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Swiss Transportation Safety Investigation Board STSB

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1 Editorial

Measures to combat the COVID-19 pandemic had scarcely any impact on the safety of public transport during the reporting year. Meanwhile, owing to the collapse in commercial air travel far fewer incidents were reported to the Swiss Transportation Safety Investigation Board (STSB) in 2020.

The pandemic nonetheless made the work of the STSB much more difficult. Safety investigations are a team effort. Depending on the complexity of the case, an investigator from the STSB will bring in a range of internal and external specialists to draw up findings that are meaningful in preventing future accidents. This close working relationship with diverse contributors both in Switzerland and abroad was impeded by the COVID-19 restrictions. It could be pursued purposefully with the aid of the right technical tools, but required more time and strict priorities. This meant that the complex safety investigation into the Ju 52 accident of 4 August 2018 near Flims in the canton of Graubünden could finally be completed. The loose threads of various other safety investigations that were put aside during this period can now be taken up again.

The structure and organisation of the STSB has proven itself capable of handling major accident investigations and difficult operating conditions over the past year. It has done so thanks primarily to experienced, well trained and highly motivated staff at all levels, agile ways of working, and not least also the STSB›s status as an independent body.

Pieter Zeilstra,
President of the extra-parliamentary commission

2 Management summary

The STSB received 1,215 incident notifications in 2020. Following assessment, these resulted in 78 new investigations. A total of 19 extensive and 42 summary investigations were completed during the year, in addition to the publication of two interim reports and one status report on ongoing investigations. In the course of those extensive investigations, both completed and still in progress, the STSB identified safety deficits that led it to issue 27 safety recommendations and 13 safety advice notices. These figures are distributed as follows across the different modes of transport:

The STSB did not receive any notifications of incidents concerning maritime navigation in 2020. No reports were published in this area in 2019, either.

Indeed, far fewer incidents were reported overall in 2020 than in previous years. While the number of notifications to the Public Transport Division has remained relatively steady, there was a striking decline in reports to the Aviation Division from April onwards as commercial air travel collapsed owing to the COVID-19 crisis.

	Aviation	Public transport
Incidents reported	894	321
Investigations opened	59	19
Extensive investigations completed	9	10
Summary investigations completed	31	11
Safety recommendations issued	16	11
Safety advice notices issued	9	4

With a total of 61 investigations completed, the STSB's output was lower than in recent years. The number of investigations completed depends considerably on the nature of the incidents concerned, and on what the STSB needs to do to establish circumstances and causes. Particularly relevant here was the investigation into the accident involving a Ju 52/3m g4e, which had been ongoing since August 2018. This accident continued to occupy the STSB Aviation Division to a considerable extent into 2020.

The proportion of investigations requiring more extensive enquiries than usual was also much higher where public transport was concerned. One reason for this is the growing complexity of the rail landscape over the past few years. It has arisen primarily because of the large number of companies involved, and the many points at which they intersect, be that in production (rail journeys) or in the maintenance of rolling stock and infrastructure.

With a significant proportion of resources tied up completing the investigations into the Ju 52/3m g4e aviation accident, there was a knock-on effect on the achievement of the targets that the STSB had set it-self for 2020 under the Federal Administration's New Management Model (NMM). Work on the project to revise the Swiss Ordinance on the Safety Investigation of Transport Incidents (OSITI, SR 742.161) could not progress as planned, for example. The 'Prompt completion of safety investigations concerning serious incidents and accidents involving aircraft' performance target could not be met in 60% of cases.

The investigation into the accident involving a Ju 52/3m g4e also impacted on the costs accrued in 2020, as it alone accounted for around CHF 1.5 million, or just less than 20% of the annual budget. Between August 2018 and December 2020 the STSB had to spend a little under CHF 3.8 million investigating this accident – costs that the regular budget could not cover. In autumn 2018 the STSB thus applied for a special budget facility, which was subsequently granted.

The steady increase in the number of aviation incidents reported, from 976 in 2013 to 1,566 in 2019, prompted the Board to look into ways of expanding resources for this area. An additional investigator was subsequently appointed in autumn 2020. An additional 0.5 FTE was also allocated to Central Services to increase capacity for the necessary support processes.

3 The STSB

3.1 Remit

The Swiss Transportation Safety Investigation Board (STSB) investigates incidents in civil aviation, public transport and maritime navigation in accordance with the requirements of the Swiss Ordinance on the Safety Investigation of Transport Incidents (OSITI, SR 742.161). 'Incidents' refers to both accidents and other events, termed 'serious incidents', the investigation of which may help to improve safety.

The investigations consist of an independent examination of the technical, operational and human circumstances and causes that led to the event. The findings are intended to help prevent similar incidents in the future. As stated explicitly in the Swiss Railways Act (RailA; SR 742.101) and the Swiss Aviation Act (AviA; SR 748.0), questions of blame and liability are beyond the scope of the investigations.

Where the STSB establishes safety deficits in the course of its investigations, it submits safety recommendations to the supervisory authorities, or safety advice notices to the companies concerned. The task then is to determine what measures are appropriate to reduce or eliminate the risks attached to the deficit that has been identified. The authorities do this as part of their supervisory activities, the companies as part of their safety management systems.

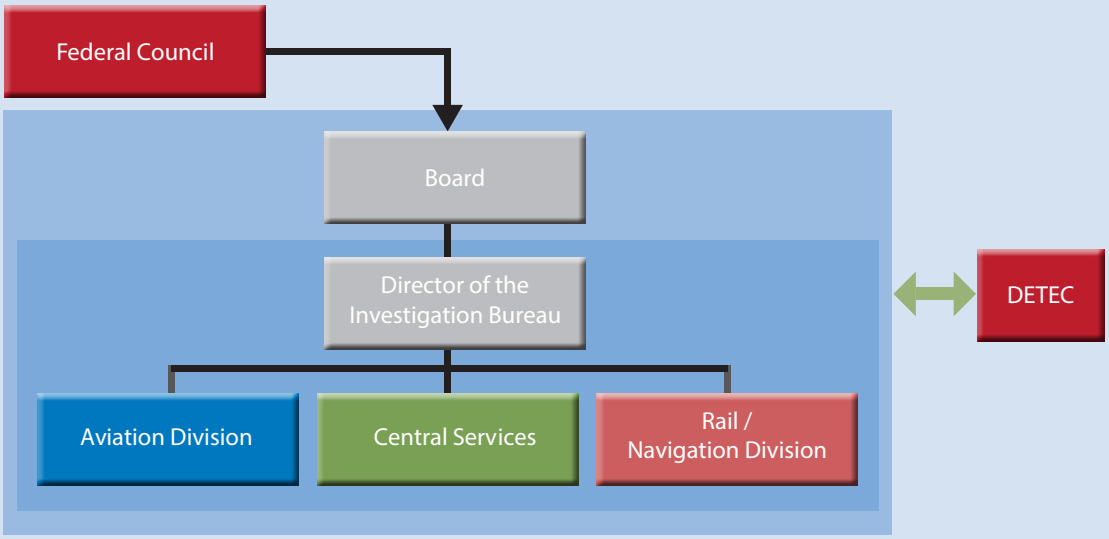
The STSB collates and publishes the findings of investigations in reports aimed at professionals in the sectors concerned and the interested public. They are explicitly not addressed to judicial and administrative authorities.

The STSB forms part of the overall transport safety framework in Switzerland. This is made up of companies, authorities and organisations, such as transport operators, manufacturers, vehicle keepers, safety investigation bodies, supervisory authorities, accreditation and certification bodies, conformity assessment bodies, and others. Each element of the system helps to ensure the safety of its particular mode of transport by performing specific tasks that are assigned to it under the relevant legal provisions.

3.2 Organisation

On 1 November 2011, the Aircraft Accident Investigation Bureau (AAIB) and the Investigation Bureau for Railway, Funicular and Boat Accidents (IRFBA) merged to form the Swiss Accident Investigation Board (SAIB). The objective was to concentrate specialist knowledge within a single organisation and to ensure a unified approach in incident investigations. With effect from 1 February 2015, the Swiss Accident Investigation Board (SAIB) was renamed the Swiss Transportation Safety Investigation Board (STSB). This name change arose from a legislative revision in which the three ordinances that had previously defined the SAIB were combined and consolidated into a single ordinance.

With the reform, the Swiss Transportation Safety Investigation Board (STSB) was restructured as an extra-parliamentary commission under Articles 57a-57g of the Swiss Government and Administration Organisation Act (GAOA; SR 172.010). The Board is appointed by the Federal Council. It comprises between three and five independent experts from the relevant fields within the transport sector, and has an Investigation Bureau which is responsible for conducting the investigation process. Administratively, the STSB is attached to the General Secretariat of the Federal Department of the Environment, Transport, Energy and Communications (DETEC), although it acts independently.



3.3 Performance targets

The Federal Administration's New Management Model (NMM) was introduced on 1 January 2017. It is designed to strengthen administrative management at all levels and to increase the transparency and manageability of performance. Within the framework set by the NMM, the STSB defined the following operational projects, guidelines and performance targets for 2020:

Projects and initiatives

- **Revision of the OSITI:** The Ordinance on the Safety Investigation of Transport Incidents (OSITI) entered into force on 1 February 2015. International law requirements governing the investigation of such incidents have since changed. Experience with the implementation of the OSITI also revealed a need for amendments and greater clarity. The revision project began in 2019, with the objective of having the revised Ordinance adopted by the Federal Council at the end of 2020. In effect, only a small section of the necessary preparatory work, consisting of advance discussions and the settlement of revision issues, could be completed, primarily as a result of the COVID-19 situation and because a significant proportion of Aviation Division resources were tied up completing the investigation into the Ju 52 accident of 4 August 2018 (see Chapter 4). The project plan had to be adjusted as a result. The target for 2021 is now to produce a draft of the revision that can be submitted to the federal government department in charge.
- **Updating the publication of investigation findings:** Options for updating the publication of investigation findings were identified in 2020. In view of the purpose of these investigations, i.e. prevention, it is important that findings are communicated quickly, clearly, and in a way that is appropriate for their target readership. The measures that the Board has adopted will be introduced on an ongoing basis according to the available staff and financial resources.

– **Effectiveness monitoring:** This project had to be postponed owing to other priorities, which involved considerably more work than expected. It will be taken up again in 2021 as an internal STSB initiative.

Performance targets

The STSB sets itself challenging performance targets regarding the application of recognised, up-to-date investigation methods and the swift publication of investigation findings.

Targets and indicators	2020 TARGET	2020 ACTUAL	2021 PLAN
Conformity assessment: The internal guidelines and procedures in the Aviation Division are adapted to the latest international requirements.			
One conformity assessment procedure annually in accordance with ICAO Annex 13, Regulation (EU) 992/2010 (yes/no)	yes	yes	yes
Rapid conduct of safety investigations: By applying suitable measures, the STSB ensures that incident investigations are conducted promptly and in compliance with the law.			
Prompt completion of safety investigations concerning serious incidents and accidents involving aircraft (%, minimum)	60	38	70
Prompt completion of safety investigations concerning serious incidents and accidents involving railways, buses and boats (%, minimum)	60	67	70

The target for the 'Prompt completion of safety investigations concerning serious incidents and accidents involving aircraft' indicator was not met. In two-thirds of all cases, the time taken to conduct investigations and draft reports was longer than the general set period of 12 months, 18 months for large aircraft.[1] In many of these cases, however, it was exceeded by only a few weeks. The following situations prevented the target being met:

– The completion of investigations into the major accident involving a Ju 52 on 4 August 2018 consistently tied up more than half of the staff resources in the Aviation Division.
– In just a few years up to and including 2019, the number of events reported to the Aviation Division rose by more than 50%. This resulted in a sizeable backlog of cases. Working through these older cases led to delays in preparing reports on more recent incidents.

Despite these circumstances, Chapters 4.1 to 4.3 demonstrate that the STSB's output did not fall significantly compared with previous years.

[1] An aircraft that has a maximum take-off mass (MTOM) of at least 5,700kg and is classified in the 'Transport' subcategory of the 'Standard' airworthiness category, or has more than ten seats for passengers and crew.

3.4 Resources

The STSB had a budget of just under CHF 8.7 million available in 2020. This comprised the regular estimated budget, provisions and the special budget facility for the investigations into the accident involving a Ju 52 (HB-HOT) on 4 August 2018. Approximately CHF 3.5 million was budgeted for personnel expenses, the remaining CHF 5.2 million for material and operating expenses. The latter item included CHF 2.7 million for external services. The SUST uses this to finance investigations conducted by external experts and specialist organisations. Unlike in previous years, the budget was exhausted entirely during the year under review.
Investigations into the Ju 52 accident of 4 August 2018 were completed in 2020, with the Board approving the final report on the incident in December 2020. The STSB applied for, and was granted, a special budget facility for these investigations. It could be foreseen that the necessary investigations would be extensive, and could not be financed via the regular budget. Indeed, the concluding phase in 2020 accrued costs of CHF 1.5 million. Investigating this accident, from August 2018 to the end of December 2020, cost around CHF 3.8 million in total.
As is also usual in other countries, the work of the Swiss Transportation Safety Investigation Board is a basic service provided by the state to improve safety. It is therefore almost exclusively publicly funded. Consequently, all STSB products and in particular the final reports on investigations are provided free of charge on the internet.

At the beginning of the reporting year the STSB had a staff of 14.7 FTEs across 15 employees. The number of incidents reported to the Aviation Division rose by 60% from 976 to 1,566 between 2013 and 2019. This sustained upward trend prompted the Board to look into options for bringing in additional resources. These were implemented in 2020, with the Aviation Division gaining an additional investigator in the autumn. At the same time, a further 0.5 FTE was allocated to Central Services to improve capacity for support processes. These additional resources are funded by internal budget shifts, i.e. the reallocation of funds from the material and operating budget to the personnel budget. As a result, the STSB now has 16.2 FTEs across 17 employees.

4 Investigations and findings

4.1 Overview of investigations by the entire Investigation Bureau

The STSB received 1,215 incident notifications in 2020. Following assessment, these resulted in 78 new investigations. A total of 19 extensive and 42 summary investigations were completed during the year, and two interim reports and one status report on ongoing investigations were published. In the course of the extensive investigations, both completed and still in progress, the STSB identified safety deficits that led it to issue 27 safety recommendations and 13 safety advice notices. These figures are distributed as follows across the different modes of transport:

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The STSB did not receive any notifications of incidents concerning maritime navigation in 2020. No reports were published in this area in 2019 either.

The total number of incidents reported during the year under review was significantly lower than in previous years. While the number of notifications to the Public Transport Division has remained relatively steady, there was a striking decline in reports to the Aviation Division. It is clear that this decline is associated with the collapse in commercial air travel owing to the COVID-19 crisis.

With a total of 61 investigations completed, the STSB's output was lower than in recent years. The number of investigations completed depends on a number of factors, including the nature of the incidents that are to be investigated, or rather the scope of action required to achieve the objective of that investigation, i.e. a preventive effect. The investigation into the accident involving a Ju 52/3m g4e on 4 August 2018 was the dominating factor in this respect, as it occupied a significant proportion of the Aviation Division's available resources in both 2019 and 2020.
The proportion of investigations requiring more extensive enquiries than usual was also much higher where public transport was concerned. The rail landscape has become more complex over the past few years. Its division into infrastructure managers and railway undertakings, the introduction of 'Entities in Charge of Maintenance' (ECM), conformity assessment bodies and certification bodies, etc. resulted in many points at which these different entities intersect. These must be factored into investigations. In particular, common current practices with regard to the awarding of maintenance contracts or the organisation of engineering works result in a complex mesh of responsibilities that are often very time-consuming to disentangle.

4.2 Aviation

The STSB received 894 notifications of incidents in aviation during 2020. In the interests of fulfilling the STSB's primary purpose as effectively as possible, each of these incidents is reviewed in terms of its potential preventive value. Additional technical aids were brought in to assess the danger in incidents that were judged to be serious, especially aircraft proximity hazards (airproxes), where there is a risk of collision between two aircraft. These preliminary enquiries resulted in a total of 26 accident investigations and 33 serious incident investigations. These included eight airproxes involving a high or considerable risk of collision. An extensive investigation was opened for 11 incidents, while the initial investigation findings for 48 events indicated a summary investigation.

In the reporting year there were 29 accidents involving aircraft registered in Switzerland. Ten people suffered fatal injuries as a result.

As was the case in 2019, 2020 was marked by the investigation into the accident involving the Junkers 52/3m g4e, which occurred on 4 August 2018 near Flims in the canton of Graubünden. In June 2020, the STSB was able to send the confidential draft of the final report for comment to those involved in and affected by the investigation. The comprehensive statements received in return were then reviewed and worked through in close detail. Finally the Board of the STSB itself reviewed and approved the report, thus clearing the way for its publi-

cation in January 2021. The experience gained during this investigation will be evaluated and fed into the National Investigation Management Plan (NIMP) required by the European Network of Civil Aviation Safety Investigation Authorities (ENCASIA).

The crashed Ju 52/3m g4e was not fitted with any form of recording equipment such as a flight data recorder or cockpit voice recorder. Consequently, there was none of the basic information that would otherwise be available to reconstruct the flight path, for example, or to determine the aircraft's position both absolutely and in relation to air flow. Similarly, there were no direct indications of the nature of the problem, as might have been discussed in the cockpit. Reconstructing the flight path and the sequence of events that led to the accident thus proved to be very complex and time-consuming. Worthy of special mention here are the observations, photographs and videos made available to the STSB by the general public, which contributed significantly to the investigation and to the final report.

In addition to the wide-ranging work on the Junkers Ju 52/3m g4e accident, a further 40 investigations were completed, and their findings published in 9 final reports and 31 summary reports. The final reports contained 16 safety recommendations and 9 safety advice notices (Chapter 5.2).

4.3 Public transport

Railways

In 2020, 284 safety-related incidents on the railways were reported, 23 of which concerned trams. An investigator attended on site in 29 cases. An analysis of the notifications resulted in an investigation being opened in 14 cases. Most of these concerned a collision or derailment. The preliminary findings indicate that, in addition to technical factors such as broken axles and brake and signalling failures, in all likelihood organisational and human factors also contributed significantly to the incidents concerned.

A total of eight extensive and eight summary investigations were completed last year, and one interim report was published during an ongoing investigation. In response to the safety deficits identified during the extensive investigations, the STSB addressed seven safety recommendations to the supervisory authority and three safety advice notices to transport/infrastructure operators (Chapter 5.3).

Five of the incidents for which investigations were concluded occurred in connection with engineering works. The circumstances that led to these incidents were similar. Specifically, they all have in common deficits in preparations for the work or in the way in which the site was organised, not least owing to the many interfaces between the companies concerned.

The STSB investigations into the accident involving persons in Baden on 4 August 2019 demonstrated that maintaining rolling stock is a fundamental factor in ensuring safety.
The railway system has recorded dynamic growth since the beginning of this millennium, and has had to cope with many changes. The infrastructure has been expanded significantly, new rolling stock purchased, and rail services themselves have become ever-more frequent. At the same time, new technologies have been introduced and operating regulations amended accordingly. In the Baden case, this meant that

the new regulations governing pre-departure checks had overtaken the technology fitted to the older rolling stock, thereby creating a safety issue. The investigations into this and other incidents revealed that change management plays an increasingly important role in preventing safety deficits.

Cableways

There were 20 notifications of safety-related events involving cableways during the reporting year. An investigator attended the scene in five cases. Preliminary enquiries also resulted in an investigation being opened in five cases. These concerned collisions, one aircraft crash and one hazardous situation. One person was fatally injured when a chairlift crashed. Considerably more investigations were opened in this area in 2020 than in previous years.

The STSB concluded two extensive and three summary reports into this mode of transport during the year under review. It also published one interim report on an investigation that is still in progress. The extensive investigations identified a variety of safety deficits. As a result, four safety recommendations were issued to the supervisory authority and one safety advice notice to the cableway operator in question (Chapter 5.4).

Buses

Twelve bus-related incidents were reported in 2020. None of these events offered any potential preventive benefits that would justify opening an investigation.

Inland navigation

Five notifications of inland navigation events were submitted to the STSB during 2020. One of these concerned an incident on the Rhine, the investigation of which is the responsibility of the Central Commission for the Navigation of the Rhine and the Waterway Police. No investigations were opened.

4.4 Maritime navigation

No notifications of maritime navigation incidents were received during the reporting year. Nor were any reports published for this mode of transport in 2020.

5 Safety recommendations and advice

5.1 General

In the first half of the last century, accidents in the transport sector were usually investigated by the respective supervisory authorities. However, since these may be involved in causing an accident or a hazardous situation as a result of their activity, a separation of tasks and powers has prevailed over the course of recent decades: in most countries, in addition to the supervisory authority, an independent, state-run safety investigation body also exists, which is expected to impartially clarify the reasons for an accident or a serious incident. Because of the separation of powers, the investigation body does not itself mandate measures to improve safety but proposes such measures to the relevant authorities. Consequently, these retain their full responsibility. The safety investigation body – the STSB in Switzerland – presents to the relevant supervisory authorities a possible safety deficit and issues corresponding safety recommendations in an interim or final report. It is then up to the relevant supervisory authority, together with the stakeholders concerned, to decide whether and how the safety recommendations should be implemented.

The EU established the European Aviation Safety Agency in 2002. In 2018, the Agency was placed on a new legal foundation (Regulation (EU) 2018/1139) and renamed the European Union Aviation Safety Agency, EASA. EASA's mission is to provide uniform and binding rules on aviation safety in the European aviation sector on behalf of the member states. Since 2003, EASA has increasingly exercised its authority, particularly in the areas of technology, flight operations, air traffic control and aerodromes and airports. Here, the national supervisory authorities primarily play an executive and mediating role and their exclusive competence is increasingly limited solely to the nationally regulated aspects of civil aviation. Since Switzerland decided to participate in EASA, this change also applies to Swiss civil aviation. For this reason,

the Swiss Transportation Safety Investigation Board addresses its safety recommendations concerning aviation to either EASA or the Federal Office of Civil Aviation (FOCA), depending on the area of competence.

Regulation by the EU is becoming increasingly important for the railways, in particular where technical and operational interoperability in international transport are concerned. The EU Safety Directive (2016/798/EU), which is set out in the Annex to the Overland Transport Agreement between Switzerland and the EU, stipulates that each member state must have an independent safety investigation body, and must equip it with the necessary human and material resources. Supervisory authority over railway safety essentially lies with the national body. However, since June 2019 the European Union Agency for Railways (ERA) has issued safety certificates and market authorisations for vehicles and given its approval for train control and train safety projects. As a further result of the change to the legal foundations in the railway sector, other authorities and organisations also take on a supervisory role alongside Switzerland's national supervisory authority, the Federal Office of Transport (FOT). These include the Swiss Accreditation Service (SAS) and certification bodies for companies that are responsible for maintenance.
Article 48 paragraph 1 OSITI requires the STSB to submit its safety recommendations for railways to the FOT. However, with the above changes to the legal foundations it is likely that the STSB will also be able to address its safety recommendations to other authorities or organisations in future.

Safety objectives and requirements for cableway installations and their operation are regulated by the EU Cableways Regulation (EU) 2016/424 dated 9 March 2016. Supervision and enforcement are exclusively within the remit of the national supervisory authorities, in the case of federally licensed cableways within the remit of the FOT. STSB recommendations are therefore addressed to this authority.

The regulations applying to licensed inland navigation in Switzerland are primarily national ones. Consequently, recommendations from the STSB are addressed to the FOT as the national supervisory authority for safety.

With regard to maritime navigation, the European Union established the European Maritime Safety Agency (EMSA) in 2002. Its mission is to reduce the risk of accidents at sea, the pollution of the seas through maritime navigation and the loss of human life at sea. The EMSA advises the European Commission on technical and scientific matters concerning the safety of maritime traffic and in relation to preventing the pollution of the seas by ships. It plays a part in the ongoing development and updating of legislative acts, the monitoring of their implementation and in assessing the efficacy of existing measures. However, it has no authority to issue directives over Switzerland. Any safety recommendations from the STSB are therefore addressed to the Swiss Maritime Navigation Office (SMNO) as the national supervisory authority.

Having received a safety recommendation, the supervisory authority will notify the STSB of the action it intends to take to rectify the safety deficit, as well as a timeline for its implementation. Based on feedback from the supervisory authority, safety recommendations are classified as follows:

– **Implemented:** Measures have been adopted which are very likely to significantly reduce or eliminate the identified safety deficit.
– **Partially implemented:** Measures have been adopted which are very likely to slightly reduce the safety deficit or eliminate it in part, or a binding implementation plan with a defined timeline is at hand and has been initiated which is very likely to lead to a significant reduction in the safety deficit.
– **Not implemented:** No measures have been adopted which have led or will lead to any noteworthy reduction in the safety deficit.

Following the introduction of the OSITI, the STSB started to issue safety advice in addition to the safety recommendations, as and when required. As stated above, safety recommendations are addressed to the relevant supervisory authorities and propose improvements which can only or, at least primarily, be brought about through stipulations from this authority or its supervisory activity. However, occasionally safety deficits also become apparent as part of an investigation. These cannot be eliminated by amending rules or regulations or by direct supervisory activity, but rather by changing or improving risk awareness. In these cases, the STSB formulates safety advice which is addressed to particular stakeholders or interest groups in relation to transport. This is intended to help the people and organisations concerned to recognise a risk and provide possible approaches to dealing with it sensibly.

All of the safety recommendations and safety advice notices issued by the STSB in interim or final reports during 2020 are set out below. To aid understanding, these are accompanied by a brief description of both the incident concerned and the safety deficit which is to be eliminated.

Each safety recommendation is followed by the implementation status as at end-April 2021. The current implementation status of safety recommendations and further details can be found on the Swiss Transportation Safety Investigation Board website.

5.2 Aviation

Crash of a historic airliner south-west of Piz Segnas, 04.08.2018

The historic Junkers airliner Ju 52/3m g4e took off from Locarno airport in the late afternoon en route to the Dübendorf military airfield. After approximately 40 minutes, the aircraft took a north-north-easterly course into the valley basin south-west of Piz Segnas. Towards the northern end of the basin, the aircraft began to bank left, which then developed into a downward spiral. A few seconds later the aircraft collided almost vertically with the ground. All of the 20 people on board were killed, and the aircraft was destroyed.

Safety deficit

Considerable corrosion damage was found on the wreck of the HB-HOT on the spars, hinges and fittings of the wings and in the area of the cabin floor plate. Two of the three engines were equipped with newly manufactured cam disks which had defects.

Given the same year of construction and similar operating mode and operating hours, it is expected that the sister aircraft, HB-HOP and HB-HOS, have similar defects.

Safety Recommendation No 548, 20.11.2018 (interim report)

The Federal Office of Civil Aviation (FOCA), in cooperation with the flight operator, should take appropriate measures to ensure that the sister aircraft, HB-HOP and HB-HOS, are inspected for corrosion damage and defects in system components.

Implementation status

Implemented. In a letter dated 28 March 2019, the Federal Office of Civil Aviation (FOCA) announced that it supported the safety recommendation. It has withdrawn the certificate of airworthiness for the two aircraft HB-HOS and HB-HOP until further notice. On the basis of the findings of the accident investigation and the Ageing Aircraft Programme, the FOCA has already placed requirements on Ju-Air regarding engineering support, the establishment of an inspection programme, and the operation and maintenance of the aircraft. The relevant inspections and the resulting findings must be carried out and rectified before a permit to fly is issued.

In the meantime, several audits and an inspection of Ju-Air by the FOCA have resulted in Ju-Air being forbidden to continue its operations under Part 145 owing to serious and systemic deficiencies. With the suspension of the Part 145 certificate, Ju-Air had to stop all work on its aircraft with immediate effect.

The FOCA will determine how to proceed, including on the basis of the results of the pending Part 145 inspections.

In the FOCA's view, there are growing indications that the use of historic aircraft or aircraft without a type certificate (TC) holder entails increased risks. On the one hand, the aircraft's fuselage, wing structures and systems were not designed for indefinite use and should therefore only continue to be operated in compliance with an ageing aircraft programme. On the other hand, aircraft without a TC holder lack an essential function to maintain airworthiness. The FOCA is currently examining whether to implement measures to ensure flight safety in the absence of a TC holder. The following points are being considered as safety measures. However, depending on further findings, this list may be expanded:

- Banning the carriage of passengers or limiting their number
- Introducing measures to increase the risk awareness of potential passengers
- Restricting flyovers of populated areas or critical infrastructure
- Requiring maintenance to be carried out in an approved maintenance organisation similar to Part 145
- Introducing a continuous maintenance management system based on a continuing airworthiness management organisation (CAMO)
- Integrating a safety management system for maintenance
- Developing and implementing the necessary engineering competencies
- Integrating a quality inspection system for manufacturing activities
- Introducing an ageing aircraft programme

Safety deficit

The safety investigation revealed that the implementation of legal requirements by both the supervisory authority and the air operator for operations with historic aircraft was primarily formal in nature. Many of the processes described in the manuals represented the operational requirements to a limited extent only. In particular, only partial provisions had been made for the relevant risks of visual flight rules operations involving annex II aircraft, as specified in Regulation (EC) 216/2008 (equivalent to today's Annex I aircraft, as specified in Regulation (EU) 2018/1139). Overall, regulation proved to be complex and not well adapted to the actual needs of flight operations. Regardless of the organisational form, the level of safety required for air operations involving passengers should be guaranteed. A consultation on possible safety recommendations has shown that a solution needs to be sought at national level. As the legislative process is likely to take some time, a two-step approach is recommended.

Safety Recommendation No 561, 22.12.2020

The Federal Office of Civil Aviation should ensure that rules are adapted to air operations with passengers on aircraft referred to in Annex I of Regulation (EU) 2018/1139 and that these effectively address the risks specific to such operations.

Implementation status

Partially implemented. The FOCA is in partial agreement with Safety Recommendation No 561. Since the new EASA basic regulation came into force (Regulation (EU) 2018/1139, in force for Switzerland since 1 September 2019), it is no longer possible to use aircraft without a certificate of airworthiness under European law (so-called 'non-EASA aircraft', including in particular historic aircraft) in commercial air transport operations under EU regulations. Commercial use of such aircraft will also not be possible in future on the basis of Swiss domestic law.

On 19 October 2020, the FOCA management decided to introduce the following restrictions and accompanying measures:

- Passenger restriction on aircraft in the special category 'Historic': In future, a maximum of nine occupants, of which a maximum of six are passengers, may be carried on these aircraft;
- Ban on commercial operations under national law for non-EASA aircraft in orphan status and non-EASA aircraft in the special category 'Historic';
- Duty to inform: For paid (non-commercial) flights with aircraft in the special category 'Historic' (as well as the other special categories listed in the DETEC Ordinance on the Airworthiness of Aircraft [AAwO; SR 748.215], in part also for commercial flights), passengers must be informed of the details of the aircraft's certification details before departure. In addition, signage near the passenger door must indicate the aircraft's status.
- Changes to certification status: Only restricted certificates of airworthiness are now issued for non-EASA aircraft registered in Switzerland in 'orphan' status, and only national permits to fly are issued for non-EASA aircraft registered in Switzerland in the special category 'Historic'. These permits do not meet the requirements of ICAO Annex 8 and therefore no longer automatically entitle the holder to operate flights abroad.
- The FOCA also intends to apply the passenger restriction (max. nine occupants of which max. six passengers) to foreign aircraft in the special category 'Historic'.

Where necessary, application of the measures agreed by the FOCA management will be included in the related legislation. Draft legislation relating to flight technology for non-EASA aircraft was already being drawn up before the HB-HOT accident on 4 August 2018. The initial intention was to revise the AAwO and its annexes (subcategories Ecolight, Ultralight, Historic, Self-Constructed, Limited, Experimental, Restricted) in line with the 'safety continuum'. Already at this stage, the plan was to factor into the legislation the risks attached to the different types of aircraft. In addition to changes to the AAwO and its annexes, amendments are being made to the DETEC Ordinance on Aircraft Manufacturers, SR 748.127.5, the DETEC Ordinance on Aircraft Maintenance Companies, SR 748.127.4 and the DETEC Ordinance on Aircraft Maintenance Staff, SR 748.127.2. Following the accident, the draft legislation now also focuses on the implementation of the resulting measures.

The specific features of the various annexes were considered as the legislation was being drawn up, and a distinction drawn between individual aircraft mentioned in a single annex. For example, historic aircraft are divided into four risk classes. An aircraft is assigned to a subclass on the basis of its mass and speed and the typical scenario in which it operates. A certain degree of schematisation is unavoidable. The following classes are envisaged:

- Class I: Gliders, motor gliders and balloons.
- Class II: Single and multi-engine aircraft with a piston engine or aircraft with a turboprop engine up to 2,730kg MTOM.
- Class III: Single- and multi-engine aircraft with piston/turboprop engines between 2,730kg and 5,700kg MTOM and helicopters up to a maximum of 3,175kg MTOM.
- Class IV: Aircraft over 5,700kg MTOM or turbo-jet powered, and helicopters over 3,175kg MTOM.

With increasing risk, stricter maintenance regulations must be observed in order to take effective account of the specific risks for passengers and also third parties on the ground. The passenger restriction for aircraft in the special category 'Historic' is likely to be included in Annex 3 of the AAwO. In the case of foreign aircraft, no amendment to the legal basis is necessary. The restriction can be implemented when a special licence for the use of Swiss airspace (Art. 2 para. 1 let. e AviA) is issued. The ban on commercial operations and the obligation to provide information will be added to Art. 100 para. 3 and Art. 101 of the Civil Aviation Ordinance (CAO); SR 748.01). The amendment to the bases for certification for aircraft in 'orphan' status appears in Art. 10b para. 1 AAwO (for aircraft in the special category 'Historic', various risk-based standards are included in the AAwO [or its annexes] [e.g. with regard to maintenance]).
Considerable work is involved in amending the legislation; the new provisions are not expected to come into force before the end of 2023.

Safety Recommendation No 562, 22.12.2020
Until Safety Recommendation No 561 has been implemented, the Federal Office of Civil Aviation should ensure that the risks specific to the particular flight operations involving passengers on Annex I aircraft, as defined in Regulation (EU) 2018/1139, are identified and effectively reduced with an effort suited to the complexity and scale of the respective operation.

Implementation status
Implemented. The FOCA agrees with Safety Recommendation No 562. Since the entry into force of the new basic EASA regulation (Regulation (EU) 2018/1139 (in force for Switzerland since 1 September 2019), it is no longer possible within the framework of EU regulations to conduct commercial air operations using aircraft that do not have a certificate of airworthiness under European law ('non-EASA aircraft', including historic aircraft). Furthermore, the commercial operation of such aircraft will no longer be possible in the future under national law.
On 19 October 2020 and at further dates, the FOCA management decided to introduce the following restrictions and accompanying measures:

- Passenger restrictions on aircraft that fall within the special 'Historic' category: in the future, a maximum of nine

people, including a maximum of six passengers, may be carried on these aircraft;
- Division of the highly heterogeneous special 'Historic' category into four risk classes, each with different maintenance requirements that become more stringent as risk increases (risk-based approach with the highest risk class (4) including aircraft over 5,700kg MTOM or turbojet propulsion and helicopters over 3,175kg MTOM. Maintenance work on risk class 4 aircraft must be carried out by approved maintenance organisations; authorised individuals in accordance with AAwO, Art. 34 are no longer sufficient).
- Exclusion of commercial operations under national law by non-EASA aircraft in the special 'Historic' category;
- Information obligation: for paid (non-commercial) flights with aircraft in the special 'Historic' category (as well as other special categories under the DETEC Ordinance on the Airworthiness of Aircraft (AAwO), and also in some cases for the commercial operation of flights), passengers must be informed about the special features of the aircraft's certification before take-off. In addition, signage near the passenger door must indicate the status of the aircraft.
- Change in registration: for aircraft in the special 'Historic' category registered in Switzerland, only national permits to fly are issued. These permits do not meet the requirements of the ICAO, Annex 8 and therefore no longer entitle to the holder to fly these aircraft outside of Swiss airspace.
- The FOCA further intends to apply passenger restrictions (max. 9 people, including max. 6 passengers) to foreign aircraft in the special category.

The implementation of the measures decided on by the FOCA management will be included, where necessary, in new legislation, which was already being drafted before the HB-HOT accident on 4 August 2018. The new legislation aims to adapt the DETEC Ordinance on the Airworthiness of Aircraft (AAwO); SR 748.215.1) where flight technology is concerned.
At present, no aircraft in accordance with the Annex I of Regulation (EU) 2018/1139 operate commercially with passengers in Switzerland. The Ju-Air aircraft built by Junkers have been grounded until they obtain the new national permit to fly. The historic Super Constellation HB-RSC aircraft is not airworthy and has been grounded until it obtains the new national permit to fly.

Safety deficit
The safety investigation revealed that, at the time it was commissioned for use in civil aviation, the aircraft was categorised in accordance with legal requirements which have changed over time. As a result, the type classification was no longer correct at the time of the accident. Based on the original classification of the type, various requirements for approval were declared inapplicable by way of exemption. These decisions were not reviewed even in the case of major changes to the law.

Safety Recommendation No 563, 22.12.2020
When granting exemptions for Annex I aircraft, as specified in Regulation (EU) 2018/1139, the Federal Office of Civil Aviation should take into account the risks specific to their operation, and periodically review the exemptions.

Implementation status
Implemented. The FOCA agrees with Safety Recommendation No 563. The exception for the commercial use of the historic aircraft in the standard category was granted within the framework of the commercial certification (operating licence and AOC) for the Ju-Air aircraft under the EU law applicable at the time: the former basic EASA regulation, Regulation (EC) No 218/2008. Since the entry into force of the new basic EASA regulation (Regulation (EU) 2018/1139 (in force for Switzerland since 1 September 2019), it is no longer possible within the framework of EU regulations to conduct commercial air operations using aircraft that do not have a certificate of airworthiness under European law ('non-EASA aircraft', including historic aircraft). The reason for this is that the new basic EASA regulation no longer recognises the exception contained in Art. 4 para. 5 of the former basic EASA regulation, which allowed commercial air operations with historic aircraft. The exceptions mentioned in Safety Recommendation No 563 will no longer be in-cluded in the new legislation.

Safety deficit
The safety investigation demonstrated that, on numerous occasions, the flight crews violated rules and took high risks during the operation of historic aircraft. This high-risk behaviour was detected by neither the air operator nor the supervisory authority due to a lack of effective management, monitoring and oversight. Numerous other safety-related incidents were neither detected by the operator nor the regulatory body and, where they had been detected, were not addressed in a manner that enhanced safety.

Safety Recommendation No 564, 22.12.2020
The Federal Office of Civil Aviation, together with organisations which operate historic aircraft primarily for the transport of passengers, should define effective risk-based management and supervisory measures which are capable of identifying and correcting the specific problems with this type of operation at an early stage.

Implementation status
Not implemented. The FOCA has taken note of Safety Recommendation No 564 and agrees with it in principle. Now that Regulation (EU) 2018/1139 is in force, the commercial

transport of passengers on historic aircraft is no longer permitted. Safety Regulation No 564 thus refers to the transport of passengers in private operations. The aircraft concerned differ greatly in terms of equipment and type of operation. An individual assessment in each case and an agreement with the operators are thus necessary. Additional measures create additional work for the operators. It must therefore be ascertained upon which legal basis additional management and monitoring systems can be required by the FOCA. Supervising additional measures requires additional resources at the FOCA.
The FOCA will look closely at the applicable legislation and initiate any necessary amendments. Individual activities in the transport of passengers with historic aircraft will then be assessed and measures agreed upon or ordered where necessary. It will take some time to implement the measures (especially the legal amendments). The FOCA plans in due course to issue a follow-up statement on the status of implementation of Safety Recommendation No 564.

Safety deficit
The safety investigation demonstrated that the audits and inspections performed by the Federal Office of Civil Aviation were not capable of providing a realistic overview of the actual operations or actual processes conducted by the air operator and in the maintenance companies. Supervision was largely formal and ineffective, particularly as there was a lack of critical attitude within the authority and because the exchange of information between the technical inspectors was inadequate.

Safety recommendation No 565, 22.12.2020
The Federal Office of Civil Aviation should improve its organisation of audits and inspections in such a way as to improve the exchange of information within the authority, as well as to enable both critical analysis of the organisation concerned and the identification of relevant problem areas more effectively.

Implementation status
Partially implemented. The FOCA has taken note of Safety Recommendation No 565 and agrees with it in principle. The safety recommendation concerns the improvement of the FOCA's internal organisation and the exchange of information when conducting audits and inspections in certification and oversight activities.
In order to implement the recommendation, the FOCA launched a project involving several divisions in December 2020 (oversight and tools cluster). The project comprises the following sub-areas:

1. Uniform standards for certification and oversight activities in the three safety divisions (Flight Operations, Infrastructure, Aircraft).
2. Harmonisation of methods for carrying out audits and inspections.
3. Centralised and uniform recording of results in the specialist application in a workflow-controlled, digital environment.
4. Office-wide dissemination of relevant information via the specialist application.
5. Systematic inclusion of the findings from the reporting process in oversight activities.

Sub-area 5 has already been implemented. An SRM-generated consolidated reporting method is applied in the specialist divisions. Steps have been taken to procure further necessary modules for the specialist application and the first extensions can be used operationally in 2021. Until the digital environment is fully available, the established information system ('traffic light reporting') will be used. This contains consolidated information from a number of federal offices on the status of Swiss flight operations, and is updated on a quarterly basis. Initial steps to implement sub-areas 1 and 2 are expected in 2022. The focus is on overseeing the management systems of the certified organisations. The FOCA plans in due course to issue a follow-up statement on the status of implementation of Safety Recommendation No 565.

Safety deficit
The safety investigation revealed that the staff of the Federal Office of Civil Aviation were often unable to identify the safety-related problems during audits and inspections of the air operator and the maintenance organisations. With regard to supervision of technical aspects, a lack of technical and methodological expertise in such historic aircraft played a major role in this. This led to a certain dependence on the know-how of the staff employed by the maintenance organisations under supervision. With regard to supervision in the field of operations, the inspectors no doubt had the expertise, but they were insufficiently critical towards the air operator's pilots. As a result, the activities of these companies were not effectively supervised.

Safety recommendation No 566, 22.12.2020
The Federal Office of Civil Aviation should acquire the necessary technical and methodological expertise for the supervision of historic aircraft or procure it from an independent party. Furthermore, it should ensure that supervision is exercised in an effective manner.

Implementation status
Partially implemented. The FOCA is in partial agreement with Safety Recommendation No 566. The FOCA, specifically its Aircraft Safety Division, has already taken some measures. Further measures are planned to cover the various aspects of Safety Recommendation No 566. These will involve a series of milestones (implementation plan).

Measures already taken:

- The management system process for certification of historic aircraft was already adapted following Safety Recommendation No 506. Thereafter, applications to register aircraft in the special category 'Historic' underwent an internal risk analysis. In preliminary clarifications relating to aircraft type and the corresponding serial number and to aircraft operation, the requirements and conditions for mitigating risks could be checked in a standardised manner. However, these measures have not yet been applied in practice as no 'distinctive' aircraft have been entered in the Swiss Aircraft Register since. Meanwhile, the licensing process for historic aircraft is being revised. Individual risk analysis will be replaced by legislative measures, that is to say abstract and risk-based norms (see Safety Recommendation No 561). Furthermore, the licensing process will be mapped much more comprehensively in the new management system, showing all interdependencies and detailed process steps.
- Changes to section portfolios. Oversight of the Swiss Aircraft Register is currently organised into two sections. The Airworthiness Section Zurich (STLZ) is responsible for all complex aircraft and commercially operated aircraft (AOC operators). The Airworthiness Section Bern (STLB) is responsible for all non-complex aircraft, all helicopters and special category aircraft (incl. historic aircraft). Since the Ju 52 was used commercially, oversight was conducted by inspectors from STLZ. Changes have been made since to the section task portfolios. Although there will no longer be any non-EASA aircraft that can be operated commercially (AOC), it makes sense to exploit synergies and combine different disciplines and specialisations. In future, both airworthiness sections will cooperate on the oversight of historic aircraft (non-EASA), which under the EASA definition belong to the 'Complex aircraft' category.

Medium- and longerterm measures:
Various approaches to improving oversight and making it more effective are being reviewed. Working groups have been formed and have started work in the following areas:

a) Method review of airworthiness check by aircraft inspectors. How can direct oversight of historic aircraft be exercised more effectively? Broad consideration of all aspects incl. timing, planning, methodology, organisation, the administrative and technical scope of the check, etc. (lead: STLB/STLZ).
b) The inspectors conducting checks could be deployed on a 'rotation principle' in order to prevent audits and inspections from being one-sided and routine. Aircraft should be double-checked by a fresh pair of eyes and a second opinion given. However, this principle should not only apply to historic aviation oversight (lead: STOZ).
c) Work is also being done on an RPBO method (Risk and Performance Based Oversight), with which oversight is shaped by considerations of stakeholder risk and performance in the longer term. The FOCA has already introduced this method in various supervisory areas, although it has only been possible to implement it in a rudimentary fashion, since the introduction and implementation of this method is highly dependent on the establishment of IT tools. In the meantime, the Aircraft Safety Division is examining an interim solution, in particular looking at how findings from the oversight of organisations can be increasingly and systematically incorporated into the over-sight of aircraft and vice versa. Combined oversight (organisation and aeronautical equipment) is also being considered (lead: STOB).
d) Review of the competences (competence matrix) of the inspectors involved in historic aviation oversight (organisations and aircraft) and determination of any initial training and further training requirements (lead: STSS).
e) Plans to conduct an independent expert assessment of the effectiveness of the FOCA's oversight activities in historic aviation were already in place in 2019. It was not possible to implement them owing to the coronavirus pandemic and the restrictions and measures imposed in response to it. The assessment will take place in due course (the exact start date depends on known external factors). The findings and results should/could be taken into account in the above concepts (a-d) (lead: division management).
f) The FOCA internal quality monitoring system is limited to the aviation areas regulated by EASA in accordance with the corresponding EASA requirement. The scope exempted by EASA (in particular non-EASA aircraft) is not currently covered by the monitoring system. Integration is being considered (lead: division management).
g) Furthermore, cooperation with suitable associations and also aviation authorities (in particular AustroControl) is being examined with the aim of exploiting synergies and competencies (lead: division management).

Timing/outlook in relation to the medium- and long-term measures: some of the analyses and concepts mentioned have already been commissioned or launched. Concrete results are not expected until mid-2022 at the earliest. Some aspects will relate to the drafting of legislation, which is also already under way (see Safety Recommendation No 561), and some to Safety Recommendation No 565 in the case of matters pertaining to several divisions. It is thus expected that the new legal bases will come into full force and the new oversight concepts will be implemented sometime after mid-2023.

Safety deficit

The safety investigation demonstrated that certain aspects of the aircraft's performance and operating data were no longer accurate or were missing. It was, for example, no

longer possible to achieve the documented performance for cruise flight, there was a lack of information on manoeuvring speed, and the performance after an engine failure was insufficiently documented.

Safety Recommendation No 567, 22.12.2020
The Federal Office of Civil Aviation should require the air operator to determine key performance data of its Ju 52/3m g4e aircraft following a major overhaul, and adapt the corresponding documents accordingly prior to the aircraft type being released for service.

Implementation status
Not implemented. The FOCA is essentially in agreement with Safety Recommendation No 567. In the light of emerging developments, the wording of the safety recommendation appears obsolete. The two aircraft HB-HOY and HB-HOP have been deleted from the Swiss Aircraft Register. It can be assumed that the aircraft will never be put back into service. According to the FOCA, the only HB-HOS aircraft still on the Aircraft Register will not be rebuilt/restored. It is therefore highly unlikely that the HB-HOS historic aircraft will fly again. Determining performance data for 'overhauled' aircraft of the type Ju 52 is therefore an obsolete issue according to the wording of the safety recommendation. However, it is of course conceivable and possible that other aircraft of this type will be re-registered in the 'historic' sub-category at a later date and permitted to fly. A full overview of the determination of performance data that is the analysis of all manufacturer's data (e.g. flight manual, maintenance documentation, etc.), is given in the context of Safety Recommendation No 566 (oversight of historic aviation/specialist and methodological competence). In terms of meaning and intent, the implementation of the safety recommendation is therefore factually covered by Safety Recommendation No 566. For this reason, we would ask that Safety Recommendation No 567 be concluded on this basis.

Safety deficit
An investigation into maintenance work found a variety of irregularities, in particular in documentation where major modifications had been made, and with regard to spare parts management. Such shortcomings constitute a risk.

Safety advice No 25, 20.11.2018 (interim report)
The flight operator and the aircraft maintenance companies, together with the continuing airworthiness management organisation (CAMO), should review current processes and improve them to ensure both transparency about maintenance work and clarity in spare parts management.

Safety deficit
The safety investigation demonstrated that the pilots at Ju-Air had a tendency to systematically commit reckless violations of the recognised rules of aviation. Furthermore, it found that the flight crews no longer had sufficiently up-to-date knowledge of elementary principles of aviation, such as airspace structure, flight preparations, mass and balance calculations, nor were they appropriately familiar with the provisions of air traffic law.

Safety advice No 32, 22.12.2020
The flight operator should conduct specific refresher training courses with its flight crews on discipline, rule compliance and, in particular, safe mountain flying and the application of elementary principles of aviation.

Safety deficit
The safety investigation showed that even highly experienced flight crews often made basic errors such as airspace violations. The aircraft were often flown by two experienced, captain-ranked pilots, but this did not prevent such errors. Performance reviews were occasionally signed off without comment, and obvious mistakes went unrecognised or were not addressed with the intent of rectifying them. Such conduct reveals considerable deficits in cooperation, especially between experienced crew members of equal rank.

Safety advice No 33, 22.12.2020
The flight operator should optimise crew resource management such that it satisfies the specific requirements of its operations: visual flights, mountain flying, extensive experience, crew of equal rank, etc.

Safety deficit
The safety investigation showed that flight crews at the flight operator often cultivated an irresponsible attitude towards the freedoms offered by the company's operating conditions. Experienced crew members who had worked for many years at major airlines also displayed this type of risky behaviour, and also violated basic safety rules. The companies at which they had previously worked all had effective management and monitoring mechanisms in place that would immediately have revealed any deviations from the required standards. By contrast, Ju-Air did not have any means or tools by which to identify these safety problems. It may thus be concluded that even flight crews who had long been trained in a safety-conscious environment may fall into indiscipline in the absence of effective management and monitoring mechanisms.

Safety advice No 34, 22.12.2020
The flight operator should develop and introduce management and monitoring mechanisms that recognise breaches of basic safety principles and statutory regulations, thus ensuring compliance with the same.

Safety deficit
The safety investigation identified a large number of quality problems with the maintenance of the aircraft operated by Ju-Air. Similarly, many examples showed that notifications of safety-related events were not forwarded or handled in a way that would improve safety. This prevented lessons being learned from such incidents, or at least significantly reduced their value. Although the flight operator officially had a security management system, in practical terms it remained largely ineffective.

Safety advice No 35, 22.12.2020
The flight operator should improve its internal processes in particular where quality assurance and the handling of risk are concerned, so that safety problems can be recognised in good time and rectified appropriately.

Safety deficit
The safety investigation proved that the flight operator never analysed the key risks of its flight operations. This meant that flights were regularly operated under conditions in which even a minor failure could have led to an accident. The accident that is the subject of investigation here is also typical, in that common risky practices combined with natural, everyday operating conditions to fatal effect.

Safety advice No 36, 22.12.2020
The flight operator should conduct the event and risk analysis neglected at the time. It should ensure that, in the event of engine failure and when flying in the mountains, the proper choice and planning of flight paths mean that flights can always be terminated safely.

Safety deficit
The safety investigation demonstrated that the flight operator's flight crews did not have experience of how a Junker Ju 52/3m g4e behaves under critical flying conditions on passenger flights with the usual load distribution.

Safety advice No 37, 22.12.2020
The flight operator should document critical flying con ditions in realistic operating situations. Crews should be familiarised as well as possible with critical flying conditions.

Extension of spoilers upon take-off of a passenger aircraft, Porto (Portugal), 15.07.2018

When initiating take-off of the A220-300 on a scheduled flight from Porto (LPPO) to Geneva (LSGG), the throttle levers were not advanced far enough, meaning that the auto-throttle (AT) that had previously been armed was not engaged. Having covered 1.5 times its calculated take-off distance, the aircraft took off approximately 1,000 metres before the end of the runway.

Safety deficit
When initiating take-off, the pilot flying (PF) advanced the thrust levers, assuming that the auto-throttle (AT) – which had already been armed – would now engage and would set the take-off power to the required level (N1 rpm). As the thrust levers were only advanced to a thrust lever angle (TLA) of 20.6°, the AT remained armed without becoming engaged.
After exceeding a wheel speed (WS) of 60kt, the spoilers deployed by design.
At an indicated airspeed of between 90 and 100kt, the flight crew noticed that the power had been set too low. After advancing the throttles past the critical TLA of 23°, the spoilers retracted by design. During this time, the CONFIG SPOILER warning was displayed for four seconds.

Safety Recommendation No 552, 25.02.2020
Together with the manufacturer, National Aircraft Certification at Transport Canada (TC) should ensure that the spoilers are not automatically deployed when taking off with insufficient take-off power.

Implementation status
Partially implemented. By letter of 6 November 2020, Transport Canada (TC) agreed with the Swiss Transportation Safety Investigation Board (STSB) safety recommendation and, in response, TC's National Aircraft Certification Continuing Airworthiness division required the development by Airbus Canada of a corrective action plan to address the hazard of automatic deployment of spoilers with insufficient take-off power.
As a result, Airbus Canada is conducting an evaluation of the A220 Ground Lift Dumping (GLD) control logic used during take-off in order to determine if it must be modified to ensure that spoilers do not automatically activate inappropriately during take-off. TC is monitoring this evaluation and, subject to its findings, will take safety action as needed.

The evaluation is expected to be concluded by the end of June 2021.
Prior to completion of the evaluation, and in order to reduce the possibility of inappropriate automatic deployment of spoilers during take-off, the following corrective actions are performed or planned:

- A220 training material enhancement aimed at improving flight crew management of the auto throttle and understanding of the GLD control logic during take-off. Airbus Canada's training team is working to schedule the simulator session which was identified as a prerequisite to acceptance of the training material, but was unable to secure Transport Canada Civil Aviation Flight Standards availability before late March or early April. The final details and scheduling are still being discussed.
- A220 Flight Crew Operating Manual (FCOM) Volume 2, procedures enhancement to better ensure correct setting of thrust levers for take-off, including a new pilot monitoring callout for correct engagement of the auto throttle were reviewed and published as part of FCOM Vol. 2 issue 016C (A220-100 and A220-300). The procedures are currently available in the Interactive Electronic Technical Publication (IETP).
- Additionally, a software update to make the display of auto-throttle status clearer to flight crews is under development and is expected to be released in avionics build 8A3, currently planned for March 2023.

In a letter dated 26 April 2021, Transport Canada (TC) announced that TC and Airbus Canada have since held a simulator session, and that the training material has now been released and is being used by the Airbus training centre.

Safety deficit
When initiating take-off, the pilot flying (PF) advanced the thrust levers, assuming that the armed auto-throttle (AT) would now engage and set the take-off power to the required level (N1 rpm). However, since the PF had only advanced the levers to a thrust lever angle (TLA) of 20.6°, the AT remained armed without becoming engaged. When the indicated speed of 60kt was exceeded, the AT immediately switched to HOLD mode.
Standard operating procedures require the crew to monitor flight and engine data once engine power has been set. Furthermore, when exceeding the indicated speed of 80kt they must expressly check whether the required take-off power (N1 rpm) has been set.
At an indicated speed of between 90 and 100kt, the PF noticed that the power was too low, and pushed the throttle forward. The investigation established that AT logic permits a switch to HOLD mode even when the necessary take-off power (target N1) has not yet been reached, and that this holds considerable risks. If the PF corrects the power by advancing the throttle in HOLD mode, the AT is deactivated and the corresponding acoustic and visual alerts can be heard and seen. If the set engine power is not checked until the aircraft reaches 80kt, it is too late, and if the runway is uneven it becomes more difficult to read off the values than at lower speeds. If the engines are not generating the calculated take-off power by this point at the latest, there is no guarantee that take-off can continue safely or that the take-off path is clear. The later it is recognised that take-off power is too low, the greater the risk attached to a subsequent aborted take-off.

Safety advice No 26, 25.02.2020
Issue: Check take-off power
Target group: Pilots of aircraft flying in formation
The flight operator should take appropriate action to ensure that, once set, the necessary take-off power is immediately checked and confirmed by the flight crew.

Collision with cable, Chauderon gorge (commune of Montreux), 27.07.2016

A helicopter of the type Airbus Helicopter AS 350 B3 was in slow forward flight during a visual overhead line inspection. During this inspection, the helicopter collided with a black fibre-optic cable, approximately 26 mm thick, which led from an antenna mast across a gorge to an overhead line mast. The pilot was able to land the slightly damaged helicopter in close proximity.

Safety deficit
At the point of collision, the fibre-optic cable had a height of about 110 metres above the ground and was neither registered in the aviation obstacle database of the Federal Office of Civil Aviation (FOCA) nor marked.
The FOCA's aviation obstacle database did not match the actual situation at the time of the accident. In addition to the fibre-optic cable, an overhead power line was present that was not registered in the database. In contrast, there were overhead power lines entered in the aviation obstacle database that did not exist in reality.

Safety Recommendation No 556, 20.10.2020
The Federal Office for Civil Aviation (FOCA) should take the following measures to prevent cable collisions:

- Ensure an aviation obstacle database that represents the current state as far as possible.
- Promotion programme for sensor-based, autonomous obstacle warning systems.

Implementation status
Partially implemented. The Federal Office for Civil Aviation (FOCA) is in partial agreement with Safety Recommendation No 556_a.

In the FOCA's view, the main problem in the case of the fibre-optic cable cut through by the helicopter, as mentioned in final report no 2364, was that the owner had not reported the cable despite the obligation to obtain approval under the Ordinance on Aviation Infrastructure (AvIO; SR 748.131.1). This opinion was also stated in the final report. Consequently, no conditions could be imposed during the required FOCA approval procedure and the cable was not included in the database of air navigation obstacles. Whilst defaulting owners can be sanctioned in administrative proceedings under the AvIO, the FOCA is consistently making it easier for owners to report air navigation obstructions.
Following the full revision of the AvIO, which came into effect on 1 January 2019, approval is now required only for air navigation obstructions above a height of 100 metres from ground level (apart from a few exceptions such as wind turbines). Furthermore, in order to simplify processes for the owners, registration is only required for obstructions from a height of 25 metres above ground level. The FOCA has specially developed and introduced a new Obstacle Collection System (OCS), an online tool which allows owners to register their structures as air navigation obstacles simply and quickly and with the necessary assistance. This can be done free of charge. It is also planned to introduce a Data Collection Service (DCS), a national data collection interface which will simplify internal processes and improve coordination with the various bodies involved. This is currently being developed and will probably replace or integrate the OCS in two years' time.
Furthermore, as already mentioned in the STSB final report under section 4.3 (Measures taken since the accident), the FOCA, in collaboration with the Federal Office of Topography, Swisstopo, will carry out a pilot project to improve the accuracy and timeliness of data on air navigation obstacles above 100 metres. This is to be achieved using air laser measurements (surface model). The air navigation obstacle database will be updated with the findings and data obtained. The project was launched in autumn 2020 with a series of workshops; it is planned to incorporate the latest data into the new DCS by the end of 2022.

The FOCA agrees in part with Safety Recommendation No 556_b.
Sensor-based, autonomous obstacle warning systems will become increasingly important. This is true of both manned and unmanned aviation. The FOCA thus agrees that developments in these systems should be monitored (in order to acquire the necessary skills and understanding) and encouraged. However, the costs of funding a programme to further develop the technology is far beyond the FOCA's means. This technology is now highly specialised and is being further developed by large corporations.
The Hensoldt system provides one example of this technology: www.hensoldt.net/what-we-do/air/situational-awareness
However, the cost and weight of such a system are very high (> CHF 100,000; > 30kg).
In the case of simpler, less reliable systems, the FOCA believes that the actual benefit must again be placed in relation to the behaviour of the crew, who should not be tempted to prepare less seriously for a flight or to engage in riskier flight behaviour. Furthermore, EASA approval is required to install such equipment (minor or major change/STC).
Financial support for individual structures and small developments is already provided for under Article 87 of the Federal Constitution. The issue of sensor-based, autonomous obstacle systems was made a multi-year priority topic in November 2020. Such projects can be subsumed under the 'accident prevention programmes in civil aviation' and 'research and development projects' measures in the Safety category.

No further measures are planned by the FOCA Aircraft Safety Division for the time being.

Crash of a glider during a tow launch, Sion Airport, 26.06.2016

During its tow launch run, a large-wingspan glider swung out to the side after the wingtip had touched the ground while accelerating, and the glider pilot then did not release the towline. As the launch run continued, the pilot lost control of the aircraft, causing it to rise up and turn over.

Safety deficit
The investigation identified a systemic risk in the procedure by which the towed aircraft is not aligned with the centre line of the launch runway prior to launch.

Safety advice No 31, 14.07.2020
Operating procedures at aerodromes from which gliders operate should be amended so that gliders can be aligned with the centre line of the runway for launch.

Wingtip strike upon landing, Geneva Airport, 06.04.2016

A business jet touched the runway with the tip of one wing during landing (wingtip strike). The most likely cause was wake turbulence from a previous commercial aircraft taking off on the same runway.

Safety deficit
It was found that there is no minimum separation requirement for wake turbulence between a preceding departing

and a landing aircraft. In addition, there are generally no minimum separation requirements regarding wake turbulence between aircraft of the same weight category. In the case of the MEDIUM weight category, this includes all aircraft with a maximum take-off mass (MTOM) between 7t and 136t according to EASA regulations.

Safety Recommendation No 558, 15.09.2020
The Federal Office of Civil Aviation (FOCA), together with air traffic control and the airport operator of Geneva, should take appropriate measures to reduce the risk of a landing aircraft being endangered by the wake turbulence of a previously departing aircraft.

Implementation status
Not implemented. The Federal Office of Civil Aviation (FOCA) is of the opinion that the cause of this accident cannot be attributed to insufficient separation between the aircraft that had taken off and was flying on ahead and the aircraft that had the accident on landing. Rather, the FOCA believes that the accident was due to the actions of the pilot landing the aircraft. The aircraft was kept hovering in ground effect for far too long during landing and was near stall point with high pitch attitude. The FOCA also believes that the high bank angle was quite possibly caused by the control inputs. The FOCA thus takes note of the final report No 2359 and Safety Recommendations Nos 558 and 559 issued therein but refrains from adopting and implementing them.

Safety Recommendation No 559, 15.09.2020
The Federal Office of Civil Aviation (FOCA), together with air traffic control and the operators of all national and regional airports in Switzerland, should review the existing operational procedures regarding the hazard of wake turbulence.

Implementation status
Not implemented. The Federal Office of Civil Aviation (FOCA) is of the opinion that the cause of this accident cannot be attributed to insufficient separation between the aircraft that had taken off and was flying on ahead and the aircraft that had the accident on landing. Rather, the FOCA believes that the accident was due to the actions of the pilot landing the aircraft. The aircraft was kept hovering in ground effect for far too long during landing and was near stall point with high pitch attitude. The FOCA also believes that the high bank angle was quite possibly caused by the control inputs. The FOCA thus takes note of the final report No 2359 and Safety Recommendations Nos 558 and 559 issued therein but refrains from adopting and implementing them.

Safety Recommendation No 560, 15.09.2020
The European Union Aviation Safety Agency (EASA) should reconsider and adapt the insufficiently differentiated minimum separation requirements regarding wake turbulence, especially in the case of displaced runway thresholds.

Implementation status
Not implemented. The European Union Aviation Safety Agency (EASA) considers that appropriate and proportionate guidance already exists in EASA regulations to adequately address the needs of national competent authorities and air navigation service providers in establishing minimum separation distances with respect to wake turbulence. These measures allow national authorities and air navigation service providers to take into account the specificities of local conditions and to adapt operations accordingly. This approach was chosen in order to provide member states with common principles and at the same time allow sufficient flexibility to deal with local circumstances, such as a displaced runway threshold. In a specific case such as this, EASA states that additional, nationally applicable measures could be implemented, as mentioned in Safety Recommendations Nos 558 and 559 addressed to the Federal Office of Civil Aviation (FOCA).

Airprox between a business jet and a passenger aircraft during take-off run, Geneva Airport, 24.07.2015

Authorised to proceed towards holding bay Z, the flight crew of a Cessna Citation C525 passes the holding point ahead of the CAT I runway of concrete runway 05 without having been cleared to do so. The aircraft stopped approximately 15m from the edge of the runway and came into conflict with an approaching Airbus A320 that was rolling for take-off.

Safety deficit
The intersection of taxiway Z with concrete runway 05 has been identified as a risk point for runway incursions. To draw pilots' attention to this, it had previously been marked on airport diagrams as a hotspot.

Safety Recommendation No 549, 14.01.2020
The Federal Office of Civil Aviation should ensure that the risk of a runway incursion at the intersection of taxiway Z with concrete runway 05 is indicated on the airport diagrams.

Implementation status
Implemented. In a letter dated 10 December 2020, the Federal Office of Civil Aviation (FOCA) informed the Swiss Transportation Safety Investigation Board (STSB) that the geometry of the CAT I taxiway holding bar at TWY Z in front of runway 04-22 had been simplified and that the publication

incl. hotspot runway incursion would be amended effective at the beginning of 2021.

Safety deficit
The intersection of taxiway Z with concrete runway 05 has been identified as a risk point for runway incursions. When authorising an aircraft to taxi towards the CAT I or CAT II holding points or holding bay Z, the GND controller should thus be required to systematically direct pilots to wait away from this runway by giving the 'HOLD SHORT OF RUNWAY (position)' instruction.

Safety Recommendation No 550, 14.01.2020
The Federal Office of Civil Aviation should ensure that air traffic control's operating procedures are adapted to take account of the risk of runway incursions identified at the intersection of taxiway Z with concrete runway 05.

Implementation status
Partially implemented. In its response dated 28 April 2020, the FOCA indicates that, according to information provided by Skyguide, the following remedial measures have been taken:

- A Safety Letter has been published to draw air traffic controllers' attention to the hotspot.
- A Safety Letter has been published to recommend that air traffic controllers issue the 'hold short of RWY' instruction.
- The 'conditional line-up clearances' relating to taxiway Z were suspended as of 19 December 2019.

According to information provided by Skyguide, the following remedial measures are planned:

- Amalgamation of the CATII/III and CAT I stop bars,
- Round-the-clock use of the stop bars

Safety deficit
On taxiway Z, when visibility is good, the protected area of the runway is bounded by the holding point in front of the CAT I runway. The RIMCAS (Runway Incursion Monitoring and Conflict Alert Sub-System) alarm was triggered when the Cessna 525 had passed the point by 12m.
The verbal alarm emitted via the RIMCAS 'safety net' indicated the runway incursion but failed to attract the attention of the GND and ADC controllers, who were managing scheduled traffic; thus RIMCAS did not perform its safeguarding role.

Safety Recommendation No 551, 14.01.2020
The Federal Office of Civil Aviation should ensure that the RIMCAS safety net is configured in such a way that it emits an alarm that is noticed in weather conditions other than poor visibility.

Implementation status
Implemented. In its response dated 28 April 2020, the FOCA approved this safety recommendation.
On 30 January 2017, Skyguide modified the SAMAX and RIMCAS systems (RWY Incursion Monitoring and Collision Avoidance Subsystem) in such a way that runway incursions are detected immediately after the holding point in question (CAT I, CAT II/III) has been passed.

5.3 Railways

Hazardous situation between shunted vehicles and passenger train at Thalwil, 14.05.2019

On 14 May 2019, early in the morning, prior to the start of operations, the closed track between Horgen Oberdorf and Thalwil was reported to be clear. Because there were still shunted vehicles waiting at the Thalwil entry signal, a configuration was displayed to the movements inspector that he was unable to remove by resetting the axle counter. A passenger train was therefore required to proceed from Horgen Oberdorf to Thalwil 'running at sight'. The train was able to stop behind the shunted vehicles in time.

A hazard can arise between shunted vehicles and a passenger train owing to a failure to comply with a number of regulations. A section of the track was reported to be clear, despite still being occupied by vehicles.

The following risks were identified during the investigation:

- If vehicles leave a track section monitored by axle counters and other vehicles remain behind it, it is possible to reset the axle counter for this section. In such a case, the first train can run without restriction even though the track is still occupied.
- The parties involved did not seem to be aware that only consistent implementation of the relevant regulations could ensure there was the necessary degree of safety to declare the track clear.
- Although there was some doubt about the matter, they did not question their own decisions.

Safety deficit
In this event, the combination of the shunting movements was such that it was not possible to reset the axle-counter and as a result the first train had to be ordered to run at sight. However, with a different combination this could have led to an incident with greater impact had the safety manager declared the track section to be clear. The case of 20 February 2016 in Sihlbrugg demonstrates this possibility. If the track vacancy detection system uses track circuits, in

the event of an occupied signal section the first train is required to 'run at sight'. The same is true if the track vacancy system employs axle counters and there is an occupied signal that cannot be reset. If the axle counter can be reset despite the signal section showing occupied, the first train may still run at the maximum permissible speed.

Safety Recommendation No 152, 25.02.2020
The Federal Office of Transport (FOT) should examine whether the same procedure – ordering 'run at sight' – should always be used for the first journey after the signal is given that the track is clear, irrespective of the type of track vacancy detection system.

Implementation status
Implemented. The Federal Office of Transport (FOT) confirms that with the entry into force of the RSR A2020 on 1 July 2020, the provisions relating to notifications of when a train can run when track is occupied have been tightened. In accordance with the core process for incidents (RSR R 3009 clause 2), track vacancy detection equipment may only be reset after a run at sight or an additional track check.

Safety deficit
Multiple requirements that help the person responsible to ensure greater safety when declaring that track is clear were not met. Maximum safety can be ensured only if all of the requirements are met together. The investigation found that in practice the requirements are not always fully observed.

Safety advice No 23, 25.02.2020
Issue: Compliance with requirements
Target group: Infrastructure operators and construction companies
Infrastructure operators and construction companies should review how consistently current requirements are observed, and take action where necessary.

Accident involving persons at Exergillod, 22.06.2019

On Saturday, 22 June 2019, a special photo train, consisting of the Transports publics du Chablais (TPC) No 2 railcar and No 35 wagon, stopped shortly before Exergillod station in the bend of the Folles Bridge. Passengers alighted to take pictures before re-boarding. On arrival at Aigle station, it was noted that one passenger was missing.

During the stop on the bend of the Folles Bridge, the victim had moved over to the left side of the bridge. The reason why the victim fell from the bridge could not be determined by the STSB.
The way the train stopped in the bend of the bridge led to a dangerous situation. This situation was exacerbated by the various vehicle movements, without regard to the presence of the passengers, and by the lack of regulatory controls to ensure that all passengers were on board the train before it resumed its journey to Aigle.

Contributing factors:
- The lack of established rules for special trackside stops;
- The train attendant's lack of training in the duties he exercised.

Safety deficit
The Swiss Rail Service Regulations (RSRs) state that infrastructure managers may regulate special stopping points in their implementing provisions (RSR-IPs). There is no mention of this in TPC's RSR-IPs.

Safety Recommendation No 149, 28.04.2020
The STSB recommends that the Federal Office of Transport (FOT) ask TPC to add provisions on full-track stops to its RSR-IPs.

Implementation status
Implemented. The FOT confirms that a working group has been set up at TPC to define and create a catalogue of stopping points on open track. Work is in progress. Until it is concluded, the TPC is not permitted to run photo trains or other special passenger trains requiring stops on open track.

Safety deficit
The safety management system must identify and evaluate the risks and provide answers on how they are to be managed. It also defines the organisation and responsibilities.
The infrastructure manager must determine on the basis of a risk analysis the locations where exceptional stops can

be made on open track. The safety measures to be implemented during such stops must be defined. This responsibility must not be delegated to the locomotive engineer under any circumstances.

Safety Recommendation No 150, 28.04.2020
The STSB recommends that the Federal Office of Transport (FOT) ensure that procedures and risk mitigation measures for exceptional stops on open track are addressed as part of the implementation of TPC's safety management system (SMS).

Implementation status
Implemented. The FOT reports that the measures to be taken to address the risks form part of the requirements that TPC must meet in order to obtain a safety certificate and safety authorisation. TPC has a safety certificate and safety authorisation valid until 31 March 2021.

Safety deficit
Persons whose activities are relevant to railway safety must receive appropriate training. The company must, when organising staff deployments, ensure that adequate resources are allocated to the activities to be carried out.

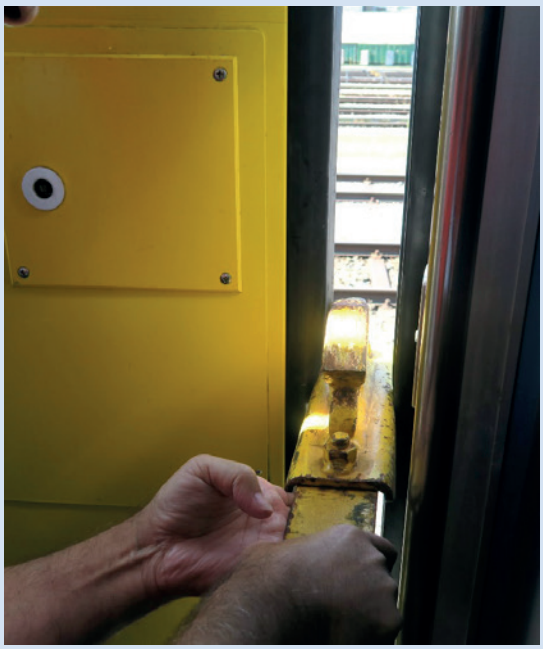
Safety Recommendation No 151, 28.04.2020
The STSB recommends that the Federal Office of Transport (FOT) require TCP to introduce a resource management system that ensures that only suitably trained staff are employed for railway safety-related activities.

Implementation status
Implemented. The FOT states that the human resource management is also one of the criteria checked in the context of obtaining a safety certificate and safety authorisation.

Fatal industrial accident involving a train manager at Baden, 04.08.2019

On Sunday 4 August 2019 at 00:10 the train manager of the Interregio train IR 1893 was trapped in a door as the doors were closing, and was dragged along as the train was departing from Baden station, sustaining fatal injuries as a result.

The train was departing from Platform 2 at Baden station. After passengers had alighted and boarded, the train manager instructed the train driver by text message to move off and activated the UIC door closing command for the train at No 4 door set of the fifth-last carriage, using a square wrench. The doors where the command is given remain open so that door closing can be monitored. These doors then have to be closed by the train manager by pressing a separate button. The train manager was trapped in No 4 door set during the closing action.



Safety deficit
The pneumatic anti-trap system must be switched off for technical reasons shortly before the closing action.
The reliability of the switching point of the 'doors 98% closed' sensor that deactivates the pneumatic anti-trap system is not guaranteed, which means that the protective anti-trap function can no longer be guaranteed before the 98% doors-closed position, contrary to its specification.

Safety Recommendation No 141, 20.08.2019 (interim report)
The STSB recommends that the Federal Office of Transport (FOT) asks vehicle keepers to replace the current system for deactivating the anti-trap protection on the EW IV by a reliable system.

Implementation status
Implemented. Among other things, the ruling issued by the FOT on 22 August 2019 required the SBB Passenger Division to fit carriages with a door control system, including anti-trap protection, that is based on current technology. The FOT also ruled that the SBB must arrange an external audit of the organisation of and procedures for vehicle maintenance.

Safety deficit
Persons or objects trapped in doors must be detected with a high degree of reliability. The current system of the EW IV with a pair of door limit switches connected in parallel

does not meet this requirement. The doors can be displayed as closed to the train driver even though they are not fully closed, resulting in uncertainty on the part of train driver, and can lead to accidents.

Safety Recommendation No 142, 20.08.2019 (interim report)

The STSB recommends that the Federal Office of Transport (FOT) ask train operators to have the door limit switch system of EW IV to be modified so that the red indicator lamps display the correct door status to the engine driver.

Implementation status

Implemented. On 22 August 2019, the FOT ordered that Safety Recommendation No 142 must be implemented. The FOT also ordered that the SBB arrange for train maintenance organisation and activities to be audited by an external body.

Safety deficit

At railway stations at which permission to depart is still granted by means of a platform-based signal box, the train manager must give permission before boarding the train and closing their own door. If the door has a technical defect – modern door controls check the contact circuits, while the older EW IV door controls do not – the door is reported closed to the train driver, although it is actually still open. There is therefore the continued risk that the train will depart before the train manager has boarded.

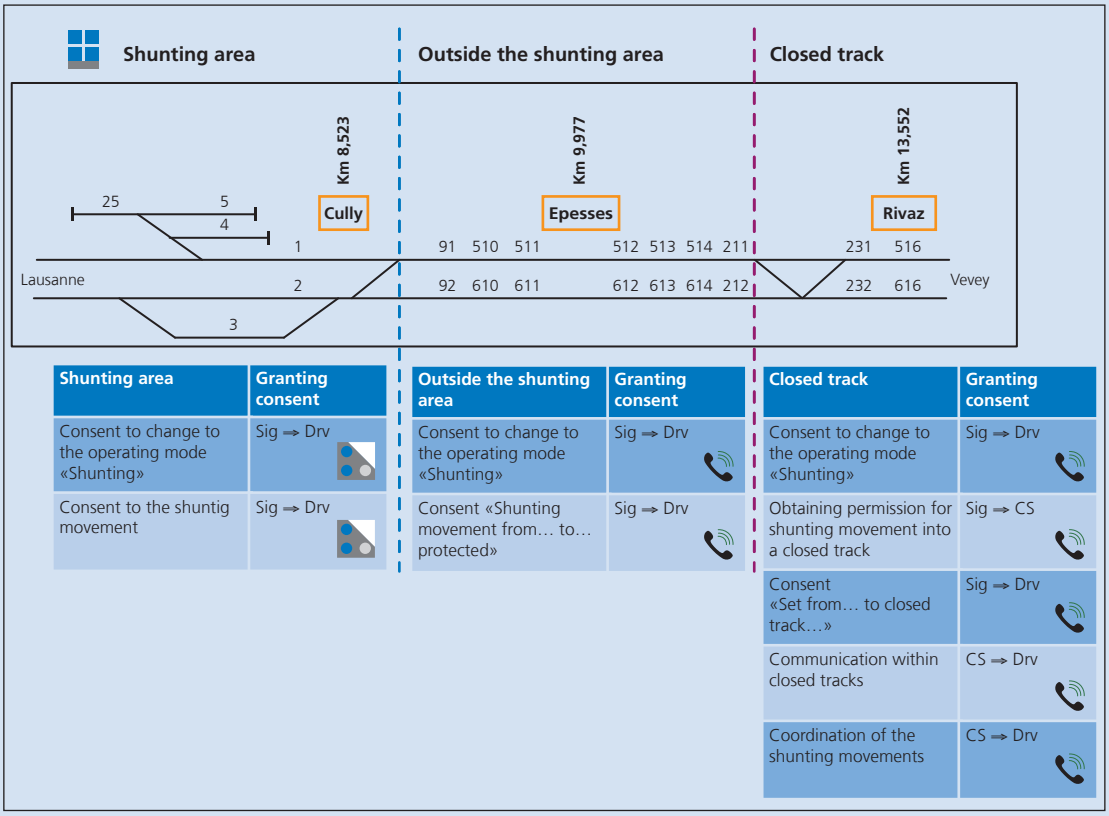
Safety advice No 22, 26.05.2020

Issue: 'Permission to depart via signal box' process
Target group: SBB Passenger Division

On 30 September 2019 a new procedure was introduced at stations in which Re 460 commuter train compositions with EW IV systems are still given permission to depart using a platform-based signal box (i.e. permission is given before the train manager has boarded the carriage). The SBB Passenger Division should review whether the risk to train crews from this new procedure is acceptable.

Hazardous operating situation at Cully, 15.11.2019

At approximately 04:30 on Friday, 15 November 2019, on the section of track with ETCS Level 2 in-cab signalling, an infrastructure shunting movement ran without authority on the in-service tracks 513-512-511-510 between Rivaz and Cully.



Operations were endangered because a vehicle from the engineering worksite made a return journey at the end of the works without authorisation to move on the five kilometres of the ETCS Level 2 line between Rivaz and Cully, while the tracks were in service.
The following contributed to the incident:

- A lack of planning and coordination in preparing the works so that there was no agreed definition of the operating restrictions to be applied on the same site.
- The complexity, number of operating regimes and various ways of conveying approval on this portion of the line.
- The lack of information to staff on the ground on the status of the operations that would allow them to know unequivocally which operating mode was active on the section of track concerned.

Safety deficit
Centralisation of traffic management, the widespread development of automation and computerisation of systems represent a challenge for the persons who must interact with these systems. There is an increased risk of human error when a person has to at some point take over and assume certain system functions that are no longer active or run by the system. Without planned support, humans cannot take over part of the operation of an automated application and ensure a level of safety equal to the system's. In current systems, not all persons involved have the same level of information on the state of the system and the resulting operating situation.

Safety Recommendation No 157, 13.10.2020
The STSB recommends that, in the development of centralised traffic management and widespread automation, the Federal Office of Transport (FOT) ensure that when humans are required in certain situations to take control of safety functions assigned to the system, these functions automatically default to predefined substitute processes.

Implementation status
Implemented. The FOT is of the opinion that the current specifications in the RSR R 300.1 section 2.1.6 are sufficient. This paragraph prescribes the cases in which checklists for rail services (CL-F) are to be used. The RSR form the basis for the creation of the checklists. There are no explicit specifications for the creation of checklists. Thus, it is theoretically conceivable that the suppliers of technical systems create such checklists. The responsibility for the preparation and application of the checklists lies with the transport companies, which have the expertise to create specific checklists tailored to their technical systems. The FOT therefore assumes that the transport companies will also involve their suppliers in the preparation of checklists where necessary.

Safety deficit
Where two engineering service providers are working at two sites in the same area under the same engineering coordinator, it makes sense to plan and define common operating restrictions. Had such restrictions been defined clearly, it would have been possible to standardise the procedure for the return journeys of both shunting movements at the end of work. Errors occur more easily in the absence of proper working plans.

Safety advice No 25, 13.10.2020
Issue: Coordination of operational measures for engineering sites in the same area
Target group: SBB Infrastructure
To standardise working processes, where there are two engineering sites in the same area at the same time, SBB Infrastructure should ensure that the service providers concerned coordinate with each other to plan and define common operating restrictions.

Accident involving persons in Bern, 01.03.2020 (interim report)

At 01:09 on Sunday, 1 March 2020, a passenger's hand became caught in the closing boarding door of a Eurocity passenger coach of the Intercity (IC) Bern-Interlaken Ost at Bern station. The train left a short time later. The passenger ran alongside the carriage and tried to free his hand. After running alongside the carriage for about 45 metres, he finally managed to pull his hand out of the rubber door seals. He sustained minor injuries in his efforts.

Safety deficit
The rubber profile used (second-generation) is so hard that persons or objects coming into contact with the front edge of the door when it is closing are not reliably detected. This

creates the risk of people or objects becoming trapped or of people falling.

Safety Recommendation No 153, 17.03.2020
The STSB recommends that the Federal Office of Transport (FOT) urge the train operators to replace the second-generation rubber profile used on all affected vehicle types with a rubber profile that detects any obstacles in the door area and opens the door again to prevent persons and objects from becoming trapped or knocked over.

Implementation status
Implemented. In a letter dated 31 March 2020, the FOT ordered the SBB to replace, on all affected vehicle types, the rubber profiles that are too hard with a rubber profile that is soft enough to detect the presence of a person or object in the doorway. The rubber profiles had to be replaced by 31 July 2020 at the latest.**Safety deficit**
The reliability of the switching point of the 'Doors 98% closed' sensor that deactivates the pneumatic anti-trap system is not guaranteed, which means that the anti-trap function cannot be guaranteed before the 98% door closure, contrary to its specification.
The pneumatic anti-trap system has been designed to switch off shortly before the doors close. This means there is a risk of parts of the body (e.g. fingers, hands) becoming trapped every time the doors close. This also means that there is always a risk that a person trapped in doorway could be dragged along once the train starts moving. The risk exists for all carriage types with the same or similarly designed door closure.

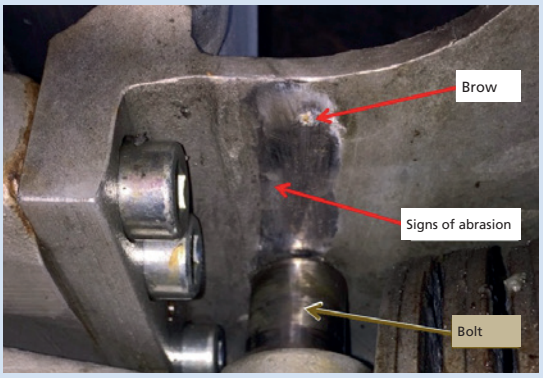
Safety Recommendation No 154, 17.03.2020
The STSB recommends that the Federal Office of Transport (FOT) require the vehicle owners concerned to replace systems involving an inactive anti-trap protection circuit, such as those installed on Eurocity passenger coaches, standard carriages IV and Intercity driving trailers, with a reliable system that also prevents hands from being trapped.

Implementation status
Partially implemented. The FOT reports that the replacement of the door system of EW IV, EC and driving trailers for SBB passenger transportation is in progress. According to SBB's plans, the upgrade will be completed in 2025.
At the same time, other rolling stock owners were asked whether carriages with such door controls are in use and how the transport companies deal with them. No additional risk or need for further action on the part of the FOT is apparent from the survey and the analysis of the railway undertakings' responses. Apart from SBB, there are no other railways whose vehicles need to be adapted in the door area.

5.4 Cableways

Crash of a four-seater chair at Flumserberg, 11.02.2016

On 11 February 2016 at around 15:20, an empty four-seater chair on the Obersäss-Stelli circulating chairlift in Flumserberg crashed to the ground during the descent. The crash occurred in the vicinity of the third pylon from the top, No 16. Noone was injured. The chair that crashed, No 36, was damaged in the event.



The chair crashed owing to a clamp failure. During the last clamp revision, the operator installed a non-compliant heavy-duty dowel pin. The mechanical loads and weathering in combination with the properties of the heavy-duty dowel pin resulted first in longitudinal cracks followed by transverse fractures. As a result, the bolt in the pin joint moved against the clamp housing wall and prevented the clamp from closing completely. The clamp thus no longer gripped the cable forcefully and tightly. At pylon No 16, the clamp was forced open and detached itself from the cable.
Contributing factors to the accident were:

- The operator was not aware of the requirement to use surface-treated heavy-duty dowel pins.
- The heavy-duty pin used was not dacrometised (surface treatment in the form of a zinc flake coating for corrosion protection), so under corrosive conditions longitudinal cracks were more likely to form.
- The required maintenance work on the clamps was not carried out as specified (one quarter of the clamps each year, or last maintenance in 2015).
- As a result of the wedged clamp design, an exceptional condition occurred in which the faulty condition was not detected in the spring force test.

A further risk was identified during the investigation:
If cableway operators, manufacturers and distributors do not report to the supervisory authority new findings that

may have an influence on installation safety, the authority cannot check in its supervisory activities whether the undertakings concerned have taken measures to remedy the defects.

Safety deficit
Despite bezels, support bars, spring force testing, maintenance and service specifications, a faulty clamp was not detected.
The investigations showed that, in the design of the monitoring facilities and maintenance and testing specifications, it had been assumed that a dead centre clamp can only ever be in one of two positions: either fully open or fully closed. A scenario in which a clamp does not close completely and is not in full positive contact with the cable was not considered. This means that a chair with the AK4.1 type clamp can leave the station with the clamp only partially closed and blocked. Consequently, the clamp may slip on the cable, which may lead to a collision of the vehicle with a vehicle in front or behind, or the clamp may open and the vehicle crash to the ground.

Safety Recommendation No 155, 15.09.2020
For the operation of cableways with this or similar types of clamp and monitoring equipment, the Federal Office of Transport (FOT) should require companies to provide evidence that blocked clamps can be reliably detected and vehicles with only partially closed clamps can be reliably identified and prevented from leaving the station.

Implementation status
Partially implemented. During the market surveillance process, the FOT informed the relevant supervisory authorities abroad about the STSB findings.
During the market surveillance process, the FOT informed the relevant supervisory authorities abroad about the STSB findings. The manufacturers were requested to ensure that the systems are optimised.
The FOT will check the maintenance measures taken by the operators with regard to clamps in its safety monitoring processes.

Safety deficit
During the safety investigation, it was found that the manufacturer did not notify the supervisory authority of findings concerning installation safety. It was therefore not possible for the FOT, in its supervisory activities of the cableway companies, to identify changes made on the basis of significant findings and to examine the precautions taken.

Safety Recommendation No 156, 15.09.2020
The Federal Office of Transport (FOT) should ascertain whether safety-relevant information from new findings is consistently passed on in the safety network between manufacturers, distributors, operators and supervisory authorities.

Implementation status
Partially implemented. As part of its market surveillance activities, the FOT draws the relevant legal provisions to the attention of manufacturers, distributors and operators in writing. The communication channels are defined and communicated to all parties involved. Active feedback is required.

Safety deficit
Those responsible did not have any existing, systematic and case-specific procedures, including decision-making criteria, to follow when deciding whether chairs should be put back into or taken out of service, or when evacuating the chairlift.

Safety advice No 24, 15.09.2020
Issue: Decision-making when putting a chair back into service
Target group: Cableway operators
Cableway operators should draw up an internal emergency checklist to determine whether chairs should be evacuated/returned to service following an event.
This would give them a well-considered tool suited to the specific nature of their operations and their particular facility. Covering as many different scenarios as possible, it would ensure systematically that key safety-related considerations are factored explicitly and appropriately into decision-making. In addition to decision-making criteria it would also cover authorities, capabilities and responsibilities, i.e. would define who can and may assess, decide and – where appropriate – prioritise what, to the required standard. The tool might be tested in the form of an internal emergency exercise, for example. This simulation would allow the staff members concerned to practise handling the tool, thereby testing its fitness for purpose and benefiting its use under real-life emergency conditions.

Unexpected opening of a cabin door on the Les Violettes – Plaine Morte funitel in Crans-Montana, 20.01.2020

In Crans-Montana, on Monday, 20 January 2020 at around 13:45, on the funitel that links the Violettes hut to the Plaine Morte glacier, the door of a cableway cabin carrying around 15 passengers opened just outside the lower station. The facility was immediately stopped by staff. A reverse manoeuvre was performed to return the cabin to the station. The passengers disembarked and the cabin was taken out of service. There were no injuries.

The unexpected opening of the door of cabin No 15, at the exit of the lower station, occurred because the guide rail carriage on the door leaf was faulty.
The following contributed to the incident:

- The guide carriage did not correspond to the production drawings.

Safety deficit
The unexpected opening of a cabin door on the line represents a danger to passengers. The danger is greatly increased when passengers travel standing up. If one of the guide carriages breaks, the door is no longer locked and the door leaf can be opened by simply pressing against the door.
The planned maintenance interval does not prescribe a check of the mechanical condition (impairment of the mechanical properties of the object) of the door guide bracket.

Safety Recommendation No 147, 04.02.2020 (interim report)
The STSB recommends that the Federal Office of Transport (FOT) inform the operators of similar installations of the defects on the funitel in Crans-Montana, so that similar parts of their installations can be thoroughly inspected in order to detect possible construction defects in the guide carriages.

Implementation status
Implemented. The FOT reports that the cableway manufacturer has informed the two cable car companies concerned in Switzerland by sending them a service bulletin, and requested an inspection for possible defects. The companies have found that the door slides are welded only on the side. However, they found no cracks or traces of corrosion. They found that other plants or operators, including foreign ones, were not affected.

Safety deficit
During the approval process, the installations are checked and approved on the basis of plans and production drawings. The final product must correspond to the plans.
In this case, the broken guide carriage did not correspond to the production drawings. In the drawings, the vertical tube is welded to the horizontal support by two weld seams located above and below the horizontal support. The broken part and the parts checked by the STSB were welded only at two points on the sides of the horizontal support.

Safety Recommendation No 148, 04.02.2020 (interim report)
The STSB recommends that the Federal Office of Transport (FOT) ask the CWA supplier to identify whether such parts are in service on other types of installations and then to provide evidence that the parts in service conform to the production drawings.

Implementation status
Implemented. The FOT reports back that the cable car manufacturer confirms that the parts were not manufactured according to the design drawings. New correctly welded door slides were supplied to the two cableway companies concerned.

5.5 Buses, inland and maritime navigation

In the year under review, no reports with safety recommendations were published for buses or inland or maritime navigation.

6 Analysis

6.1 Aviation

The following Chapters 6.1.1 to 6.1.4 illustrate the trend over time in the absolute number of aircraft accidents and the accident rates of various aircraft categories between 2007 and 2020. In the present Annual Report, the STSB has decided not to present accident rates (the number of accidents standardised against the number of flight movements per year). The impact of the COVID-19 pandemic on the number of flight movements would make it almost impossible to reliably interpret any comparison with previous years.

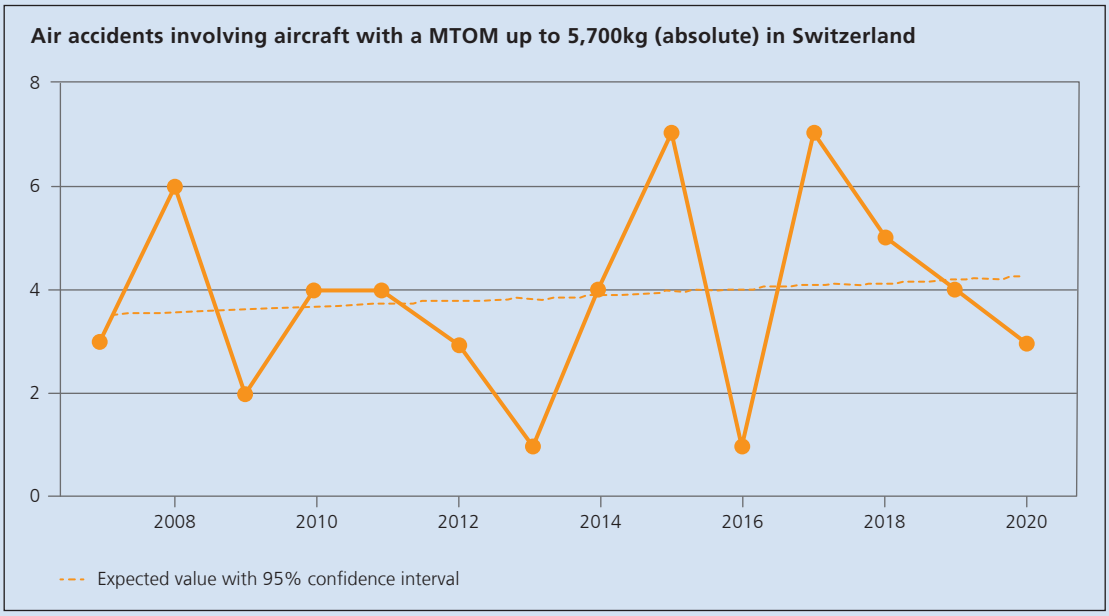
The following three aircraft categories have been analysed:

- Aircraft with a maximum take-off mass of up to 5,700kg (including motor gliders and touring motor gliders in powered flight);
- Gliders (including motor gliders and touring motor gliders when gliding);
- Helicopters.

In addition, an analysis was carried out that considered the accidents in the three aircraft categories as a whole.

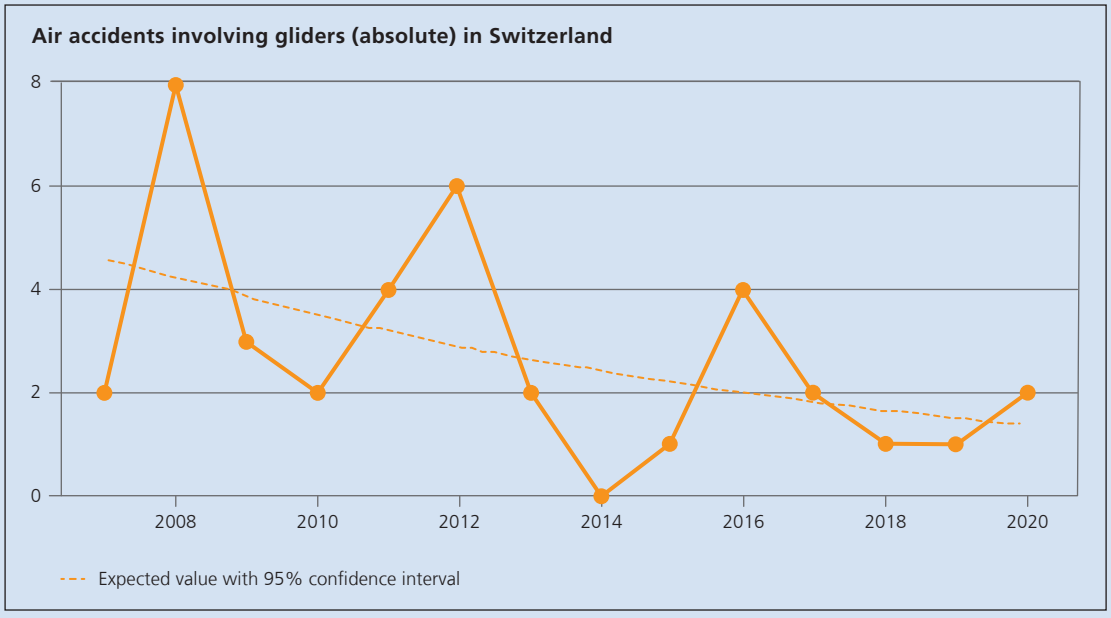
6.1.1 Motorised aircraft with a maximum take-off mass of up to 5,700kg

In 2020, three aircraft accidents were recorded in this category. Over the entire time series, the absolute accident figures range between one and seven. Three of the four highest values were recorded in the last five years. For this reason, each trend model shows a slight increase in the number of accidents and the accident rate. The three accidents recorded in 2020 are lower than the expected four calculated by the model.



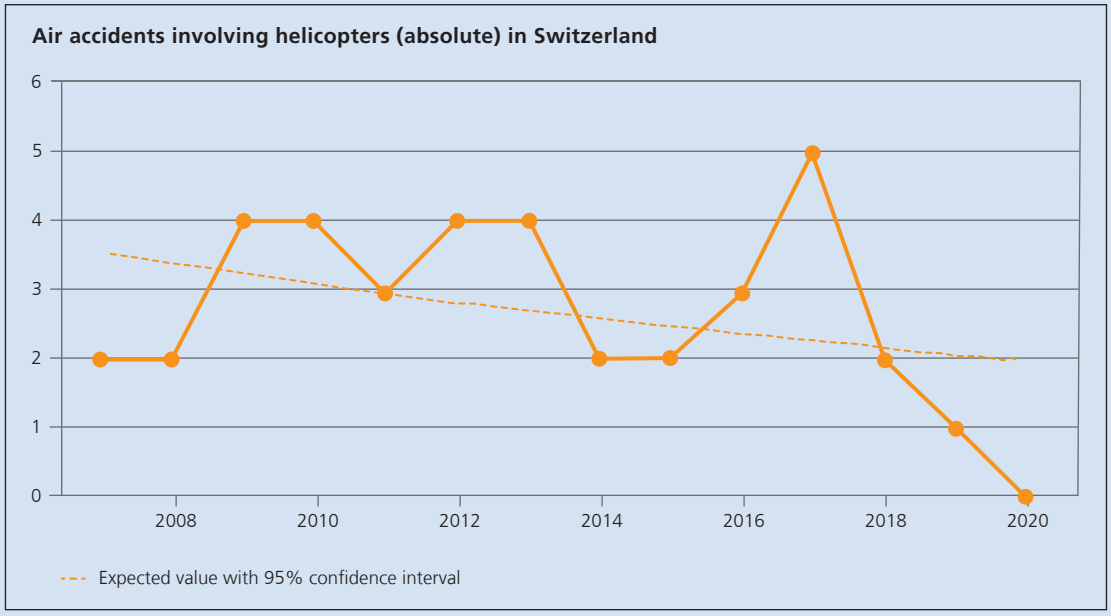
6.1.2 Gliders

Two air accidents were recorded in this category in 2020. Over the time series as a whole, the absolute accident figures range between zero and eight. In the seven years since 2014, there were fewer than two accidents in four of the years. At least two accidents per year were registered prior to 2014. The regression model thus shows a downward trend that has flattened off in recent years. The number of accidents recorded in 2020 (two) is slightly higher than the expected figure calculated by the trend model.



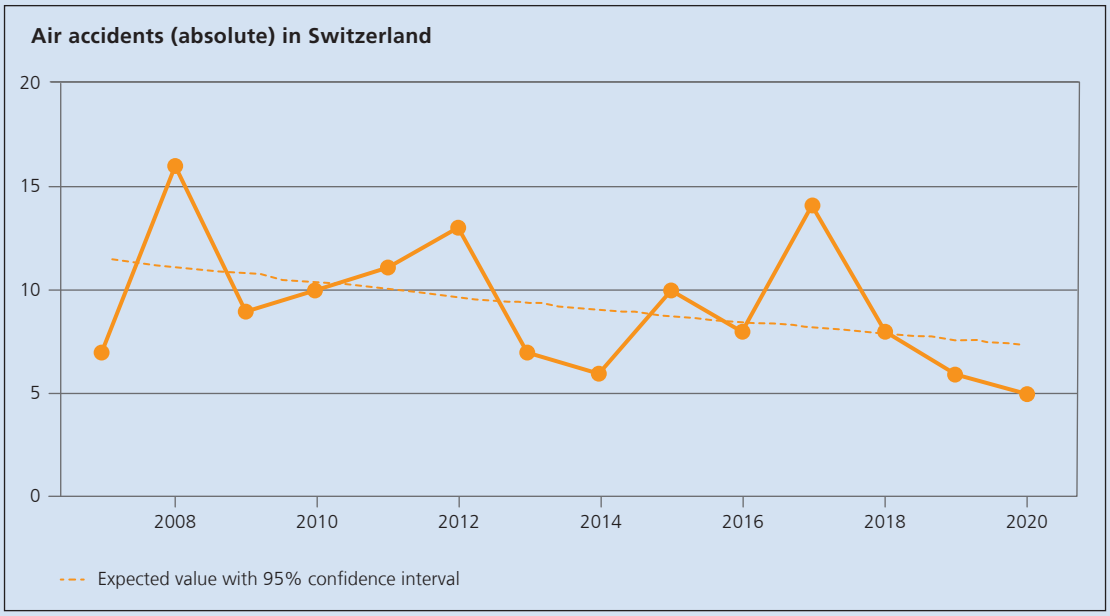
6.1.3 Helicopters

No air accidents were registered in this category in 2020. The number of accidents here has declined steadily from the highest for the time series (five) in 2017 to the lowest, at zero, in 2020. This reduction contradicts the calculated regression in the 2019 Annual Report, in which a slight upward trend was still expected for this category. It illustrates how heavily changes in individual figures affect the calculation of the regression model where the time series consists of only a few values.



6.1.4 Total for motorised aircraft, gliders and helicopters

Five air accidents were recorded in total in all three categories in 2020. Over the time series as a whole, the absolute accident figures range between 5 and 16. The decline in accident figures across all categories over the past four years, and the peaks of 2017 in two out of the three categories, determine the trend in the total number of accidents across the time series.



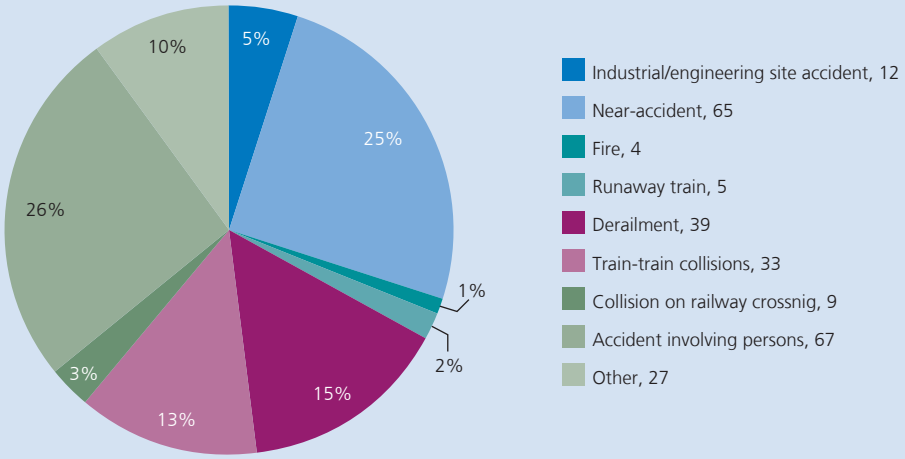
6.2 Railways, cableways, buses, inland and maritime navigation

Distribution of event notifications, investigations opened and reports published

Modes of transport	Notifications		Investigations		Final reports		Summary reports	
	Number	%	Number	%	Number	%	Number	%
Railways	261	81,3%	14	74%	8	80%	7	70%
Trams	23	7,2%	0	0%	0	0%	0	0%
Cableways	20	6,2%	5	26%	2	20%	3	30%
Buses	12	3,7%	0	0%	0	0%	0	0%
Inland navigation	5	1,6%	0	0%	0	0%	0	0%
Maritime navigation	0	0%	0	0%	0	0%	0	0%

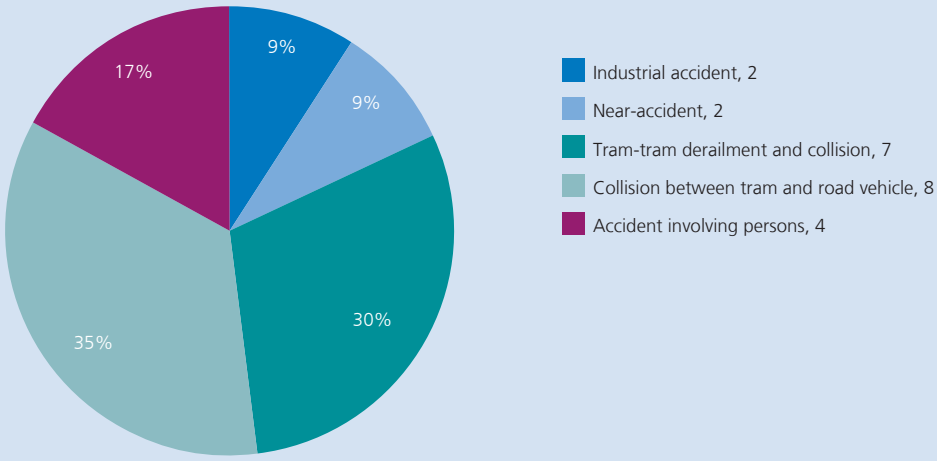
The proportion of notifications relating to railways (incl. trams) was 88%. The remaining 37 – i.e. 12% of notifications – relate to the other modes of transport: cableways and buses, as well as inland and maritime navigation. In the year under review, 14 investigations were opened into railways and 5 into cableways. The majority of reports published (incl. summary reports) relate to railways. The distribution by mode of transport is roughly equivalent to the distribution of event notifications and investigations opened.

Distribution of event types from the event notifications for railways (excluding trams)



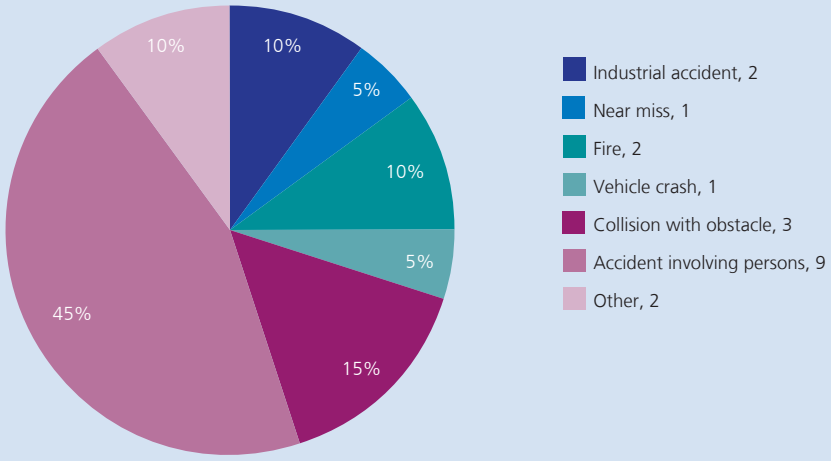
The number of event notifications for railways (excluding trams) requiring clarification was 261. The vast majority were accidents involving persons and near-accidents. Twenty-seven cases subsequently proved to be suicide.

Distribution of event type from the event notifications for trams



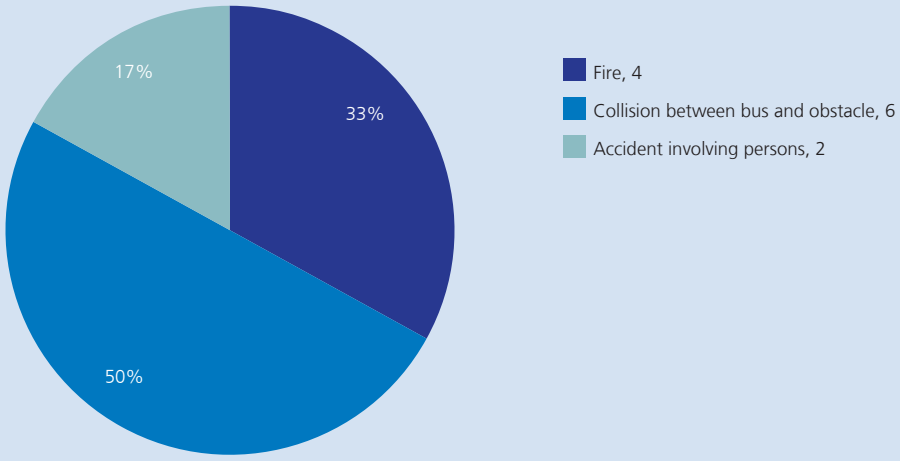
For trams, the majority of the events involved collisions with other road users, whether this was a pedestrian (accident involving persons) or a road vehicle. It should be noted that incidents on public roads that can be attributed to a violation of road traffic regulations are not required to be reported to the STSB.

Distribution of event type from the event notifications for cableways



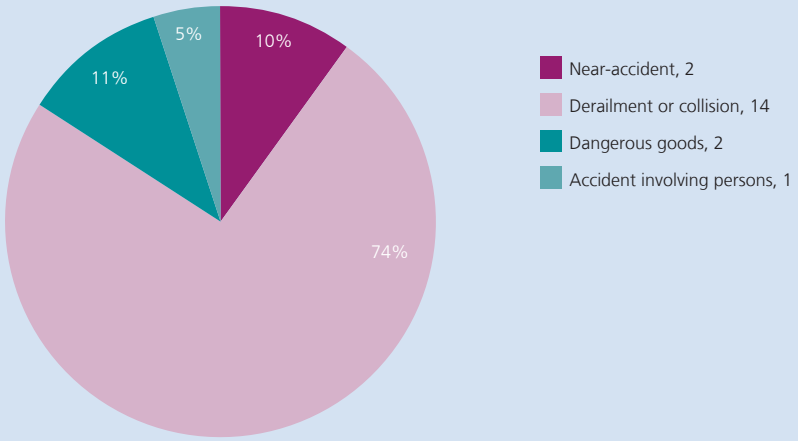
Most of the 20 notifications received for cableways concerned accidents involving persons, in which six individuals were injured. The single reported vehicle crash resulted in one passenger fatality and three passengers being seriously injured.

Distribution of event type from the event notifications for buses



Incidents on public roads that can be attributed to a violation of road traffic regulations are not required to be reported to the STSB and are also not investigated. This year collisions between buses and obstacles accounted for the majority of the events reported across all event types.

Distribution of investigations opened by event type for all modes of transport



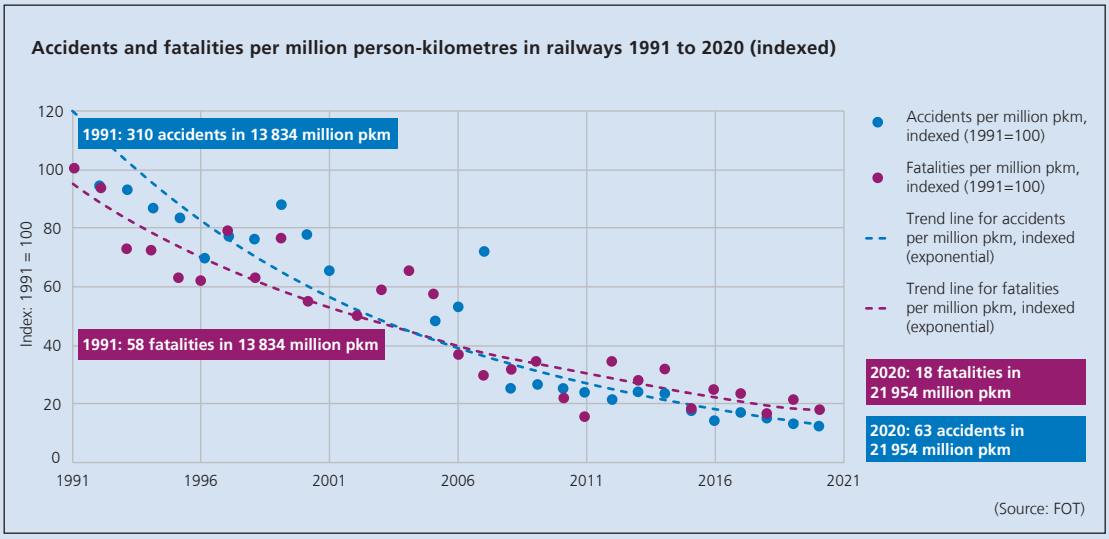
The majority of the investigations opened in 2020 relate to derailments (4) and collisions (10). These were followed by near-accidents (2) in which no damage was registered, as well as two events involving dangerous goods, and one accident involving persons.

Trend in accidents as well as fatally and seriously injured persons in public transport

	Accidents								Fatalities								Seriously injured persons							
Modes of transport	2013	2014	2015	2016	2017	2018	2019	**2020**	2013	2014	2015	2016	2017	2018	2019	**2020**	2013	2014	2015	2016	2017	2018	2019	**2020**
Railways	107	107	83	71	84	73	66	64	23	27	16	22	21	16	20	17	65	68	43	22	41	25	253	23
Trams	54	49	35	36	35	37	71	40	4	6	5	3	2	7	3	3	45	37	28	30	50	29	64	35
Cableways	4	8	9	6	5	6	8	10	1	3	1	0	0	0	1	1	3	5	8	6	5	6	9	10
Buses	39	37	49	42	42	65	74	62	2	4	5	4	7	5	4	5	34	39	44	37	39	62	69	54
Inland navigation	1	3	1	1	1	1	3	1	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0
All modes of transport	**205**	**204**	**177**	**156**	**166**	**182**	**222**	**177**	**30**	**40**	**27**	**29**	**30**	**28**	**28**	**26**	**148**	**149**	**123**	**97**	**135**	**122**	**167**	**122**

The past eight years have seen a downward trend in railway accidents, and in the number of individuals fatally or seriously injured. The number of tram accidents and persons seriously injured in such has settled back down from the 2019 peak to the level of previous years. Bus accidents display a similar trend, although the figures for 2020 are well up on those for the period from 2013 to 2017. The table shown here may contain deviations for some data compared to the table published in the 2019 Annual Report. The reason for this is subsequent corrections based on additional information regarding the incidents (e.g. suicide being determined) received by the FOT after publication of the 2019 Annual Report (Data source: FOT).

Trend in accidents and fatally injured persons on railways



The accident rate (number of accidents per million person kilometres) has dropped by around 80% and the death rate (number of deaths per million person kilometres) by around 70% over the past 29 years. This is the product of a concerted effort across the transport safety framework, including those of the STSB (chart source: FOT).

Annexes

Annex 1: List of the number of notifications, the opened, ongoing and completed investigations and the interim reports and studies published regarding aviation

Annex 2: List of the number of notifications, the opened, ongoing and completed investigations and the interim reports and studies published regarding public transport and maritime navigation

Annex 3: Statistical information on aviation incidents

Annex 4: Aviation data for statistical analysis (chapter 6) and methods and conceptual considerations used

Annex 1

List of the number of notifications, the opened, ongoing and completed investigations and the interim reports and studies published regarding aviation

Notifications, opened, ongoing and completed investigations

Aviation						
Year	Number of notifications	Opened investigations	Completed investigations[2]			Ongoing investigations
			Total:	Extensive:	Summary:	
2020	894	59	40	9	31	164
2019	1566	64	76	14	62	162
2018	1556	119	83	23[3]	53	156
2017	1259	86	93	30	48	111
2016	1219	92	58	28[4]	31	142
2015	1260	86	33	33	n/a	n/a

Annual reports up to 2019 listed the published reports in each case. This 2020 Annual Report lists completed investigations for the first time. This has the effect that investigations completed prior to 2020 but not published in their year of completion are also listed in the tables given below.

Extensive investigations completed

Number	Registration	Date of incident	Location	Safety recommendation	Safety advice
2366	HB-EZW	04.08.2018	Schattenberg – 1km south-west of Hergiswil		
2370	HB-HOT	04.08.2018	Piz Segnas, Flims	548, 561-567	25, 32-37
2355	HB-JCC	15.07.2018	Porto, Portugal	552	26
2326*	HB-KPC	02.02.2017	Orbe		
2348	HB-XEO	30.08.2016	Le Trétien		
2364	HB-ZGV	27.07.2016	Chauderon gorge, commune of Montreux	556	
2356	HB-1638 / HB-KAW	26.06.2016	Sion Airport		31
2328	HB-2139	21.05.2016	Montricher		
2359	9H-AMZ	06.04.2016	Geneva Airport (LSGG)	558, 559, 560	
2332*	HB-XLS	22.01.2016	Buttwil airfield (LSZU)		
2357*	HB-YEA	20.09.2015	Muhen		
2354	EI-DEF / N990FV	24.07.2015	Geneva Airport (LSGG)	549, 550, 551	
2279*	HB-ZRY	28.06.2015	Alp Oberkäseren, Amden		
2345*	N246PR	30.01.2015	Bernex		

* These investigations were completed prior to 2020.

[2] Figures prior to 2020 show the number of reports published, not the number of investigations completed.
[3] Icludes an interim report
[4] Icludes an interim report

Summary investigations completed

Registration	Date of incident	Location	Brief description of incident
TC-AOM*	17.08.2015	Geneva Airport (LSGG)	Fire alarm
HB-DFK	11.06.2020	Grenchen airfield (LSZG)	Propeller and nose gear damaged upon landing
HB-ZML	02.06.2020	1km north of Pfäffikon (SZ), 200m from shore	Helicopter lost load over Lake Zurich
HB-2515	21.05.2020	Speck-Fehraltorf airfield (LSZK)	Take-off accident in long grass
HB-KPA	20.04.2020	Biel-Kappelen airfield (LSZP)	Wing touched ground; sideways overrun of left runway markings
HB-KBP / HB-YLC	19.03.2020	Langenthal airfield (LSPL)	Airprox
HB-OKP / HB-KDV	14.09.2019	Schimberig	Airprox
HB-YLX	25.08.2019	2km east of Bauma	Emergency landing following engine failure
HB-ZQM	01.08.2019	Walzenhausen	Collision with telephone line
N5723H	30.07.2019	Solothurn region	Engine failure/emergency
HB-XZN*	01.07.2019	500m south-west of Kaltbach	Collision with obstacle
HB-CQM	30.06.2019	Hausen am Albis (LSZN)	Runway overrun
N90FS	29.06.2019	Raron airfield (LSTA)	Collision with obstacle
HB-ZHN*	29.06.2019	Close to Wangen-Lachen airfield (LSPV)	Precautionary helicopter landing
HB-PSG	19.06.2019	Biel-Kappelen (LSZP)	Sideways overrun of runway markings
D-CBEN / HB-ZWN	12.03.2019	Approx. 6km west of St Gallen-Altenrhein Airport	Airprox
HB-ONA	06.03.2019	Kägiswil airfield (LSPG)	Collision with obstacle on ground
HB-KCE*	23.02.2019	Bad Ragaz airfield (LSZE)	Loss of control while taxiing after landing
HB-PRS*	01.12.2018	Ecuvillens aerodrome (LSGE)	Sideways runway excursion
HB-ZHG / HB-KLE	08.11.2018	1km east of La Sarraz	Airprox
HB-IOC*	02.10.2018	Geneva Airport (LSGG)	Flight aborted owing to rubber smell in cockpit
HB-IPT	29.09.2018	Zurich Airport (LSZH), ILS14	Near miss with drone
SP-YGI	28.09.2018	Grenchen airfield (LSZG)	Runway overrun
N474CG*	22.09.2018	Zurich Airport (LSZH)	Fire in pressurised cabin compressor
HB-CCA / HB-PEW*	11.09.2018	Jungfraujoch	Airprox
N8SQ*	03.09.2018	Le Chenit, Vallée de Joux	Emergency landing
N4927*	26.08.2018	Maloja Pass	Loss of undercarriage housing during flight
HB-KOU / HB-ZMI*	19.08.2018	Samedan airfield (LSZS)	Airprox
HB-2314	18.07.2018	Locarno Airport (LSZL)	Propeller touched ground on landing

Registration	Date of incident	Location	Brief description of incident
N45WF*	27.06.2018	Geneva Airport (LSGG)	Nose gear collapsed on landing
T-729*	15.06.2018	Knonau	Airprox
HB-KFD	10.06.2018	Châtillens	Emergency landing
9H-CIO	02.06.2018	Bern	Near miss with drone
HB-ZJW	25.05.2018	Staldenhorn mountain landing site	Loss of power on ground
HB-2471	22.05.2018	Fricktal Schupfart airfield (LSZI)	Runway overrun
HB-FPC	29.04.2018	Zurich Airport (LSZH)	Emergency landing
HB-ZIR	24.03.2018	Col du Grand-St-Bernard	Collision with the terrain
HB-WAW	24.03.2018	Beromünster	Landing short of runway
HB-ZAN / J-5015 / J-5018	20.02.2018	Island of Ufenau/Lake Zurich	Airprox
G-EUUW	30.12.2017	Geneva Airport (LSGG)	Auto flight system malfunction
F-PREU	13.05.2017	Bex	Accident
HB-IXP*	10.10.2016	Geneva Airport (LSGG)	Oil vapour in cockpit
G-EZUP*	07.08.2016	Approx. 20NM east of the Orléans-Bricy (BCY) beacon, French territory	Diverted landing owing to technical problems
HB-CZN / G-OOUK	22.07.2016	Lausanne La Blécherette Airport (LSGL)	Airprox
G-EZIT*	22.01.2016	Zurich Airport (LSZH)	Failure of redundant flight guidance systems
HB-JMC	01.11.2015	Reims Control	Loss of a flight crew member
HB-PQI	10.08.2015	Lupfig	Emergency landing

* These investigations were completed prior to 2020.

Status reports published as part of ongoing investigations

Number	Registration	Date of incident	Location	Safety recommendation	Safety advice
Status report	HB-HOT	04.08.2018	Piz Segnas, Flims		

Annex 2

List of the number of notifications, the opened, ongoing and completed investigations and the interim reports and studies published regarding public transport and maritime navigation

Notifications, opened, ongoing and completed investigation

Public transport and maritime navigation						
Year	Number of notifications	Opened investigations	Completed investigations[5]			Ongoing investigations
			Total:	Extensive:	Summary:	
2020	321	19	21	10	11	32
2019	283	15	15	8	7	35
2018	304	14	32	14[6]	17	33
2017	376	25	38	27	12	50
2016	332	64	39	14[7]	26	79
2015	296	87	31	20[8]	13	n/a

Extensive investigations completed

Number	Mode of transport	Type of accident	Date	Location	Safety recommendation	Safety advice
2016021102	Cableway	Chair crash	11.02.2016	Flumserberg	155, 156	24
2019020501	Railway	Collision between train and obstacle	05.02.2019	Airolo		
2019051401	Railway	Near miss / hazardous situation	14.05.2019	Thalwil	152, (145)**	23
2019052502	Railway	Derailment of service train	25.05.2019	Busswil		
2019062201	Railway	Accident involving persons	22.06.2019	Exergillod	149, 150, 151	
2019071101	Railway	Collision between train and shunting movement	11.07.2019	Zurich Herdern		
2019080401	Railway	Industrial accident	04.08.2019	Baden	(141, 142)**	22
2019100901	Railway	Industrial accident	09.10.2019	Domdidier		
2019111502	Railway	Irregularity posing no immediate hazard	15.11.2019	Cully	157	25
2020012005	Cableway	Irregularity posing hazard	20.01.2020	Crans-Montana	(147, 148)**	

** The figures in brackets mean that the respective safety recommendation had already been published along with the interim report for the case in question or another final report.

5 Figures prior to 2020 show the number of reports published, not the number of investigations completed.
6 Includes an interim report
7 Includes an interim report
8 Includes two interim reports

Summary investigations completed

Number	Mode of transport	Type of accident	Date	Location	Safety recommendation	Safety advice
2015122901	Railway	Derailment	29.12.2015	Lauterbrunnen, Witimatte		
2017042803	Railway	Collision between two shunting movements	28.04.2017	Ittigen		
2017091901	Railway	Runaway train	19.09.2017	Alp Grüm		
2017120901	Railway	Derailment of a shunting movement	09.12.2017	Arnegg		
2019083101	Railway	Irregularity posing no immediate hazard	31.08.2019	Weissenbach		
2019092302	Railway	Collision between shunting movement and obstacle	23.09.2019	Reuchen-ette-Péry		
2019102001	Cableway	Vehicle crash	20.10.2019	Rickenbach		
2020013101	Cableway	Collision between cabin and obstacle	31.01.2020	Oberterzen		
2020022601	Cableway	Collision between cableway cabin and pylon	26.02.2020	Andermatt-Gurschen		
2020041402	Railway	Irregularity posing no immediate hazard	14.04.2020	Oberglatt		
2020081801	Railway	Collision between two trains	18.08.2020	Lenzburg		

Interim reports published as part of ongoing investigations

Number	Mode of transport	Type of accident	Date	Location	Safety recommendation	Safety advice
2020012005	Cableway	Irregularity posing hazard	20.01.2020	Crans-Montana	147, 148	
2020030101	Railway	Accident involving persons	01.03.2020	Bern	153, 154	

Annex 3

Statistical information on aviation incidents

Contents

1. Preliminary remarks

The following annual statistics contain all accidents and serious incidents investigated involving civil-registered Swiss aircraft in Switzerland and abroad, and involving foreign-registered aircraft in Switzerland.

Accidents involving parachuters, hang gliders, kites, paragliders, tethered balloons, unmanned balloons and model aircraft are not subject to investigation.

2. Definitions

Some significant terms used in air accident investigation are explained below:

Accident

An event associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down, in which

a) a person is fatally or seriously injured as a result of
   - being in the aircraft, or
   - direct contact with any part of the aircraft, including parts which have become de tached from the aircraft, or
   - direct exposure to the aircraft's jet blast,

   except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or

b) the aircraft has sustained damage or structural failure which adversely affects the structural strength, performance or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component, except for engine failure or damage when the damage is limited to a single engine (including its cowlings or accessories), to propellers, wingtips, antennas, probes, vanes, tyres, brakes, wheels, fairings, panels, landing gear doors, windscreens, the aircraft skin (such as small dents or puncture holes), or minor damage to the main rotor blades, tail rotor blades, landing gear, and those resulting from hail or bird strike (including holes in the radome); or

c) the aircraft is missing or is completely inaccessible.

Serious injury

An injury which is sustained by a person in an accident and which involves one of the following:

a) Hospitalisation for more than 48 hours, commencing within seven days from the date the injury was received;
b) A fracture of any bone (except simple fractures of fingers, toes, or nose);
c) Lacerations which cause severe haemorrhage, nerve, muscle or tendon damage;
d) Injury to any internal organ;
e) Second or third-degree burns or any burns affecting more than 5% of the body surface;
f) Verified exposure to infectious substances or harmful radiation.

Fatal injury

An injury which is sustained by a person in an accident and which results in his or her death within 30 days of the date of the accident.

Large aircraft
An aircraft which has a maximum take-off mass (MTOM) of at least 5,700kg is classified in the 'Transport' sub-category of the 'Standard' airworthiness category or has more than ten seats for passengers and crew.

Country of registration
The country where the aircraft is registered with the national aviation authority.

Country of manufacture
The country or countries that have certified the airworthiness of the prototype (type).

Country of the operator
The country in which the operator's principal place of business or permanent residence is located.

3. Tables and diagrams

3.1 Aircraft accidents and serious incidents involving Swiss-registered aircraft, number of aircraft and fatalities

Year	Number of registered aircraft[9]	Flight hours[10]	Flight personnel licences[11]	Number of accidents investigated	Number of accidents with summary procedure	Total number of accidents	Number of serious accidents		Total number of accidents and serious incidents	Number of fatalities
							incl. airproxes	airproxes investigated[12]		
2006	3822	715572	15368	27	31	58	10	7	68	10
2007	3813	766557	15076	23	20	43	4	6	47	12
2008	3765	784548	14691	28	19	47	5	6	52	11
2009	3685	842017	14973	26	17	43	4	3	47	5
2010	3705	793592	15313	21	16	37	8	4	45	8
2011	3709	873548	12855[13]	21	24	46	13	8	59	13
2012	3657	875708	12840	22	20	42	23	10	65	22
2013	3620	933752	11871	28	16	44	20	11	64	15
2014	3556	919987	11563	18	28	46	13	5	59	8
2015	3494	865404	11536	29	24	53	22	4	75	12
2016	3414	849373	12264	21	16	37	46	16	83	5
2017	3333	850525	12101	25	22	47	32	8	79	18
2018	3284	872408	12027	16	15	31	68	28	99	36
2019	3211	903030	12131	16	7	23	38	13	61	5
2020	**3181**	**551949**	**12033**	**14**	**15**	**29**	**34**	**9**	**63**	**10**

[9] Source: Federal Office of Civil Aviation
[10] Source: Federal Office of Civil Aviation
[11] Source: Federal Office of Civil Aviation
[12] Incl. airproxes involving foreign-registered aircraft
[13] Owing to the revision of the Civil Aviation Act, provisional licences ceased to be issued effective 1 April 2011

3.1.1 Air accidents and serious incidents involving Swiss-registered aircraft exceeding 5,700kg MTOM

Year	Number of registered aircraft[14]	Flight hours[15]	Number of accidents investigated	Number of accidents with summary procedure	Total number of accidents	Number of serious accidents		Total number of accidents and serious incidents	Number of fatalities
						incl. airproxes	airproxes investigated[16]		
2006	248	434 050	1	0	1	8	7	9	0
2007	260	393 368	3	0	3	0	5	3	1
2008	285	385 686	1	0	1	3	5	4	0
2009	293	394 055	0	0	0	4	3	4	0
2010	303	419 323	0	0	0	6	3	6	0
2011	299	458 225	0	0	0	9	8	9	0
2012	294	475 786	0	0	0	11	7	11	0
2013	290	540 826	1	0	1	11	8	12	0
2014	284	483 673	1	0	1	7	3	8	0
2015	284	466 086	1	0	1	11	1	12	0
2016	279	471 650	0	0	0	17	9	17	0
2017	254	482 135	0	0	0	6	2	6	0
2018	262	499 170	1	0	1	17	10	18	20
2019	260	537 046	0	0	0	8	3	8	0
2020	**264**	**191 154**	**0**	**0**	**0**	**2**	**1**	**2**	**0**

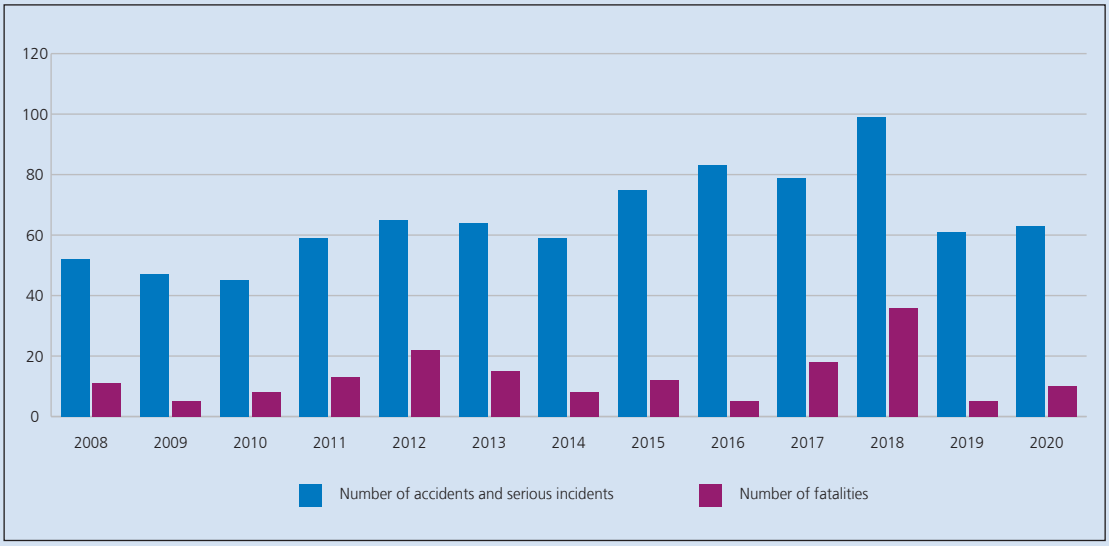
[14] Source: Federal Office of Civil Aviation
[15] Source: Federal Office of Civil Aviation
[16] Incl. airproxes involving foreign-registered aircraft

3.1.2 Air accidents and serious incidents involving Swiss-registered aircraft up to 5,700kg MTOM

Year	Number of registered aircraft[17]	Flight hours[18]	Number of accidents investigated	Number of accidents with summary proce-	Total number of accidents	Number of serious		Total number of accidents and serious incidents	Number of fatalities
						incl. airproxes	airproxes investigated[19]		
2006	3574	281522	26	31	57	2	0	59	10
2007	3553	373189	20	20	40	4	1	44	11
2008	3480	398862	27	19	46	2	1	48	11
2009	3392	447962	26	17	43	0	0	43	5
2010	3402	374269	21	16	37	2	1	39	8
2011	3410	415323	22	24	46	3	0	49	13
2012	3363	399922	22	20	42	12	3	54	22
2013	3330	392926	27	16	43	9	3	52	15
2014	3272	436314	17	28	45	6	2	51	8
2015	3210	399318	28	24	52	11	3	63	12
2016	3135	377723	21	16	37	29	7	66	5
2017	3079	368390	25	22	47	26	6	73	18
2018	3022	374743	15	15	30	51	18	81	16
2019	2951	367537	16	7	23	30	10	53	5
2020	**2917**	**362279**	**14**	**15**	**29**	**32**	**8**	**61**	**10**

[17] Source: Federal Office of Civil Aviation
[18] Source: Federal Office of Civil Aviation
[19] Incl. airproxes involving foreign-registered aircraft

3.1.3 Diagram showing air accidents and serious incidents involving Swiss-registered aircraft and fatalities



3.2 Summary of accident data for the reporting period 2019 / 2020

3.2.1 Accidents and serious incidents with and without injuries to persons involving Swiss-registered aircraft in Switzerland and abroad, and foreign-registered aircraft in Switzerland

	Accidents and serious incidents involving Swiss-registered aircraft						Accidents and serious incidents involving Swiss-registered aircraft						Accidents and serious incidents involving foreign-registered aircraft					
	in Switzerland						abroad						in Switzerland					
	Total		of which injuries to persons		of which no injuries to persons		Total		of which injuries to persons		of which no injuries to persons		Total		of which injuries to persons		of which no injuries to persons	
	2020	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019
Total	**58**	47	**5**	5	**53**	42	**5**	14	**3**	1	**2**	13	**2**	15	**0**	3	**0**	12
Aircraft with MTOM of up to 2 250kg	**32**	28	**3**	3	**29**	25	**3**	4	**1**	0	**2**	4	**0**	8	**0**	2	**0**	6
Aircraft with MTOM of 2 251-5 700kg	**5**	3	**0**	0	**5**	3	**1**	0	**1**	0	**0**	0	**0**	3	**0**	0	**0**	3
Aircraft with MTOM exceeding 5 700kg	**2**	2	**0**	0	**2**	2	**0**	6	**0**	0	**0**	6	**1**	2	**0**	0	**1**	2
Helicopters	**8**	12	**0**	2	**8**	10	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Motor gliders and gliders	**10**	2	**2**	0	**8**	2	**1**	3	**1**	1	**0**	2	**1**	2	**0**	1	**1**	1
Balloons and airships	**1**	0	**0**	0	**1**	0	**0**	1	**0**	0	**0**	1	**0**	0	**0**	0	**0**	0
Ultralight aircraft	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0

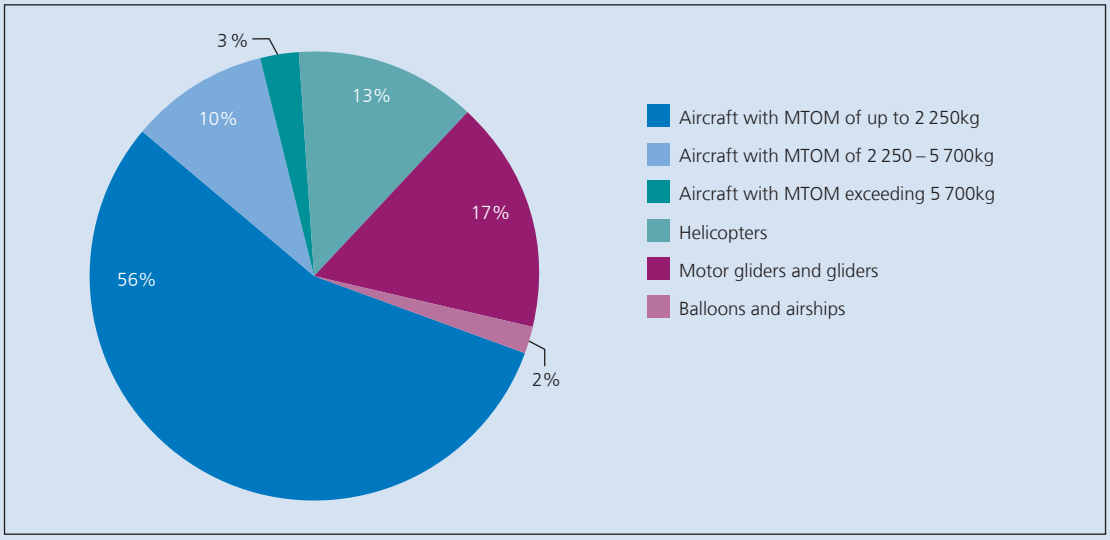
3.2.2 Number of registered aircraft and air accidents / serious incidents involving Swiss-registered aircraft

	Number of aircraft (01/01/2021)[20]		Total number of accidents and serious incidents	
	2020	2019	**2020**	2019
Aircraft with MTOM of up to 2 250kg	**1309**	1324	**35**	32
Aircraft with MTOM of 2 250–5 700kg	**150**	146	**6**	3
Aircraft with MTOM exceeding 5 700kg	**264**	260	**2**	8
Helicopters	**345**	345	**8**	12
Motor gliders and gliders	**794**	820	**11**	5
Balloons and airships	**319**	316	**1**	1
Ultralight aircraft[21]	**0**	0	**0**	0
Total	**3181**	3211	**63**	61

[20] Source: Federal Office of Civil Aviation
[21] The number of ultralight aircraft is not collated separately.

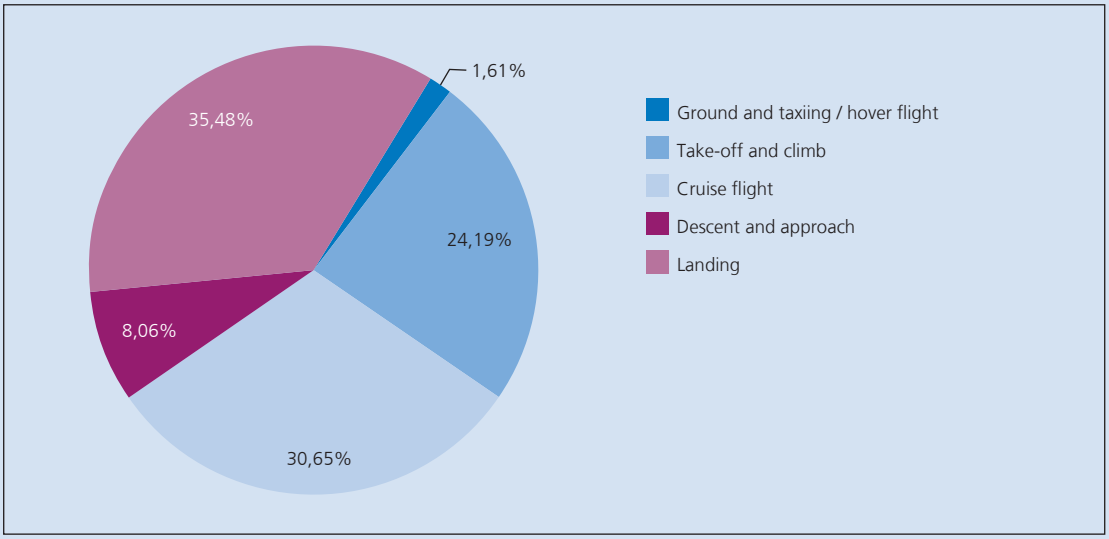
3.2.3 Accidents and serious incidents by type of aircraft involving Swiss-registered aircraft

	2020	2019
Aircraft with MTOM of up to 2 250kg	**56%**	52%
Aircraft with MTOM of 2 250 – 5 700kg	**10%**	5%
Aircraft with MTOM exceeding 5 700kg	**3%**	13%
Helicopters	**13%**	20%
Motor gliders and gliders	**17%**	8%
Balloons and airships	**2%**	2%



3.2.4 Flight phase (accidents and serious incidents involving Swiss-registered aircraft in Switzerland and abroad, and foreign-registered aircraft in Switzerland)

	Ground and taxiing / hover flight		Take-off and climb		Cruise flight		Descent and approach		Landing		Total	
	2020	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019
Aircraft with MTOM of up to 2 250kg	**1**	3	**10**	10	**9**	13	**1**	4	**14**	10	**35**	40
Aircraft with MTOM of 2 250-5 700kg	**0**	2	**0**	1	**1**	1	**2**	2	**2**	0	**5**	6
Aircraft with MTOM exceeding 5 700kg	**0**	0	**1**	1	**2**	6	**0**	2	**0**	1	**3**	10
Helicopters	**0**	0	**1**	1	**3**	3	**1**	4	**2**	4	**7**	12
Motor gliders and gliders	**0**	0	**3**	3	**4**	3	**0**	0	**5**	1	**12**	7
Balloons and airships	**0**	0	**0**	0	**0**	0	**1**	0	**0**	1	**1**	1
Ultralight aircraft	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Total	**1**	5	**15**	16	**19**	26	**5**	12	**23**	17	**63**	76



3.2.5 Injured persons by role in accidents and serious incidents involving Swiss-registered aircraft in Switzerland and abroad, and foreign-registered aircraft in Switzerland

	Accidents and serious incidents involving Swiss-registered aircraft abroad in Switzerland															
	Total		**Aircraft with MTOM of up to 2250kg**		**Aircraft with MTOM of 2250 – 5700kg**		**Aircraft with MTOM exceeding 5700kg**		**Helicop-ters**		**Motor gliders and gliders**		**Balloons and airships**		**Ultralight aircraft**	
	2020	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019
Accidents / serious incidents	**58**	47	**32**	28	**5**	3	**2**	2	**8**	12	**10**	2	**1**	0	**0**	0
Fatalities	**8**	5	**7**	4	**0**	0	**0**	0	**0**	1	**1**	0	**0**	0	**0**	0
Crew	**4**	4	**3**	3	**0**	0	**0**	0	**0**	1	**1**	0	**0**	0	**0**	0
Passengers	**4**	1	**4**	1	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Third parties	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Seriously injured persons	**1**	4	**0**	2	**0**	0	**0**	0	**0**	2	**1**	0	**0**	0	**0**	0
Crew	**1**	1	**0**	1	**0**	0	**0**	0	**0**	0	**1**	0	**0**	0	**0**	0
Passengers	**0**	2	**0**	1	**0**	0	**0**	0	**0**	1	**0**	0	**0**	0	**0**	0
Third parties	**0**	1	**0**	0	**0**	0	**0**	0	**0**	1	**0**	0	**0**	0	**0**	0

	Accidents and serious incidents involving Swiss-registered aircraft abroad															
	Total		Aircraft with MTOM of up to 2250kg		Aircraft with MTOM of 2250 –5700kg		Aircraft with MTOM exceeding 5700kg		Heli-copters		Motor glidersand gliders		Balloons and airships		Ultralight aircraft	
	2020	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019
Accidents / serious incidents	**5**	14	**3**	4	**1**	0	**0**	6	**0**	0	**1**	3	**0**	1	**0**	0
Fatalities	**2**	0	**1**	0	**0**	0	**0**	0	**0**	0	**1**	0	**0**	0	**0**	0
Crew	**1**	0	**0**	0	**0**	0	**0**	0	**0**	0	**1**	0	**0**	0	**0**	0
Passengers	**1**	0	**1**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Third parties	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Seriously injured persons	**4**	1	**2**	0	**2**	0	**0**	0	**0**	0	**0**	1	**0**	0	**0**	0
Crew	**2**	1	**1**	0	**1**	0	**0**	0	**0**	0	**0**	1	**0**	0	**0**	0
Passengers	**2**	0	**1**	0	**1**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Third parties	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0

	Accidents and serious incidents involving foreign-registered aircraft in Switzerland															
	Total		**Aircraft with MTOM of up to 2250kg**		**Aircraft with MTOM of 2250 – 5700kg**		**Aircraft with MTOM exceeding 5700kg**		**Heli-copters**		**Motor glidersand gliders**		**Balloons and airships**		**Ultralight aircraft**	
	2020	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019
Accidents / serious incidents	**2**	15	**0**	8	**0**	3	**1**	2	**0**	0	**1**	2	**0**	0	**0**	0
Fatalities	**0**	6	**0**	4	**0**	0	**0**	0	**0**	0	**0**	2	**0**	0	**0**	0
Crew	**0**	4	**0**	2	**0**	0	**0**	0	**0**	0	**0**	2	**0**	0	**0**	0
Passengers	**0**	2	**0**	2	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Third parties	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Seriously injured persons	**0**	1	**0**	1	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Crew	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Passengers	**0**	1	**0**	1	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Third parties	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0

Annex 4

Aviation data for statistical analysis (chapter 6) and methods and conceptual considerations used

Measures and their component parts

Accident

For an aviation event to be classified as an accident for the purpose of these statistics, the STSB must be aware of the event. As soon the STSB is aware of the event, the event is reviewed to see if it meets the criteria for an accident, according to article 2 of (EU) Regulation No 996/2010[22]. In this analysis, once again only those events classified as an accident are included where at least one person is seriously or fatally injured and where the event was not caused deliberately. The definitions of serious and fatal injuries can also be found in Article 2 of (EU) Regulation No 996/2010.

The reason for only including serious or fatal injuries in the accident statistics is due to the fact that the number of unreported accidents without serious or fatally injured persons is assessed as 'not insignificant'. If all accidents – or perhaps even the serious incidents – were to be included in the statistics, the figures being looked at would be higher and it would be easier to make statistical statements. However, these statements would more likely describe the reporting system and reporting culture, rather than safety.

Aircraft category

The following three aircraft categories have been analysed:

- Aeroplanes with a maximum take-off mass of up to 5,700kg (including motor gliders and touring motor gliders in powered flight);
- Gliders (including motor gliders and touring motor gliders when gliding);
- Helicopters.

Furthermore, analysis has been carried out where the accidents involving the three aircraft categories were examined jointly and were not separated into the three categories ('total').

For motorised aircraft with a maximum take-off mass exceeding 5,700kg (in particular for commercial aircraft) as well as for airships and balloons, no statistics are produced due to the sample sizes being too small.

Statistical method

The number of accidents U_t in the year t = 2007,…,2020 is a discrete random parameter range. In this case, the standard model is given by the Poisson distribution function.

$$U_t \sim Poisson(\lambda_t).$$

Here, parameter λ_t is the anticipated number of accidents in the year t, i.e. $E[U_t] = \lambda_t$. The number of accidents over time is modelled with a Poisson regression, i.e.

$$\log(\lambda_t) = \beta_0 + \beta_1 \cdot t.$$

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

The temporal development of the anticipated number of accidents can be read from the β_1 parameter. In practice, the number of accidents changes from one year to the next by coefficient $\exp(\beta_1)$. If β_1 is negative, the anticipated number of accidents decreases over time, otherwise, it increases. The β_0, β_1 coefficients are estimated using the maximum likelihood method within the generalised linear model framework. For all adapted models, the null hypothesis $\beta_1 = 0$ is tested in each case. This corresponds to the statement 'no change in the anticipated number of accidents' over time. The test result is given by the p-value. This parameter in the interval [0,1] states how compatible the observed data are with the claim of the null hypothesis (the bigger, the more compatible). The commonly used thresh-old, which is also used here, is 0.05. Which means: If the p-value is less than 0.05, the change in the number of accidents is called 'significant'. If the p-value is equal to or greater than 0.05, then the change is called 'not significant'.

Number of accidents in all categories:

Year	Motorised aircraft with a MTOM of up to 5 700kg	Gliders	Helicopters	Total, all categories
2007	3	2	2	7
2008	6	8	2	16
2009	2	3	4	9
2010	4	2	4	10
2011	4	4	3	11
2012	3	6	4	13
2013	1	2	4	7
2014	4	0	2	6
2015	7	1	2	10
2016	1	4	3	8
2017	7	2	5	14
2018	5	1	2	8
2019	4	1	1	6
2020	3	2	0	5



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