compromise operational safety in flight. This does not include the loading of dangerous goods or an assignment error at check-in.</p> <p>Wrong vehicle/equipment operation on the apron/taxiway</p> <p>A vehicle deviates from the instructions/traffic rules on the apron or taxiway, which results in an unintentional near-ground collision or a ground collision with a taxiing or towed aircraft. Equipment or vehicles are parked incorrectly on the apron and obstruct a taxiing aircraft. This does not include movement errors on the runway or a collision between a vehicle/equipment and another object/vehicle.</p>	 <p>Safety Issues</p>	<p>Safety Risk Areas</p>			
		Aircraft upset	Runway excursion	Injuries/damage	Ground collision
	Aircraft damage during ground handling operation	●		●	
	Aircraft movement error on the apron/taxiway (own power)			●	●
	Wildlife collision	●	●		
	Wrong aircraft towing/pushback or marshalling operation			●	●
	Wrong baggage/cargo loading and documentation	●	●		
	Wrong vehicle/equipment operation on the apron/taxiway			●	●

Overview of safety issues in aerodrome operations: numbers and severity of occurrences

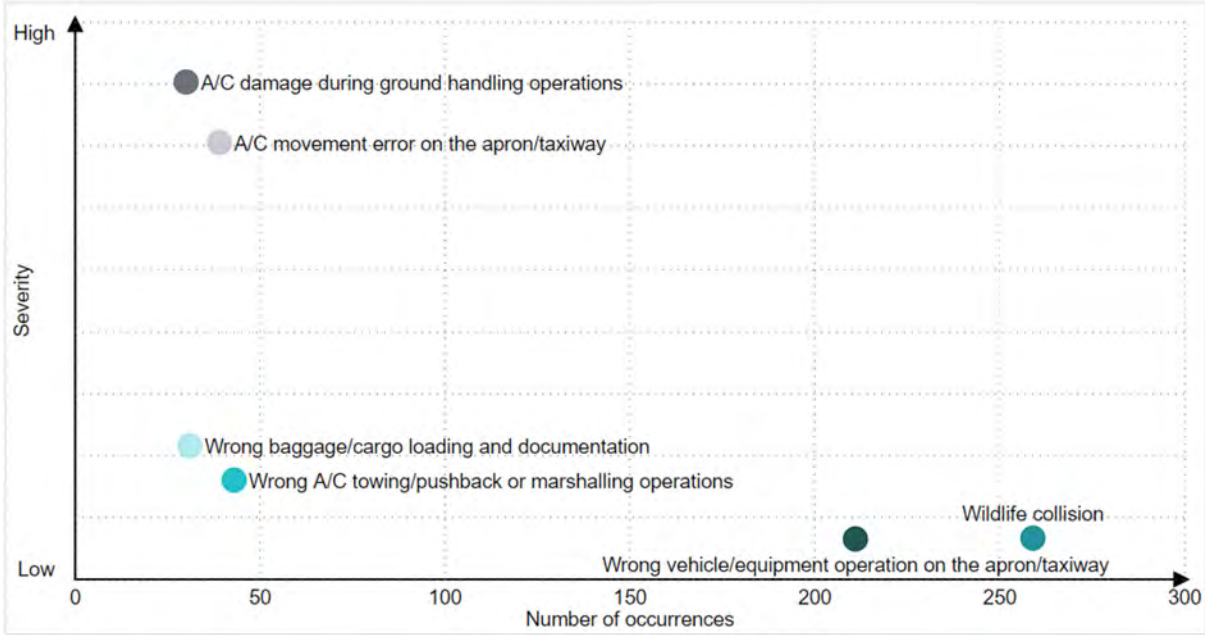


Figure 6: absolute number and severity of occurrences in ADR operations in 2021

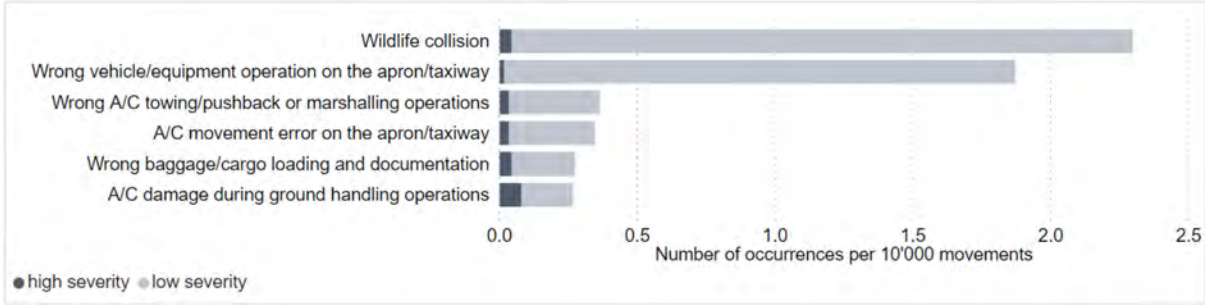


Figure 7: high/low severity occurrences in ADR operations 2021 (normalised)

Numbers of occurrences in aerodrome operations in the last five years

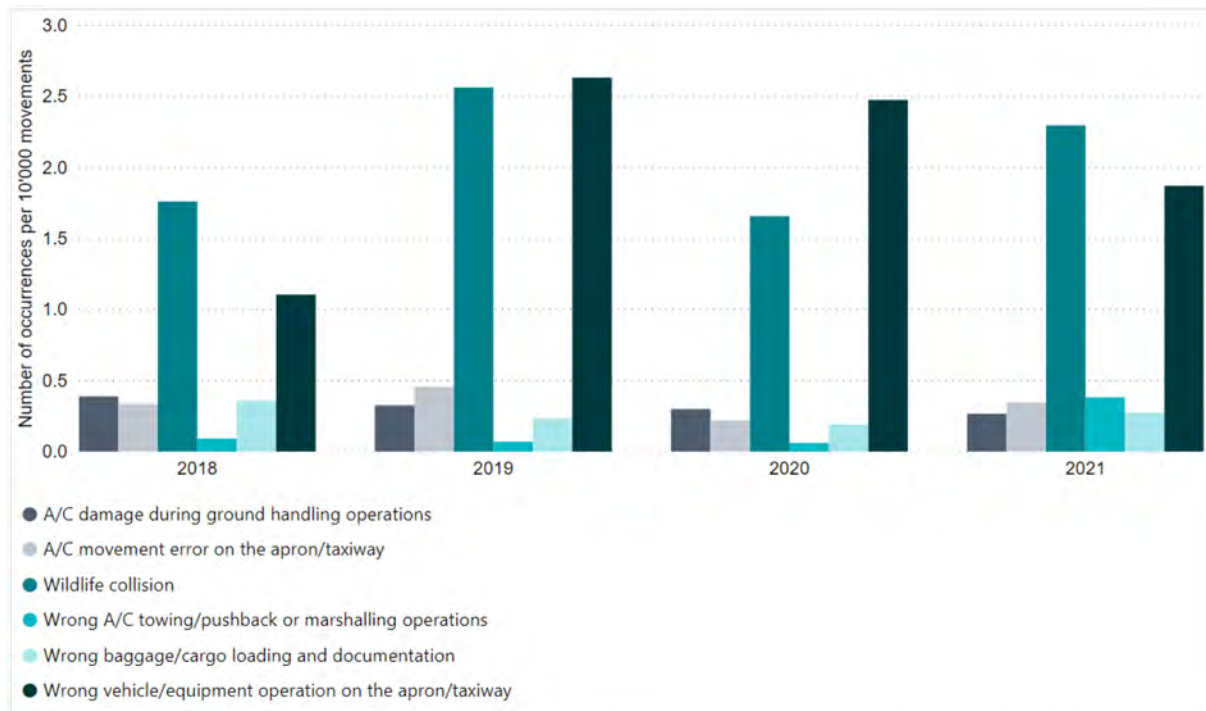


Figure 8: No of occurrences 2018-2021 in ADR operations (normalised)

Data analysis of aerodrome operations safety issues

Aircraft damage during ground handling operation

A total of 30 occurrences were reported in 2021 in which aircraft were damaged at Swiss aerodromes owing to the incorrect handling of equipment or vehicles. Commercially operated aircraft were involved in over half of the incidents reported, with the others involving non-commercial traffic. Some 30% of the occurrences reported were classified as serious, in view of the structural damage caused to the aircraft and/or its operational consequences. In most cases, collisions between equipment and a parked aircraft can be attributed to the limited space at the stand or to time pressure and/or the possible resulting lack of attention by ground handling staff.

Aircraft movement error on the apron/taxiway (own power)

A total of 39 occurrences were reported in Switzerland in 2021 of an own-powered aircraft movement error on the apron or taxiway. Almost all the occurrences reported involved taxi clearance deviations or navigation errors. Occurrences in which a non-commercially or commercially operated aircraft failed to maintain a safe distance from other aircraft, vehicles or objects while taxiing or parking, resulting in a collision where material damage was incurred, represent 16% of the total, with only 4 such occurrences classified as high-severity incidents.

Wildlife collision

An increase is noticeable for 2021 in the number of wildlife collisions reported in proportion to the number of air traffic movements for the year; but the absolute number of such collisions did not exceed the corresponding volume for 2019. In absolute terms, 259 wildlife collisions were reported in Swiss airspace. In more than 85% of these cases, the collision occurred within the airport perimeter, i.e. during the approach, landing or takeoff phase, while the remaining 15% occurred en-route. In 99% of the cases birds were involved. Fewer than 2% of all the cases reported were classified as serious. Nearly 80% of the collisions reported occurred between May and October.

Wrong aircraft towing/pushback or marshalling operation

Some 41 incidents in this category were reported to the FOCA in 2021. More than half of these involved commercial operations, while the rest related to non-commercial aviation. In commercial aviation, most such incidents are due to non-compliance with pushback/towing or marshalling procedures. In non-commercial aviation, the cases reported were mainly a matter of inadvertent errors during towing into or out of hangars, resulting in collisions with infrastructure or other aircraft and damage to the aircraft. Even though damage was found in a quarter of all the cases reported, only 4 such cases were classified as high severity. This topic has been newly included in the ASR this year, in view of the increase in such incidents in recent years.

Wrong baggage/cargo loading and documentation

Some 31 reports of occurrences involving loading errors were received in 2021. Most of these related to the incorrect loading of commercially operated aircraft. The other half were mainly a matter of loadsheet errors or misrouted baggage. Fewer than 15% of these occurrences were classified as high-severity incidents, in view of their impact on flight operations. A slight increase in this type of incident was observed over 2020, in terms of the numbers thereof in proportion to total air traffic movements for the years concerned.


Wrong vehicle/equipment operation on the apron/taxiway

In this category, some 211 reports were received of incidents at airports in Switzerland in 2021. One collision between taxiing aircraft and equipment or vehicles was recorded, which resulted in material damage. Fewer than 1% of the incidents reported here were classified as serious, however. And the number of such incidents in proportion to annual movement volumes has been decreasing since 2019. The commonest cause of such reports is an apron or taxiway incursion resulting from the incorrect positioning of equipment or vehicles in these areas.

6.4 Air traffic management

The task of air traffic management is to ensure the safe and efficient movement of aircraft during all phases of their operation. In this chapter, we provide information about the safety issues relating to air traffic management (ATM) and airborne conflicts between aircraft.

Safety issues in air traffic management

<p>Airborne conflicts This includes collisions, airproxes and occurrences that can lead to an airborne collision, as well as resolution advisories from collision warning systems.</p> <p>Airspace infringements All reported (confirmed and suspected) airspace infringements are recorded in this category. This includes airspace infringements caused by Swiss-registered aircraft abroad, as well as infringements of controlled airspace (Delta and Charlie airspace classes) by any aircraft within Skyguide's area of responsibility (i.e. including delegated airspace in Germany, France, Italy and/or Austria). This category also includes infringements of restricted areas (LS-Rxx in Switzerland, restricted areas abroad).</p> <p>Communication error between pilot and ATC This includes all occurrences that are mainly (or at least initially) due to missing, defective or misunderstood communication between pilots and air traffic control authorities (or vice versa).</p> <p>ATC clearance & navigation error by pilot Occurrences where pilots fail to act in accordance with the rules/clearance of air traffic control (ATC) or where pilots have not followed prescribed standard ATC procedures. This includes all occurrences reported by Skyguide involving all aircraft under its responsibility (controlled Swiss airspace plus delegated airspace), as well as occurrences by Swiss-registered aircraft abroad in connection with air traffic control issues (usually reported by crews, safety offices or foreign supervisory authorities).</p> <p>Pilot deviation from ATM procedures Occurrences where pilots do not operate according to internationally agreed and valid ATM rules and procedures. This includes all occurrences reported by Swiss airports or airfields, as well as occurrences reported by Swiss air traffic control service providers involving Swiss and foreign registered aircraft in Switzerland (including delegated airspace). This also includes occurrences involving Swiss cockpit crews and/or Swiss certified flight operators (mainly reported by their safety offices) in Switzerland and abroad that have violated ATM procedures and regulations.</p>	 <p>Safety issues</p>	Safety Risk Areas					
		Aircraft upset	Runway collision	Airborne collision	Ground collision (off runway)	Terrain collision	Obstacle collision
Airborne conflicts				●			
Airspace infringements				●			
Communication error between pilot and ATC			●	●	●		●
ATC clearance & navigation error by pilot			●	●	●	●	
ATM procedure deviation by pilot		●		●	●	●	

Overview of safety issues in air traffic management: numbers and severity of occurrences

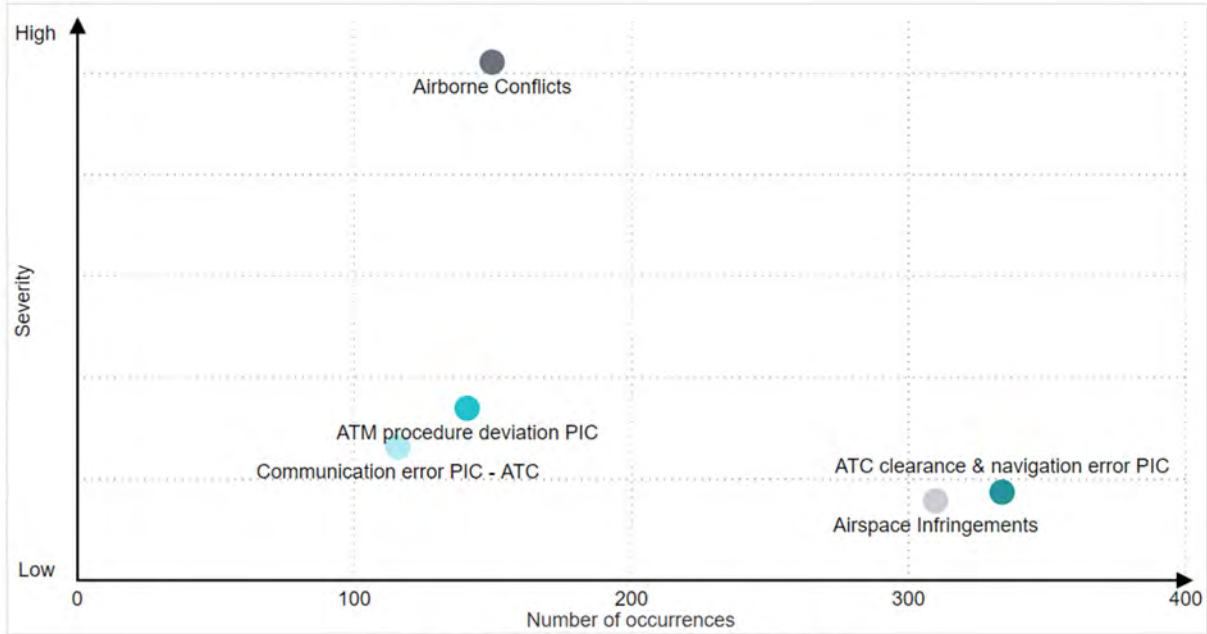


Figure 9: absolute number and severity of occurrences in ADR operations in 2021

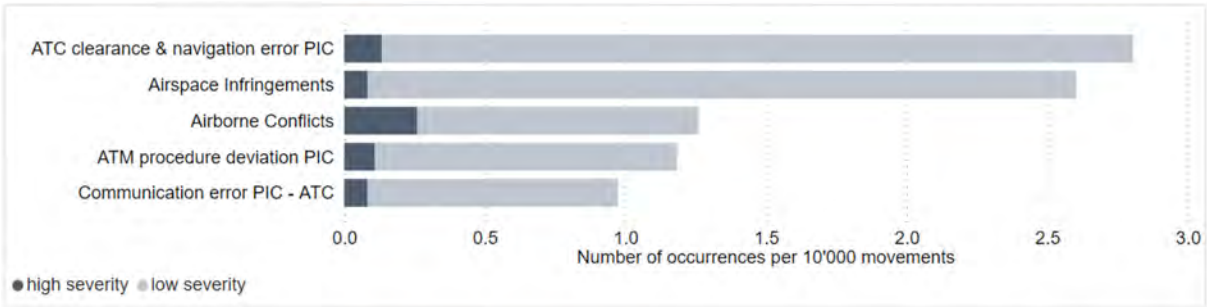


Figure 10: high/low severity occurrences in ATM operations 2021 (normalised)

Numbers of occurrences in air traffic management in the last four years

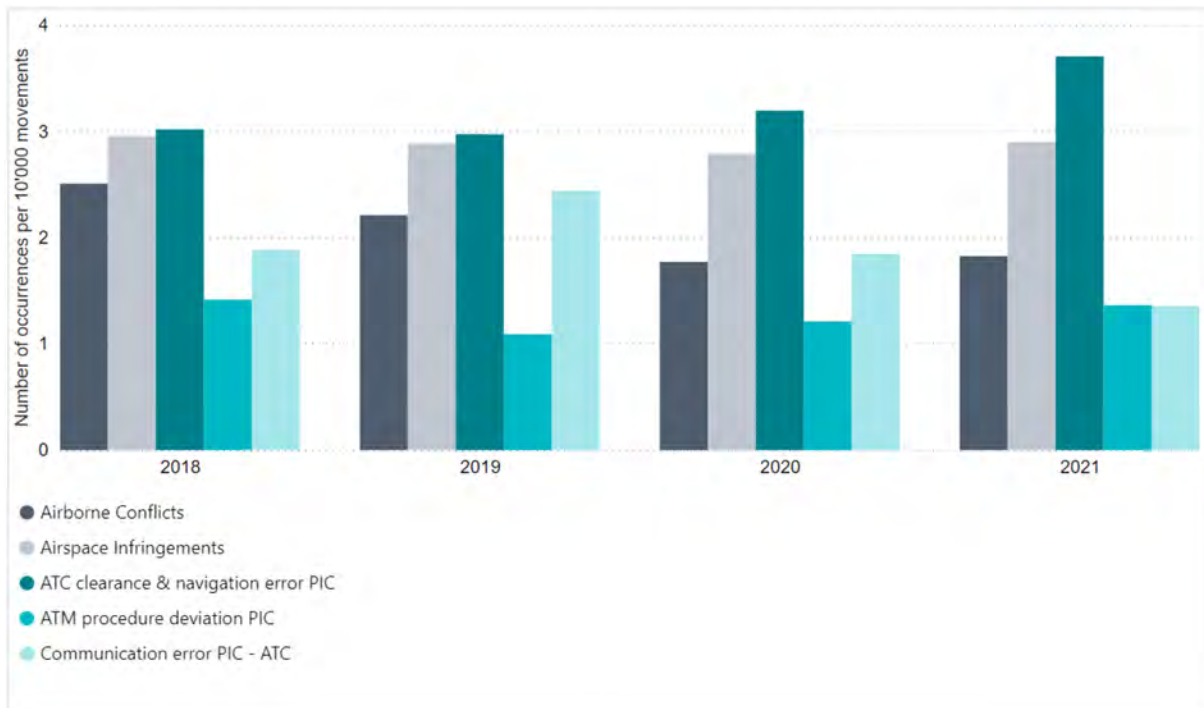


Figure 11: No of occurrences 2018-2021 in ATM (normalised)

Data analysis of air traffic management safety issues

Airborne conflicts

Airborne conflicts have increased, both in absolute numbers and relative to movement volumes. A total of 149 airborne conflicts in Swiss airspace were reported in 2021. To these must be added a further 28 such occurrences registered in the delegated foreign airspace managed by Swiss air navigation service provider Skyguide, resulting in a total of 177 reported occurrences.

The numbers of IFR/VFR conflicts in Swiss airspace have been increasing since 2019. 2021 saw a total of 58 such occurrences (2020: 39).

Regrettably, an airborne collision with five fatalities had to be recorded with the accident on Piz Neir.

Airborne conflicts by airspace class

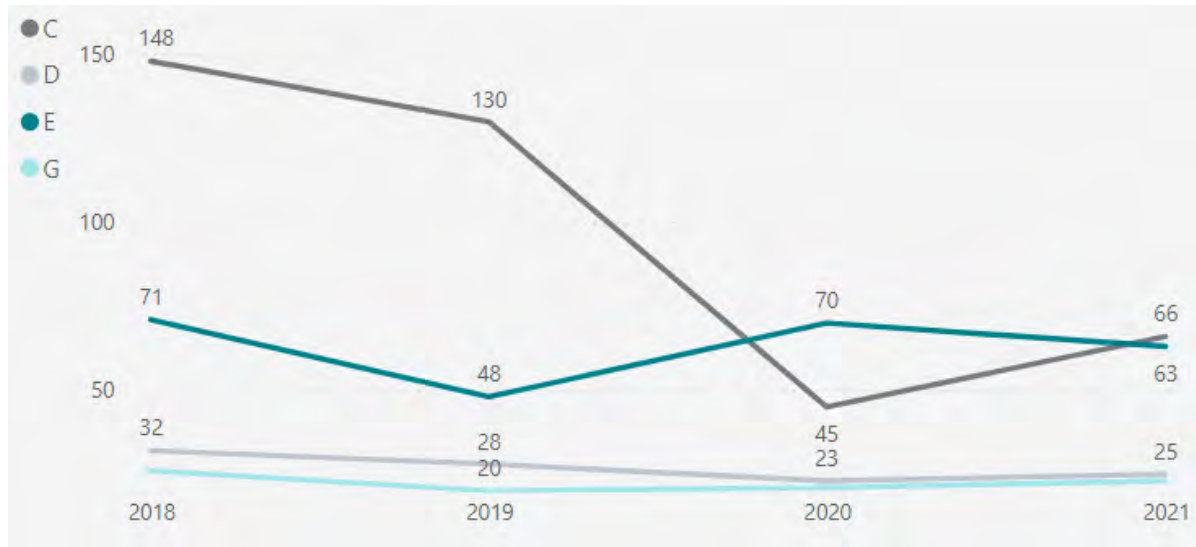


Figure 12: absolute number of airborne conflicts by airspace class 2018-2021

- **C** Airspace Class Charlie (C): controlled airspace, terminal manoeuvring areas surrounding major airports, air routes and upper airspace primarily used for IFR flights. There are clear separation criteria for air traffic in these airspaces, which must be applied by air traffic control.
- **D** Airspace Class Delta (D): controlled airspace, control zones and terminal manoeuvring areas of airports, regional aerodromes and military airfields for mixed use by VFR and IFR air traffic. Requires high discipline from pilots in mandatory radio contact with air traffic control.
- **E** Airspace Class Echo (E): controlled airspace for IFR flights at lower altitudes and from/to uncontrolled regional aerodromes and airfields, but mainly used by light aircraft operations for sightseeing flights and by the air force for VFR training flights. No permanent radio link with air traffic control authorities required for VFR flights.
- **G** Airspace Class Golf (G): uncontrolled airspace for IFR flights; only used in Grenchen and Samedan. One single maxim applies: see and avoid.

Airspace infringements by airspace class

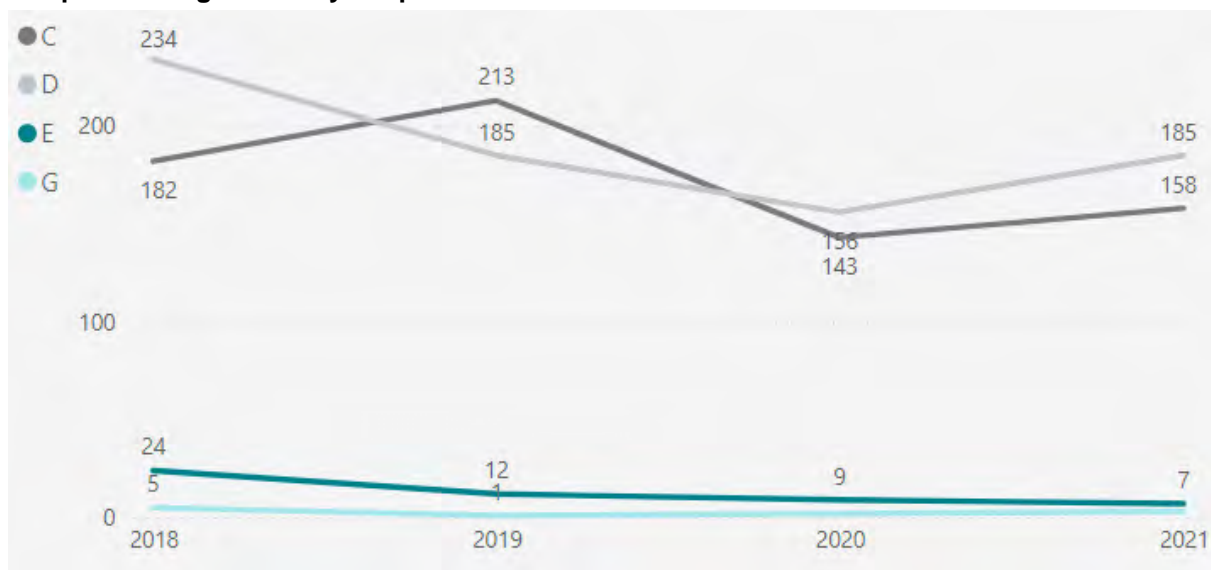


Figure 13: absolute number of airspace infringements by airspace class 2018-2021

The number of airspace violations reported by Skyguide increased by 15% in 2021 compared with the first pandemic year, but the 263 reports remained well below the absolute figures for 2015 to 2019. The vast majority of such incidents only slightly violated airspace boundaries vertically or horizontally, and were mainly classified as having low safety relevance. They can probably be attributed to the growing practice in general aviation of navigating with mobile navigation aids and apps, which deceive pilots into believing that they are flying as close to the airspace boundaries as possible, either intentionally or unintentionally, in the belief that they are not violating the boundary in this way.

Communication error between pilot and ATC

Despite a further substantial increase in traffic volumes in 2021 (in particular a renewed increase in international flights), the number and severity of communication problems decreased significantly in a normalized comparison. In particular, the number of PLOCs (prolonged loss of communication) in the commercial aviation sector fell by around a third compared with the absolute figures for the previous year. The absolute number of incidents in this category reported by Swiss crews from Spain and South America, where safety and communication problems were reported owing to the extensive use of Spanish in radio traffic, also halved.

ATC clearance or navigation error by pilot

This category shows a significant increase in reports with normalized values, and a slight increase in the weighting of the severity concerned. Once again, such incidents consisted mainly of errors during taxiing at major airports where incorrect taxiways or intersections were taken, which were classified as not serious in the vast majority of cases. There was also an increase in the number of 'level bust' incidents – non-adherence to the altitudes assigned by air traffic control. Such deviations are usually detected quickly by the air traffic control units responsible, and the crews involved are immediately requested to make the appropriate corrections.


ATM procedure deviation by pilot

The approximately 130 reports of ATM procedure deviations in Swiss airspace (including delegated foreign airspace) in 2021 represent an increase of 51% on the previous year. Total traffic volume (i.e. total IFR and VFR movements in Switzerland) increased by only about 28% to some 1.190 million movements in the same period.

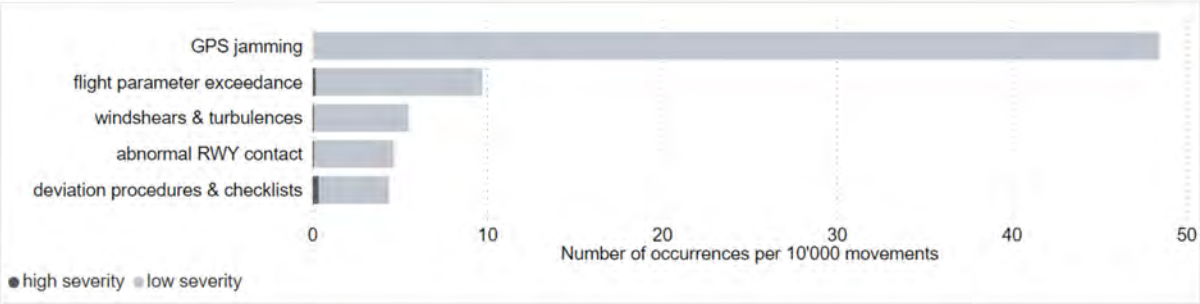
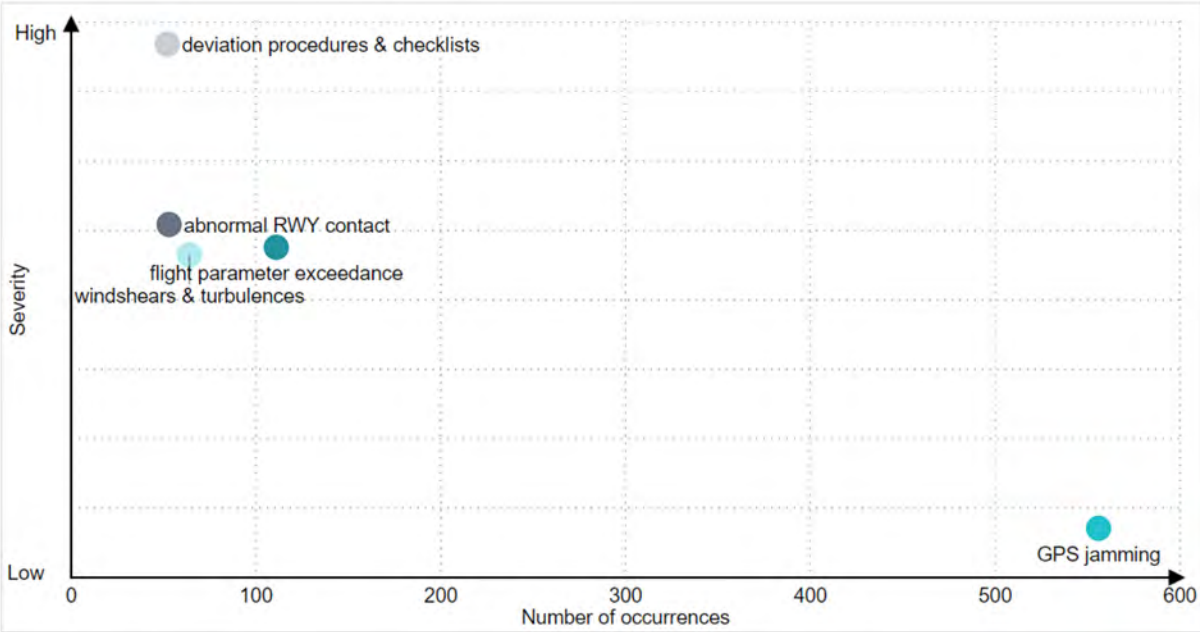
Only a few such incidents were classified as high-risk occurrences. These include two reports of major deviations from the instrument approach procedure to Sion in bad weather conditions. From Lausanne, another three reports with a high risk assessment were received, involving approaches to the wrong runway.

6.5 Flight operations

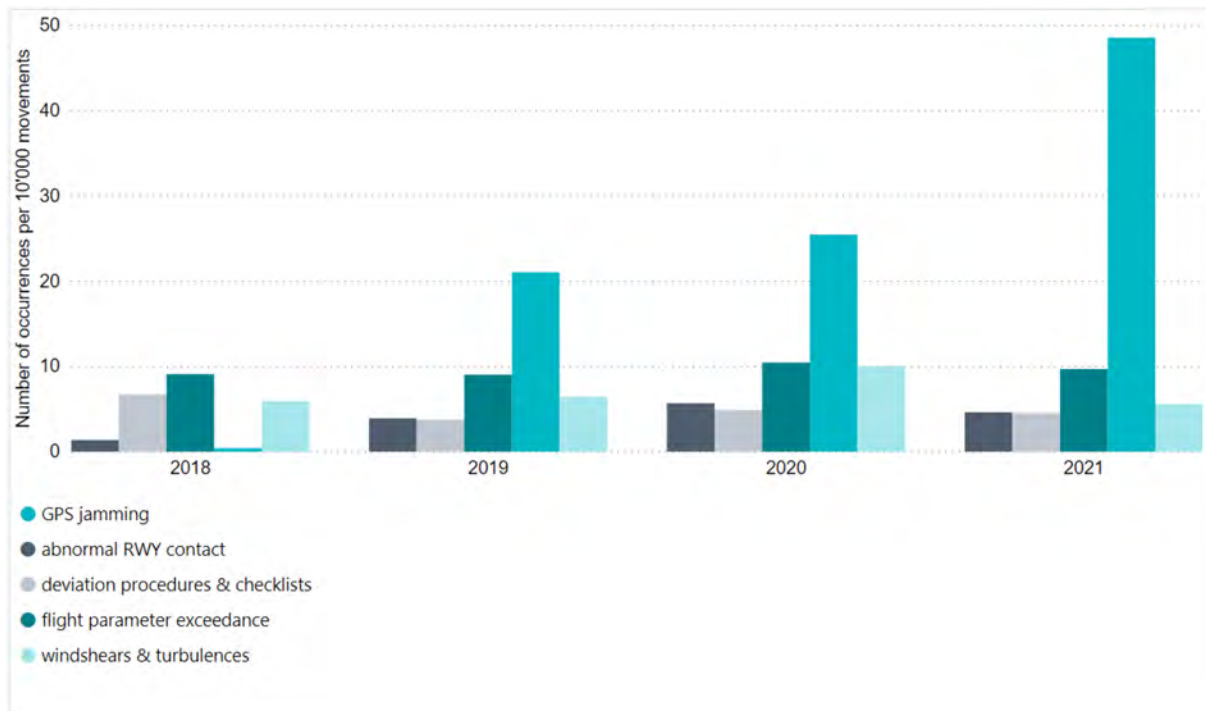
Safety issues in flight operations

GPS interference	Safety Risk Areas						
<p>GPS jamming is the process of using a frequency transmitting device to block or interfere with radio communication signals. The types of communications that can be jammed include GPS systems. The process is also known as GPS spoofing, and the devices used can also be referred to as signal blockers. GPS jammers were initially developed by the military to misguide the enemy about geographical locations and targets.</p>			Aircraft upset	Runway excursion	Injuries/damage	Airborne collision	Terrain collision
Flight parameter exceedances	Safety issues Flight operations						
<p>Flight parameters can be exceeded in any flight phase. This is usually caused by pilot carelessness or by external influences such as turbulence or wind shear, as well as sudden changes in wind direction. Such deviations generally include a rapid change in airspeed, flight direction and/or horizontal/vertical flight attitude, but may also involve the operational limits of aircraft systems such as engine/engine temperatures, g-force loads or load values on flight control surfaces. In extreme cases, such deviations can cause aircraft upset.</p>	GPS interference				●	●	
	Flight parameter exceedances	●	●				
	Wind shear and turbulence	●		●			
	Abnormal runway contact		●				
	Deviation from procedures and checklists	●	●			●	
Wind shear and turbulence	<p>Wind shear and turbulence are caused by air movements associated with convective activity, especially within or near a thunderstorm or near a jet stream. Turbulence can also occur in the absence of clouds and at high altitudes. Turbulence tends to be unproblematic for large aircraft. But for smaller aircraft, turbulence can lead to uncontrollable flight attitudes, which must be quickly counteracted. The aircraft operated by airlines and business jet operators today are equipped with advanced warning systems that alert pilots to wind shear early so that they can react as quickly as possible.</p>						
Abnormal runway contact	<p>During approach and landing, influences such as wind shear, thermal convections, optical illusions or an incorrect assessment of the rate of descent can result in abnormal runway contact: the aircraft may hit the runway too hard or, owing to too much lift, flare too long over the runway before touching down. Undercorrecting such situations can cause the aircraft to overshoot or veer off the runway; overcorrecting can result in a tailstrike.</p>						
Deviation from procedures and checklists	<p>Many years ago, the cockpit of an aircraft would accommodate two pilots, a navigator and a flight engineer. The latter roles are no longer required in modern aircraft, since much of the work is performed by computers, cutting-edge technology and the pilots. However, owing to the increasing complexity of technologies and systems, special procedures and checklists have had to be defined to minimize the error rate for operating the controls. Such procedures and checklists tell the pilots the specifications by which they should fly and the on-board systems they should use to ensure that their passengers are transported as safely as possible.</p>						

Overview of safety issues in flight operations: numbers and severity of occurrences



Numbers of occurrences in flight operations in the last four years



Data analysis of flight operations safety issues

Global positioning system (GPS) interference

Increasing numbers of cases of GPS interference have been reported by the industry over the past few years, mainly in Southeast Europe around Cyprus and between the borders of Iran, Iraq and Turkey. Such interference, also known as jamming, has intensified in geographical areas surrounding political conflict zones. In view of these trends, EASA has published a Safety Information Bulletin (No. 2022-02) to inform national aviation authorities (NAAs), air navigation service providers (ANSPs) and air operators accordingly. Pilots are fully aware of such possible interference and are prepared to revert to conventional navigation procedures using different navigation aids in all phases of flight when operating in or near the areas affected. None of the events reported had a high severity.

Flight parameter exceedances

Exceedances of flight parameters are mainly reported by commercial air transport flight crews (>95%). More than 70% of such deviations in 2021 were observed during the approach or landing phases, where they were often caused by turbulence or wind shifts. Flight parameter deviations include overspeed or underspeed (63%) in all flight phases, excess lateral bank (5%) and pitch deviations (34%). Fewer than 10% of the events reported happened in the critical takeoff phase, and 18% occurred en route. The overall incidence rate remained stable over the reporting period.

Wind shear and turbulence

The number of reports in this category received in 2021 was 50% down on 2020, and generally varies between 5 and 10 events per 10 000 movements. Some 10% of these reports were from the general aviation domain and 90% from commercial air transport. 61% of the occurrences were in the approach and landing phase, 13% during the takeoff phase and 26% en route, broadly as they had been in the previous reporting period. Wind shear is mainly encountered during the approach phase, where a specific electronic detection system is available to inform the pilots of the need for immediate action (i.e. initiating the missed approach procedure). Turbulence is not critical to the aircraft structure but it can

cause injury to the aircraft's occupants if they are not wearing seat belts. Only six minor turbulence-related injuries to cabin crew members were reported in 2021.

One accident was recorded and is under investigation by the Accident Investigation Board (AIB): a light aircraft was hit by a wind gust during the landing phase, resulting in a hard landing and main gear damage. None of the occupants was injured.

Abnormal runway contact and runway excursion

A somewhat high number of abnormal runway contacts and runway excursions were observed in the area of non-commercial air transport in 2021, as had also been the case in the previous reporting period. The main contributing factor to such incidents is inadequate training. A total of nine accidents and serious incidents without any injuries are currently being investigated by the AIB.

In commercial air transport there were 5 hard and 43 long landings recorded in 2021. These were mainly due to the influence of adverse wind conditions in the landing phase, resulting in difficult manual control of the aircraft. No such events had a high-risk bearing. The main precursors to long landings are unstabilized approaches and changing wind conditions during the touchdown phase. No accidents or serious incidents were recorded in this category in 2021.

Deviation from procedures and checklists


Other key safety issues in flight operations are deviations from procedures and checklists, including policies and procedures (42%), configuration setting errors (29%), incorrect use of checklists (16%) and wrong altimeter settings (13%). Causal factors for such deviations are the lack of action or delayed action inflight, influenced by distractions from the cockpit environment (communications, noise, navigation, weather etc.). Such distractions, errors and deviations can also lead to level busts, deviations from vital flight parameters, runway incursions, navigational errors, deviations from ATM procedures and similar.

Dangerous goods

The number of dangerous goods incidents reported increased by almost 32% from 116 in 2020 to 153 in 2021, owing probably to the year-on-year increase in aircraft movements. Most of these cases involved undeclared goods, followed by damaged goods or shipments not recorded.

6.7 Helicopter operations

Safety issues in helicopter operations

<p>Total or partial loss of load A total or partial loss of load occurs if, during transport, all or part of the external load is lost.</p>		Safety Risk Areas			
<p>Laser attack The sudden appearance of a strong light source that exposes a pilot to glare can have varying impacts, depending on its intensity. The possible consequences range from brief distraction to temporary blindness or even permanent eye damage. Exposing crews to glare is illegal and can have fatal consequences, especially in the crucial phases of approach, takeoff or low-altitude flight, which require a pilot's full attention.</p>		Aircraft upset	Runway collision	Airborne collision	Ground collision (off runway)
<p>Rotor strike A rotor strike is an event involving damage to the aircraft because its main or tail rotor blades collide with an obstacle on the ground (cable/wires, vegetation, poles etc.).</p>	<p>Safety issues Helicopter operations</p>				
<p>Total or partial loss of load A total or partial loss of load occurs if, during transport, all or part of the external load is lost.</p>	Rotor strike		● ●		
<p>Spontaneous cargo hook opening, strop disruption This category covers the failure of the hook and/or the strop used for hoisting cargo or passengers from a surface below the aircraft or of the strop used to secure cargo to the aircraft's cargo hook.</p>	Total or partial loss of load		●		
<p>Injuries due to sling load operation This category covers incidents in which injuries are sustained by persons while they are part of a sling load operation.</p>	Laser attack		●		
<p>Total or partial loss of load A total or partial loss of load occurs if, during transport, all or part of the external load is lost.</p>	Spontaneous cargo hook opening, strop disruption		●		
<p>Injuries due to sling load operation This category covers incidents in which injuries are sustained by persons while they are part of a sling load operation.</p>	Injuries due to sling load operation		●		

Overview of safety issues in helicopter operations: numbers and severity of occurrences

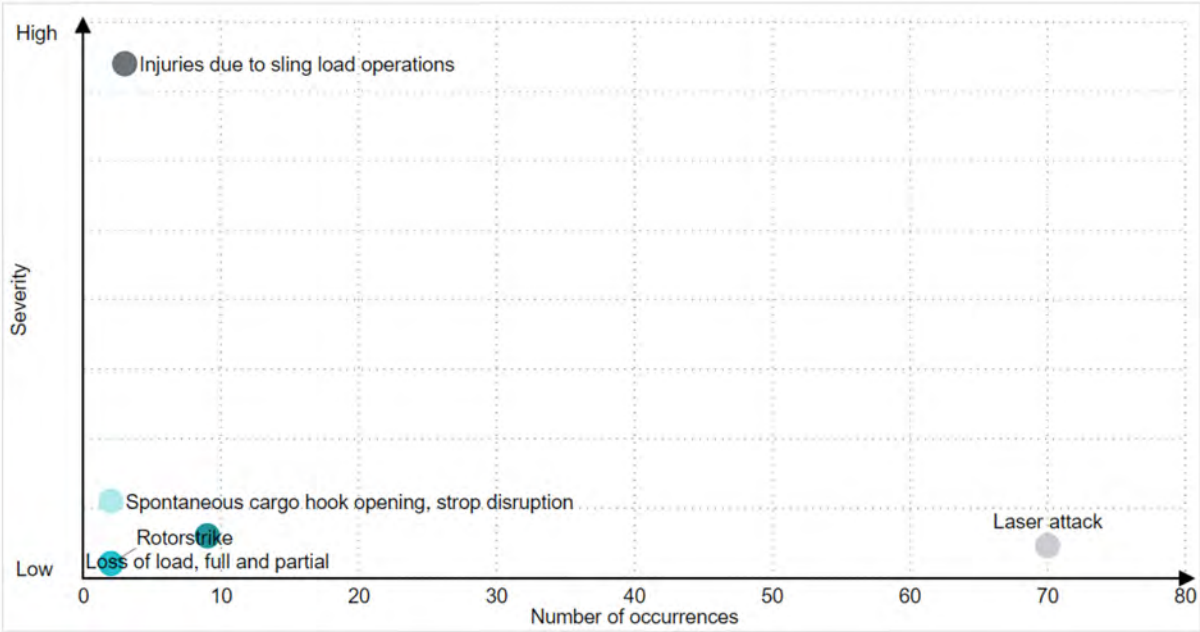


Figure 17: absolute number and severity of occurrences in helicopter operations in 2021

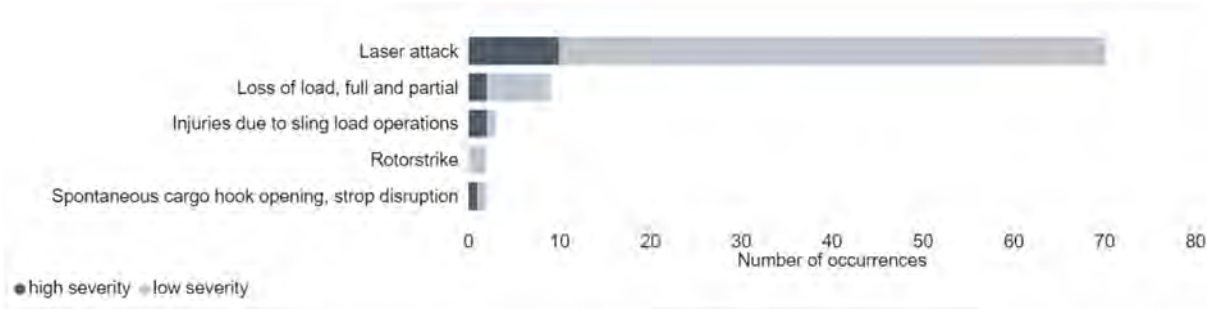


Figure 18: high/low severity occurrences in helicopter operations 2021 (not normalised)

Numbers of occurrences in helicopter operations in the last four years

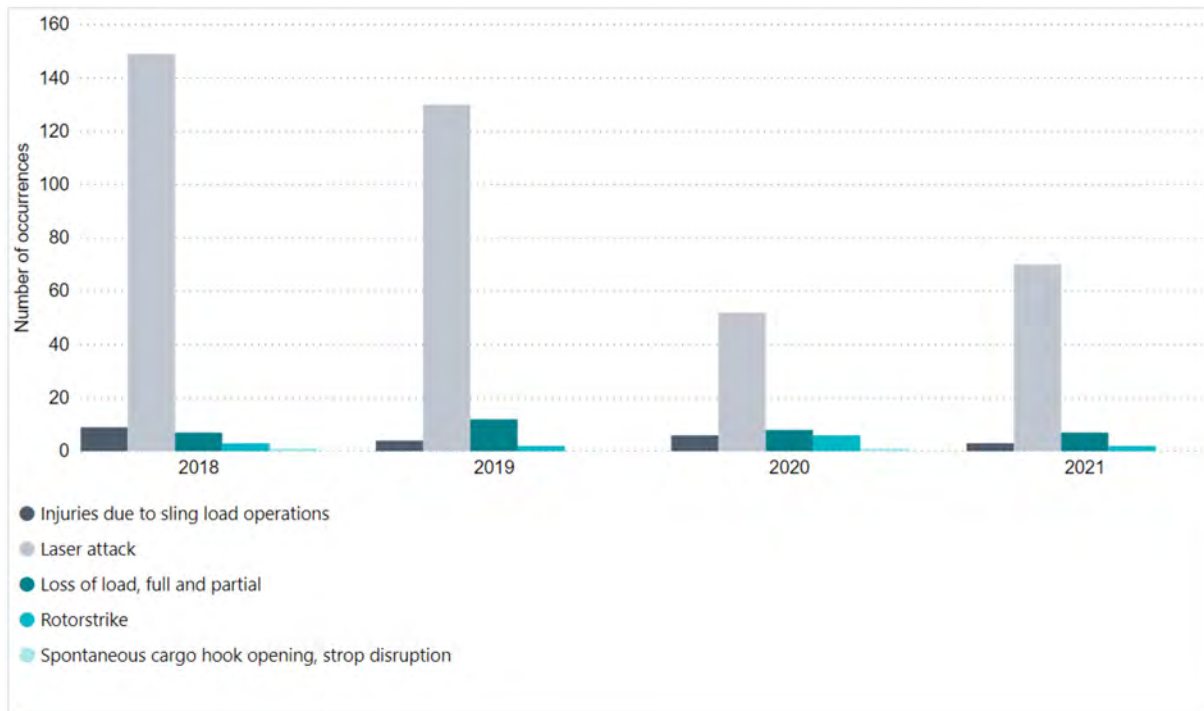


Figure 19: No of occurrences 2018-2021 in helicopter operations (not normalised)

Excluding fixed-wing laser attacks, the total number of occurrences reported increased by some 30% in 2021 and was above the average of the last four years. The most significant increase in reported incidents in 2021 related to operational single events. It must also be noted that the numbers here are consistently too small for clear conclusions to be drawn about possible trends. This small number of reports spread over a relatively wide band of operations makes it virtually impossible to conduct any meaningful analyses.

With the exception of the 'Laser attack' category (which includes fixed-wing incidents), a slight decrease was observed in each of the safety issues listed. No new safety issue was identified in 2021.

Important note: Unlike with the other areas, incident data in helicopter operations cannot be normalized. The figures available to the FOCA, especially in the SPO field, do not allow the number of incidents to be set in relation to the number of rotations, for example. The figures provided by the organizations involved do not permit a reliable comparison.

Data analysis of helicopter operations safety issues

Rotor strikes

The number of reports in this category fell again for this reporting period. Whilst seven rotor strikes had been reported in the previous year, only two such reports were submitted to the FOCA during 2021 (the same number as in 2019).

Total or partial loss of load

Following an increase in 2019, the number of reported load losses declined in 2020 and declined again in this reporting period, albeit not significantly (2020: 10, 2021: 9). The small number of reported incidents should be noted.

Laser attack

In recent years, we have seen an increase in the outdoor use of lasers for legitimate purposes, such as laser shows and commercial testing. Similarly, there has been an increase in the use by private individuals of hand-held laser pointers for the intentional (and illegal) illumination of airplanes and helicopters. Disruptions of this nature are very dangerous for pilots in critical flight phases such as takeoff and approach/landing, especially for helicopter pilots.

Awareness-raising campaigns and a legislative change criminalizing laser glare are proving effective. But after a significant decrease in the total number of reports of laser glare in 2020 by nearly 60%, the number of such reports rose again in this reporting period by approximately 35% (2019: 132; 2020: 52; 2021: 70). This figure is still significantly lower, however, than the long-term average. The numbers of helicopter crews affected by laser glare decreased in this reporting period. Helicopters were affected in 11% of all such reports (compared to 23% in 2020).

Spontaneous cargo hook opening, strop disruption


After a couple of years without or with very few incidents in this category, six such cases were reported in 2020. In 2021 the number of reported cases in this domain fell again to only two. These numbers are too small to be statistically relevant. But the trend will continue to be monitored over the next few years.

Injuries due to sling load operation

The FOCA received three reports in 2021 of injuries to flight assistants or workers on the ground during sling load operation. The numbers here vary from year to year, and no trend can be identified, not least because the figures are too small. None of the three 2021 cases are being investigated by the STSB, although one case involved fatal injuries to a flight assistant.

6.8 Technical

Technical safety issues

<p>Propulsion or fuel system malfunction</p> <p>A partial or complete loss of propulsion power can lead to an emergency landing or aircraft upset.</p> <p>Possible causes of this are technical defects in the propulsion systems (engine, propeller, transmission and related systems) or fuel system, faulty manipulation, maintenance errors, damage incurred on the ground, bird strikes, weather conditions, fuel shortage or contaminated fuel.</p> <p>A loss of power or engine failure does not always lead to an emergency. Modern passenger aircraft can be controlled even after engine failure, and crews receive ongoing training for this type of event.</p> <p>If necessary, pilots can also shut down engines or operate them at reduced power to prevent damage. This can be done, for example, in response to engine vibrations, an exhaust gas temperature (EGT) exceedance or a low oil level or low oil pressure.</p> <p>Aircraft environment (smoke, smell, fumes, fire)</p> <p>Smells can arise in an aircraft for any of various reasons. Depending on the source, concentration and chemical composition of the smell, the health or performance of the aircraft's occupants may be adversely affected. To avoid potential risks owing to smell or smoke in the cockpit, the crew may decide to make a precautionary landing or use oxygen masks. Airlines follow established procedures to investigate such incidents and mitigate their causes.</p> <p>In general, the following sources in particular can cause smells to form in aircraft:</p> <ul style="list-style-type: none"> • traces of oil from an engine or auxiliary power unit (APU) that penetrate into the air-conditioning system • defective electrical/electronic components • development of smells in the galley owing to defects, soiled ovens or coffee machines • defects in the cabin pressure and air-conditioning system • external sources of smells on the ground (e.g. de-icing, ambient air) • luggage, cargo, passengers. <p>An uncontrolled fire in an aircraft is one of the hazards with potentially the greatest impact and can lead to aircraft upset as a result of damage to the structure and/or control systems and/or injury to the crew.</p> <p>Flight control system malfunction</p> <p>The flight control system serves to control the aircraft around its three axes and comprises the various control surfaces and their control mechanisms; in helicopters, this is mainly the main and tail rotor control mechanism. A failure or malfunction of flight control systems may result in aircraft upset.</p> <p>In passenger aircraft, the key systems are generally designed with redundancy: if one system fails, others take over some or all of its functions and the aircraft can still be controlled. Failures and problems are displayed to the pilots, according to their severity, as caution indications or warnings, to enable appropriate action to be taken. In addition, crews receive periodic training to handle potential failures of the various systems.</p> <p>Flight control system malfunction</p> <p>The flight control system serves to control the aircraft around its three axes and comprises the various control surfaces and their control mechanisms; in helicopters, this is mainly the main and tail rotor control mechanism. A failure or malfunction of flight control systems may result in aircraft upset.</p> <p>In passenger aircraft, the key systems are generally designed with redundancy: if one system fails, others take over some or all of its functions and the aircraft can still be controlled. Failures and problems are displayed to the pilots, according to their severity, as caution indications or warnings, to enable appropriate action to be taken. In addition, crews receive periodic training to handle potential failures of the various systems.</p>	<p>Safety Risk Areas</p>		
	 <p>Safety issues Technical</p>	Aircraft upset	Runway excursion
Propulsion or fuel system malfunction	●	●	
Aircraft environment (smoke, smell, fumes, fire)	●		●
Flight control system malfunction	●	●	
Landing gear/brakes/wheels malfunction		●	●
Aircraft maintenance	●	●	●

Landing gear/brakes/wheels malfunction

A malfunction of the landing gear including its extension/retraction system, the brakes or a tire failure can result in a wheels-up landing, the collapse of the landing gear during landing, a failure to retract the gear after takeoff or a runway excursion.

Aircraft maintenance

Maintenance issues include, but are not limited to, incorrectly or incompletely performed maintenance tasks, foreign objects left in aircraft after maintenance, the planning and monitoring of maintenance actions, the use of maintenance documentation and the adherence to maintenance procedures.

Overview of technical safety issues: numbers and severity of occurrences

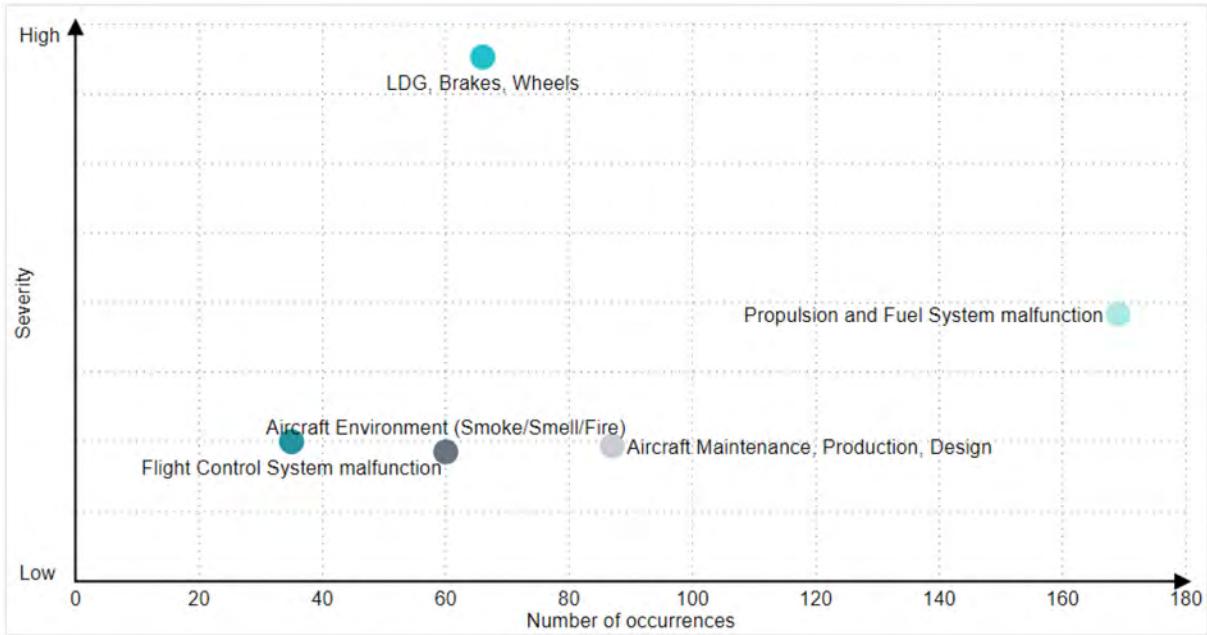


Figure 20: absolute number and severity of technical occurrences in 2021

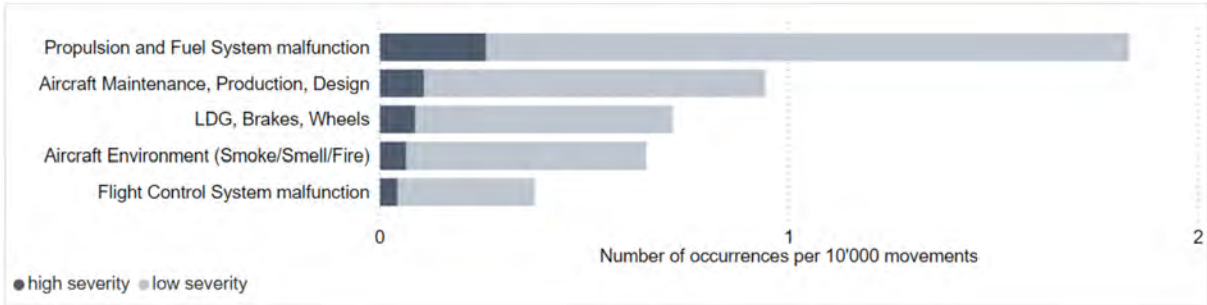


Figure 21: high/low severity occurrences in helicopter operations 2021 (normalised)

Number of technical occurrences in the last four years

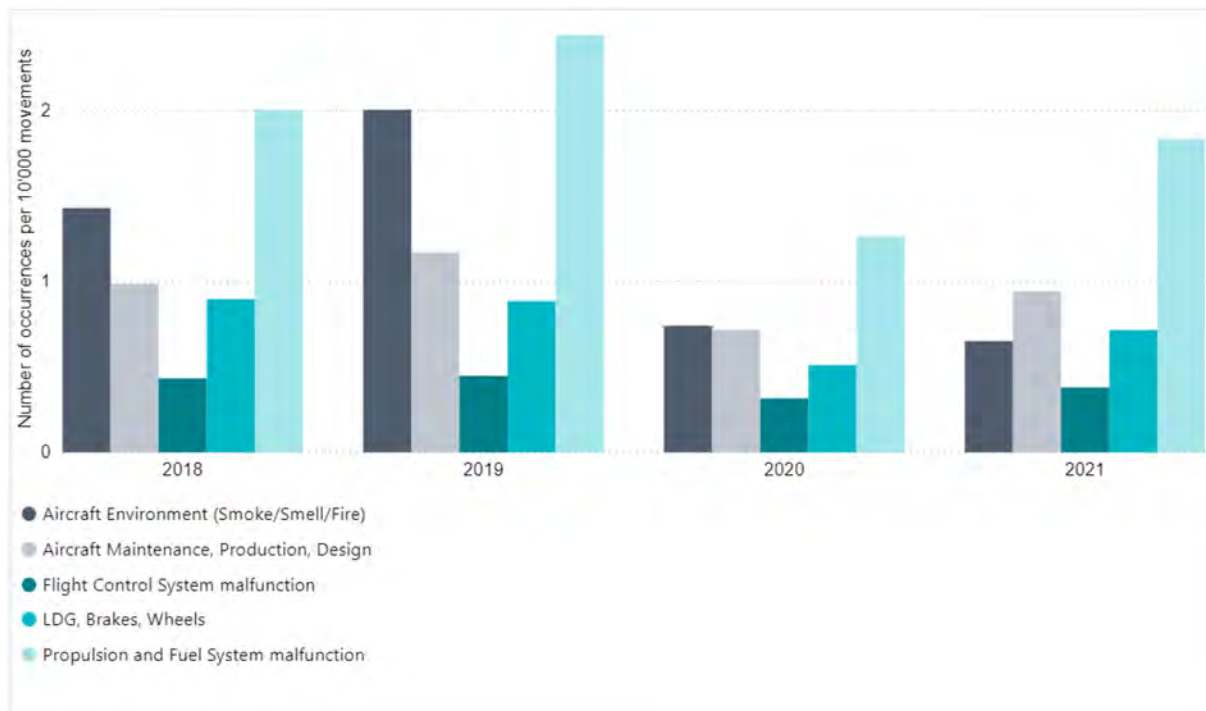


Figure 22: Number of technical occurrences 2018-2021 (normalised)

Data analysis of technical safety issues

General remark: the charts in this chapter show the figures and rates for the whole of Swiss aviation. Where necessary, differences between the individual categories of aviation are mentioned in the text.

Propulsion or fuel system malfunction

The aggregate severity of reported engine and fuel system incidents decreased in 2021 in comparison to the previous year, while an increase was seen in the number of such incidents per 10 000 movements. The main contributors here were three non-commercial aviation accidents involving power loss of reciprocating engines and several incidents of higher severity in the same category.

In commercial aviation, the rate and severity of incidents were at similar levels to previous years.

Aircraft environment (smoke, smell, fumes, fire)

The number of incidents in this category per 10 000 movements and their aggregate severity both decreased in 2021 from the previous year, and were also lower than their four-year averages.

In commercial aviation, the majority of identifiable causes of smell in the cabin or cockpit came from the engines or from electrical and hydraulic systems. However, the total number of such cases was lower than in previous years, and about half of these cases were one-off incidents with no attributable cause.

At least two non-commercial aviation incidents related to smoke from a reciprocating engine.

Flight control system malfunction

There was a slight increase in 2021 in the number of reported incidents in this category per 10 000 movements and a decrease in their aggregate severity compared to 2020. Overall, the number of incidents and the severity remained at low levels.

Landing gear/brakes/wheels malfunction

Compared to the previous year, there was a slight increase in the rate of reported incidents in this category and a decrease in their aggregate severity.

The severity of such incidents increased, however, in the non-commercial aviation field. This was primarily the result of four accidents, three of which were due to a landing gear failure during landing, a landing gear retraction during takeoff and a landing with a missing wheel.

Aircraft maintenance

A slight increase was seen in 2021 in the number of incidents reported in this category per 10 000 movements compared to 2020, which had itself been lower than previous years. The aggregate severity remained at a similar level.

The prime causes of these incidents were the incorrect or incomplete execution of repairs or installations, followed by errors in the planning or the monitoring of scheduled maintenance tasks.

7 Emerging issues

7.1 Aviation cybersecurity

With the growing extent of both digitalization and online network interconnections, the risk landscape has also expanded in the cybersecurity field. The aviation industry detected more cyberattacks in 2021 than the previous year. Possible reasons for this include:

- The COVID pandemic offered opportunities for various threat actors not limited to aviation.
- Aviation stakeholders increased their detection capabilities.
- There is a generally heightened awareness of the cyber threat within the aviation industry.

Phishing attacks increased, as this remains a cheap and easy method with a significant success rate. Good-quality and regular user awareness training is still one of the most effective measures against phishing attempts.

There was one reported cybersecurity incident in 2021 at an entity under FOCA oversight. This particular incident affected several systems of the organization concerned, but did not directly affect airline or airport systems. The incident thus did not have any safety implications.

The Council of ICAO has decided to establish a Cybersecurity Panel (CYSECP) as part of its new governance mechanism. In early 2022, ICAO nominated Switzerland, represented by the FOCA, to be one of the Panel's 33 members. This nomination is a major achievement, and demonstrates that Switzerland is a leading nation in aviation cybersecurity. Participation on the ICAO Cybersecurity Panel will also allow experts from Switzerland to ensure that increases in cybersecurity maturity can be achieved not only nationally but also across the globe. This is important to ensure that the flights of the airlines of Switzerland remain covered by cybersecurity measures throughout their journey.

In June 2021 the European Strategic Coordination Platform (ESCP) Executive Committee & Regulatory Group published its [Opinion 03/2021](#) 'Management of Information Security Risks'. The corresponding EASA Part-IS (Information Security) regulation has been drafted. The development of the refining Acceptable Means of Compliance (AMC) and Guidance Material (GM) has also been initiated and is being supported by the FOCA in various subgroups. EASA Part-IS specifies the requirements to be met by civil aviation organizations as well as by Competent Authorities, in particular, for the management of information security risks with a potential impact on aviation safety.

The FOCA, as a Competent Authority, and a large number of organizations under FOCA supervision will need to implement this regulation and ensure compliance therewith within two years after it has become effective in Switzerland. The FOCA has already initiated the implementation of an ISMS in order to comply with these EASA Part-IS authority requirements. When preparing implementation, many aviation stakeholders in Switzerland will be able to benefit from investments in cybersecurity over the past ten years based on the requirements in the National Civil Aviation Security Programme (NASP).

EASA's Network of Cyber Analysts (NoCA) went live in 2021, and aims to gain deeper insights into cyber threats to the sector by investigating and analyzing cyber incidents which affect aviation safety. The FOCA actively contributes to this committee and leads its *Threat Intelligence* and *Incident Analysis* working groups. Although the NoCA is still in an early stage, the FOCA is convinced of the benefits of such a network of authorities for the further improvement of safety in civil aviation.

In 2021, the FOCA also became a member of the European Centre for Cyber Security in Aviation (ECCSA), a voluntary cooperative partnership within the aviation industry to better understand the emerging cybersecurity risks and to provide collective support. Regular technical meetings have already shown the importance and the benefits of being closely interconnected and of sharing information within a trusted environment.

ED Decision 2020/006/R covering airworthiness information security came into effect in January 2021. This introduces airworthiness requirements dedicated to cybersecurity risk management. Its implementation is challenging for the various Swiss stakeholders as well as for the FOCA's certification experts in their compliance reviewing activities. FOCA experience and expertise in this field have, however, allowed one expert to be accredited by EASA in such issues with no interruption, so that

stakeholders can evolve in their projects (including cybersecurity) and continue to benefit from FOCA expertise.

Cybersecurity knowledge is evolving in the entire avionics certification expert community, with the aim of having more than one expert accredited by EASA to deal with cybersecurity issues. With its Pilatus PC-24, the Pilatus aircraft company already achieved compliance with the airworthiness requirement dealing with information security risk management during the original type certification; and the company is now further evolving the aircraft's design with features exploiting network connectivity that require the full application of ED Decision 2020/006/R. Without such a requirement in force or the experts able to cope with it, projects like this would have been less likely to be successfully implemented in safety and harmonization terms.

7.2 Unmanned aerial systems (UASs)

The number of occurrence reports and occurrences involving drones declined to 39 in 2021 from the 50 of the previous year. The trend was probably largely attributable to the COVID-19 situation that prevailed throughout much of 2020 and 2021.

The FOCA has long been specifically urging the various parties active in Swiss aviation to report all drone-related occurrences, so as to gain the most comprehensive and objective picture possible of the current drone situation. It will still be some time, however, before the impact of an improved reporting culture can be properly assessed. Moreover, the exceptionality of the last two years has only further delayed this process. The FOCA remains active, however, on this front.

The number of sightings of unmanned aerial vehicles (UAVs) by aircrews in 2021 was 14 cases, a decline of around 25% from the 19 of the previous year.

A further 17 incursions by UAVs (14 drones and 3 model aircraft) into prohibited zones (such as the five-kilometre-radius area around aerodromes) were recorded in 2021.

Only one crash of a UAV was reported in 2021; nobody was injured.

The sales of drones, especially for hobby flying, again rose less strongly than they had in previous years. Estimates made a few years ago suggested that over 100 000 drones had been sold in Switzerland. However, precise numbers on how many of these are currently in use are not available.

To estimate the risk of a collision between a drone and another Swiss airspace user, a detailed risk assessment was conducted back in 2018, which determined the likelihood of a collision between a drone weighing up to two kilograms and an aircraft (an airliner, business jet, small aircraft or helicopter). This risk assessment was updated in 2019, and again in 2020. The ramifications of the COVID-19 pandemic have prompted a decline in manned flights (and the reports from the pilots thereof), and this in turn has basically reduced the collision risk. Given the exceptional nature of the present situation, however, no general conclusions should be drawn from this latest trend.

The FOCA continues to assume that the risk situation here is broadly stable. It is aware, though, that ensuring the responsible use of the still-growing numbers of such devices designed for the public will require heightened attentiveness and an intensification of the Office's corresponding communications endeavours. In view of this, the FOCA invested substantially in updating its website to capture all the relevant rules, implemented EU-compliant training and examinations and conducted several public webinars on the issue in the course of 2021.

The development of the U-Space system, which will permit the adoption of automated drone traffic management, continues at both the national and the European level. Subjecting drones to such automated traffic management enables them to be identified and have their movements monitored and coordinated with those of other airspace users, and can additionally ensure the easier and more effective protection of particularly sensitive airspace areas. Since it will incorporate all the necessary elements for enforcing the applicable legal provisions, U-Space is set to become the core instrument for ensuring the safe and controlled operation of drones, and should serve as a basis for this Europe-wide.

A number of the parties required in Switzerland to operate the U-Space system have teamed up under the Swiss U-Space Implementation (SUSI) public-private partnership. SUSI not only enables U-Space to be developed and adopted on the basis of European provisions and in line with its overall objectives;

it will also permit further trials and demonstrations to be conducted in Switzerland, such as automated traffic management among the drones registered by the various service providers.

Thanks not least to our industry's strong innovation credentials, U-Space is being developed at an impressive pace, and may well deliver substantially more advantages over the next few years that will benefit manned aviation, too. The registration system and Remote Identification (Remote-ID) are two services that are already available in Switzerland, so that the FOCA has more recently been able to concentrate on the implementation of a third service, the Authorization Service.

Switzerland is still playing a leading role in the rapid-pace developments in the UAV and U-Space fields, and also had a major say in the devising of Europe's corresponding legal foundations. This has helped result in forward-looking legislation that will enable the safe integration of unmanned aviation into the existing aviation system. The rules and regulations devised also ensure that the continent's various civil aviation authorities will be fully competent in all the relevant areas, while simultaneously facilitating the outstanding research and development that are being conducted in the field. The FOCA is determined to further support all these endeavours, and to regard all these changes as genuine opportunities.

The adoption of European drone regulations in Switzerland has been delayed as a result of Motion 20.3916, which instructs the Federal Council to exclude traditional model aircraft when adopting EU Regulation 2019/947 and to leave this category under national law. What impact the present non-adoption of these European provisions may have on the safe operation of UAVs in Switzerland is still impossible to assess. Nevertheless, delays in related projects, such as the introduction of UAS geographical zones, do mean that their expected safety and societal benefits are not yet available.

8 Assessment and outlook

The safety priorities for Swiss civil aviation are well known, thanks to the data and the further information provided by the air transport industry and the private aviation sector. Analyzing occurrences is a key element in the risk assessment analyses which the FOCA conducts in connection with safety-relevant activities. More and more management decisions are being taken on the basis of risk and performance considerations and predefined criteria. The information from occurrences is serving, for instance, as a key decision-making foundation (among others) in the AVISTRAT project and on the issue of transponder mandatory zones (TMZs).

The safety risk areas of 'Airborne collision' and 'Aircraft upset' are at the top of the priority list in Switzerland, too, also in view of the European risk portfolio and the findings thereof. The Airprox Analysis Board (AAB), newly constituted in 2018, was further developed in 2021 with a new mandate and terms of reference to give it the requisite weighting. Some major decisions lie ahead here, on issues such as TMZs, which are being discussed with various specialists in the field to determine whether the creation of such zones could reduce the risk of future airborne collisions.

This Annual Safety Report should provide our industry partners with a review of the reports and occurrences in Swiss civil aviation in 2021. Our special thanks here go to our industry for its constantly improving reporting culture. The present safety report has taken a closer look at systemic, operational and other emerging issues. Drawing on our data analyses of 8 000 occurrence reports, we have been able to identify safety issues in various categories.

These focuses help the FOCA to make more targeted use of its resources, both in supervisory terms and in defining the actions required to steadily further enhance safety performance. Our analyses of these occurrence data provide a vital foundation, too, for our further discussions and work. And on the issues of drones, U-Space and cybersecurity in particular, we need to collect even more data in future to draw our lessons from such information and from any occurrences in these fields.

In addition to proactively identifying opportunities and risks in Swiss civil aviation, the FOCA will continue to put a strong emphasis on analyzing occurrence data (with due and full regard, too, to further information sources such as the findings from audits and inspections, accident reports, developments outside Switzerland and more) to maintain an optimum overview in all the areas concerned, in order to draw the right conclusions and remain as alert and sensitive as possible to further changes and developments in the aviation system.

As already mentioned, new findings from the FOCA COVID-19 risk catalogue were incorporated into the corresponding supervisory tasks in 2021. For 2022, it is a matter of incorporating the 'return to the new normal' and the Ukraine War-related topics into our planning with regard to our supervisory tasks.