APPENDIX 2
ADVANCED STATISTICS FOR AEROPLANES

Appendix 2
Advanced statistics for aeroplanes

Table of content 1

This appendix covers the advanced statistics for aeroplanes involved in:

- Commercial air transport (CAT) and non-commercial operations with complex aeroplanes (NCC) (chapter 1),
- Commercial air transport (CAT) operations with other than complex aeroplanes (chapter 2),
- Specialised operations (SPO) (chapter 3) and
- Non-commercial operations with other than complex aeroplanes (NCO) (chapter 4).

The first section of each chapter outlines the safety risks, that have been derived from occurrence data from the European Central Repository (ECR). They provide per type of operation the relative safety risk level and frequency of each key risk area (KRA). The KRA is the most likely type of accident that would have resulted if an occurrence had escalated into an accident. It is one element of the European Risk Classification Scheme (ERCS). In terms of safety performance, they are the Tier 2 safety performance indicators for the domain. The KRAs are prioritised based on their aggregated risk contribution using the ERCS, as applied by the competent authorities from 2023 onwards in accordance with the Commission Implementing Regulation (EU) 2021/2082 published in November 2021. The timespan of the 2024 edition is, therefore, limited to one year (i.e., 2023, the first year of ERCS implementation) and will be expanded on a yearly basis until a five-year timespan is achieved. The frequency of occurrences and the related aggregated ERCS numerical equivalent scores are determined per KRA, considering accidents, serious incidents, and incidents, where the KRA and the ERCS safety risk score have been completed by the competent authority. An ERCS completion rate per domain and operation type as necessary, complements therefore the presented data for the contextualisation.

The other two sections provide then an overview of the human factors (HF) and human performance (HP) issues, as well as an overview of the airworthiness issues for the different types of operations.

The term HF describes human characteristics, abilities and limitations. The knowledge of HF is used throughout the aviation industry to design systems, equipment and work in ways that support humans in performing at their best. HP refers to how people perform their tasks. Following safety occurrences, HF and HP knowledge can also be used diagnostically to better understand what went wrong, what went right and, more importantly, to understand how to prevent such occurrences from happening again. The same European Co-ordination Centre for Accident and Incident Reporting Systems (ECCAIRS) taxonomy that helps us to identify our safety issues and KRAs also provides us with HF and HP codes. This taxonomy groups event types at different levels, so that all the issues relating to personnel are grouped at the highest level into 'personnel'. The personnel issues are then further subdivided into four categories: experience and knowledge events, physiological events, situational awareness and sensory events and personnel task performance events. A further two levels of subdivision exist, providing increasing granularity on the type of HF or HP issues identified. The presented data consider all occurrences of a domain, i.e., accidents, serious incidents and incidents.

The term 'airworthiness' includes aircraft design, aircraft production and aircraft maintenance. The attribute 'event type' in the ECCAIRS taxonomy allows regulators and industry to code the causes and contributing factors to occurrences. The first level of airworthiness analysis shows the contribution of the aircraft system loss and malfunction to accidents and serious incidents, including the distribution of the main Air Transport Association (ATA) chapters and aircraft general/generic events. The second level of analysis goes a step further, showing the contribution of design, production and maintenance to aircraft system loss and malfunction, i.e., highlighting the systemic root cause of a system or equipment failure. The presented data consider all occurrences of a domain, i.e., accidents, serious incidents and incidents.

1 Advanced statistics for commercial air transport (CAT) complex aeroplanes and non-commercial complex (NCC) aeroplanes

This section provides the safety risks, an overview of the HF/HP issues, as well as an overview of the airworthiness issues, for CAT complex aeroplanes and NCC aeroplanes.

Safety risks

CAT operations with complex aeroplanes and NCC aeroplanes operations are combined into one data risk picture due to the similarity of the safety risks for these operation types, as well as the small amount of data available for NCC.

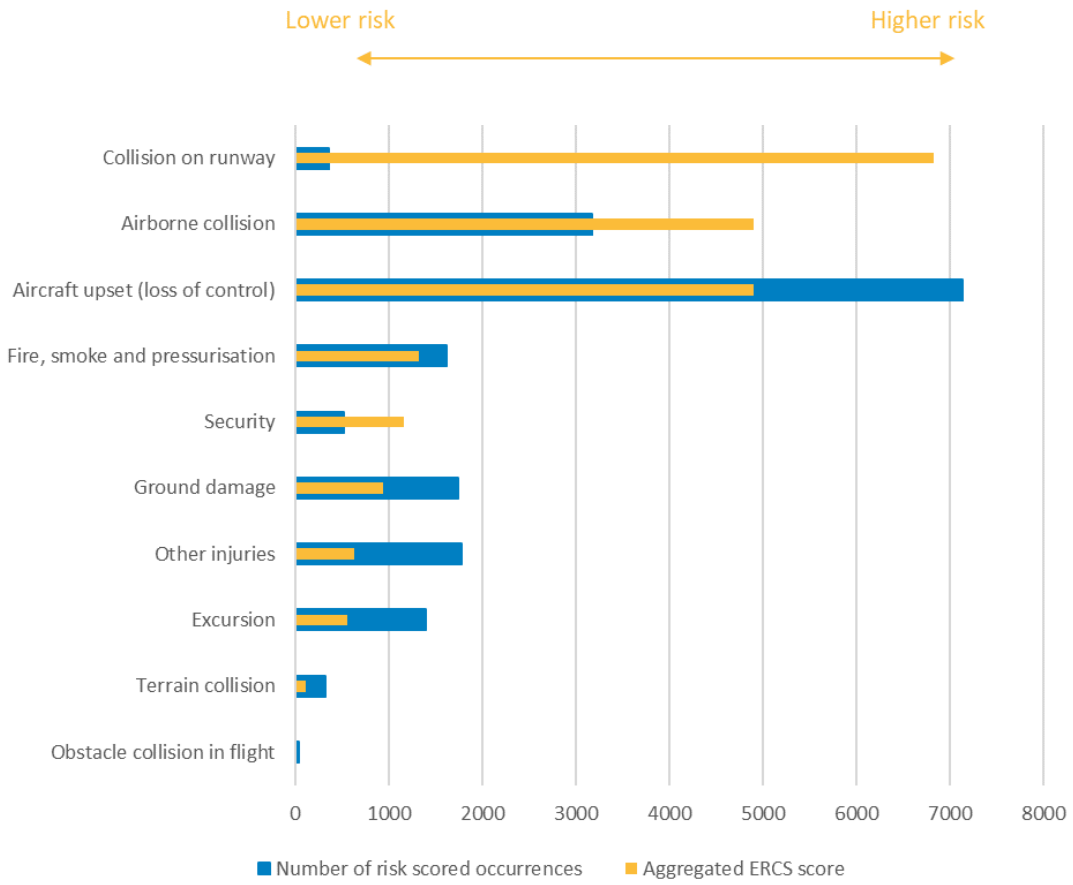
The safety risks identified hereafter are derived from occurrences data recorded in the ECR, covering the one-year period of 2023. From more than 58 000 occurrences in 2023, only 18 300 occurrences were completed with the KRA and ERCS safety risk score, representing an ERCS completion rate of 32% for the domain. The hereafter information is solely based on this restricted dataset.

The relative comparison between KRAs for this domain is highlighted in **Appendix 2 Figure 1**. KRAs and occurrence categories (refer to core document Figures 2.4 and 2.16) have different purposes. While occurrence categories describe actual factors and outcomes of an occurrence, KRAs describe the potential outcome of an occurrence. The KRA is defined by the most likely type of accident that an occurrence could have escalated to. Unlike occurrence categories, where multiple categories may be assigned to a single occurrence, there can only be one KRA per occurrence. The KRA is one element of the ERCS. This scheme is applied when determining the safety risk score of an occurrence and is further detailed in the ASR introduction.

As all occurrences that have been ERCS scored are used for this year's risk picture by KRA, it has changed, when compared to the previous year, where the dataset was limited to accidents and serious incidents of the last five years. However, this change is not significant for the higher aggregated ERCS scored KRAs and mainly is noticeable as a change in sequence, namely collision on runway KRA has changed position with airborne collision.

As illustrated in **Appendix 2 Figure 1**, the higher-risk KRAs are:

- **Collision on runway** includes occurrences involving collisions or near-collisions between an aircraft and another object (other aircraft, vehicles, etc.) or person that occurs on a runway of an aerodrome or other predesignated landing area. It does not include collisions with birds or wildlife. In 2023 the highest risk contributors were occurrences involving runway incursion by an aircraft, inappropriate clearance, separation provision related. *This KRA is mainly managed through safety issues identified in the ATM/ANS and the Aerodromes and Ground handling safety risk portfolios.*
- **Airborne collision** includes all occurrences involving actual or potential airborne collisions between aircraft, while both aircraft are airborne and between aircraft and other airborne objects (excluding birds and wildlife). In 2023 the highest risk contributors were airspace infringement, near collision with UAS and TCAS RA related. *This KRA is mainly managed through safety issues identified in the ATM/ANS safety risk portfolio.*
- **Aircraft upset** includes an undesired aircraft state characterised by unintentional divergences from parameters normally experienced during operations, which might ultimately lead to an uncontrolled impact with terrain. In 2023 the highest risk contributing occurrences were unstable approach, flight level/altitude deviations, pitch deviations related.

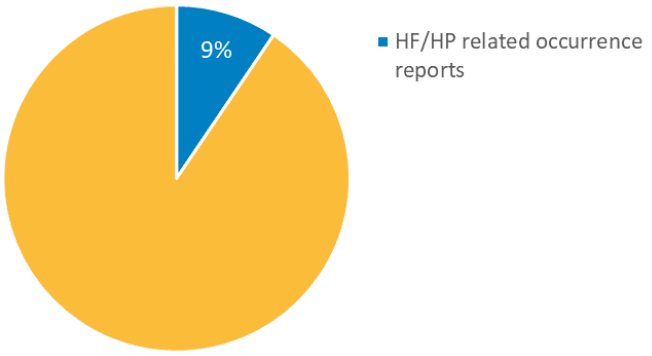


Appendix 2 Figure 1 KRAs by aggregated ERCS score and number of risk-scored occurrences involving CAT complex aeroplanes and NCC aeroplanes

Human factors and human performance (HF/HP)

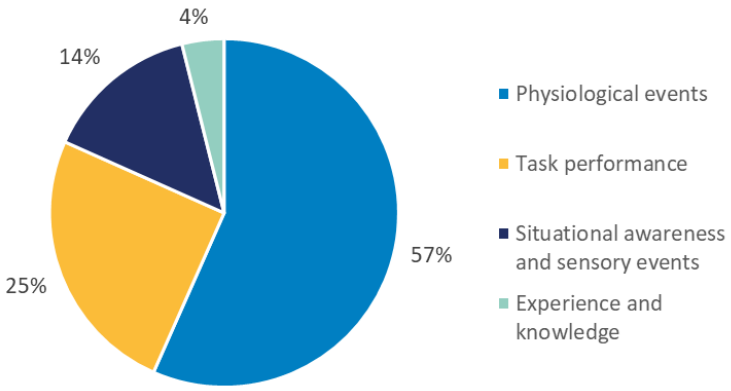
HF and HP for large aeroplanes and aeroplanes with a mass group greater than 5 700kg operated in commercial air transport

There were more than 410 000 occurrence records involving CAT large aeroplanes and CAT aeroplanes with a mass group greater than 5 700kg over the period 2019-2023. From this dataset extracted from the ECR on April 15, 2024, 38 870 occurrence records identified HF/HP as a contributing factor, including 19 accidents 97 serious incidents. These occurrences are labelled as personnel occurrences in the ECCAIRS taxonomy. It is important to highlight that HF/HP issues are often not recorded within the initial occurrence report and may surface at a later date. **Appendix 2 Figure 2** presents the percentage of HF/HP related occurrence records, relative to the total number of occurrence records from 2019 to 2023.



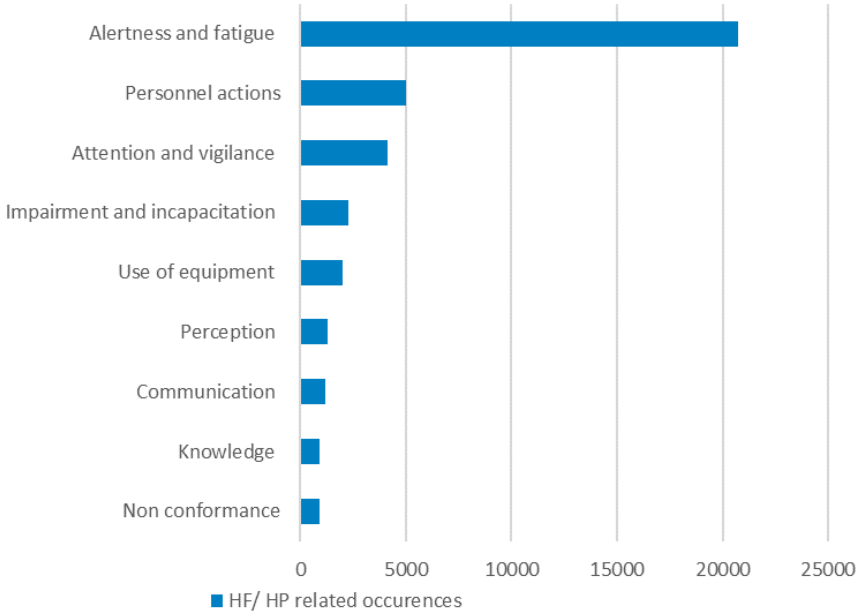
Appendix 2 Figure 2 HF/HP occurrences involving CAT large aeroplanes and CAT aeroplanes with a mass group greater than 5 700kg

The application of the first level of HF/HP codes can be seen in **Appendix 2 Figure 3**. Out of the 38 870 HF/HP related occurrence records, 23 021 were coded under psychological events, 10 184 under task performance events, 5 863 under situational awareness events and 1 580 under experience and knowledge events. Note that one occurrence may indicate more than one HF/HP event. With the use of more encompassing data for this year ASR, meaning the full set of occurrence records, i.e., not limited to accidents and serious incidents, physiological events and task performance issues were slightly easier to diagnose. This is further underscored by the data distribution presented in the last paragraph.



Appendix 2 Figure 3 High-level HF/HP event codes applied to occurrences involving CAT large aeroplanes and CAT aeroplanes with a mass group greater than 5 700kg

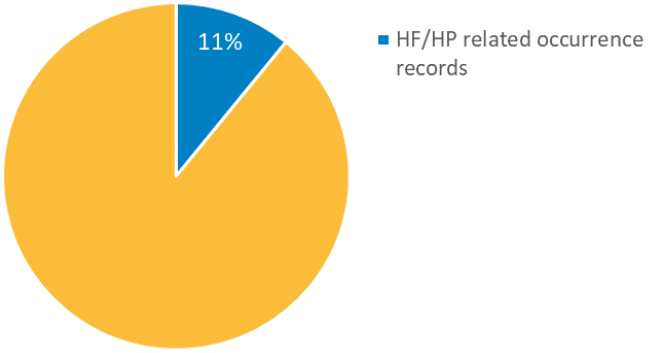
Appendix 2 Figure 4 displays the frequency of occurrences for each specific HF/HP event code concerning CAT complex airplanes. Data shows that issues related to alertness and fatigue that have been reported in 20 724 occurrence records are the most prevalent, indicating it as an area with most HF/HP related safety concerns.



Appendix 2 Figure 4 Detailed HF/HP event codes by number of occurrences involving CAT large aeroplanes and CAT aeroplanes with a mass group greater than 5 700kg

HF and HP for large aeroplanes and aeroplanes with a mass group greater than 5 700kg conducted NCC

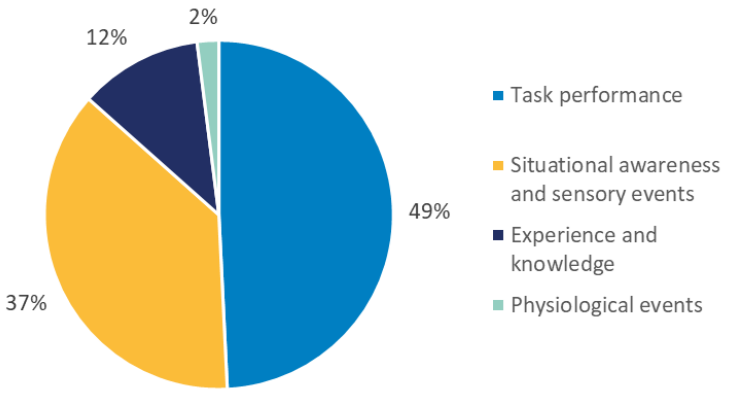
There were close to 4 900 occurrence records involving large aeroplanes and aeroplanes with a mass group greater than 5 700kg conducting NCC over the period 2019-2023. From this dataset extracted from the ECR on April 15, 2024, 533 occurrence records identified HF/HP as a contributing factor, including two accidents and seven serious incidents. **Appendix 2 Figure 5** presents the percentage of HF/HP related occurrence records, relative to the total number of occurrence records from 2019 to 2023.



Appendix 2 Figure 5 HF/HP occurrences involving large aeroplanes and aeroplanes with a mass group greater than 5 700kg conducted NCC

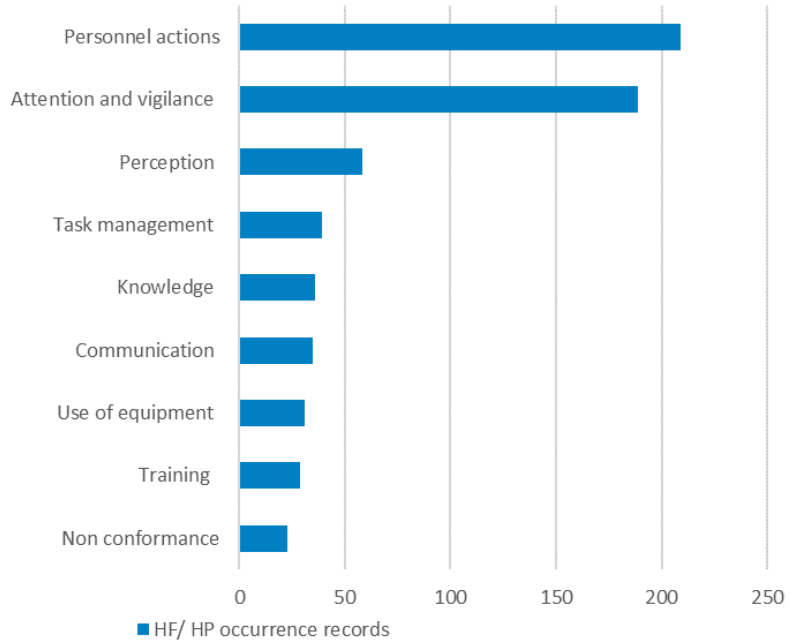
The application of the first level of HF/HP codes can be seen in **Appendix 2 Figure 6**. Out of the 533 HF/HP related occurrence records, 319 were coded under task performance events, 242 under situational awareness events, 74 under experience and knowledge events and 13 under psychological events. Note that one occurrence may indicate more than one HF/HP event. As in the previous ASRs, task performance issues remain more easily discernible following

an occurrence than the factors that cause them, such as physiological or experience and knowledge events. This remains particularly true where investigations are not yet complete.



Appendix 2 Figure 6 High level HF/HP event codes applied to occurrences involving large aeroplanes and aeroplanes with a mass group greater than 5 700kg conducted NCC

Appendix 2 Figure 7 compares the number of occurrences per detailed HF/HP event codes. Data shows that issues related to personnel actions that have been reported in 209 occurrence records and to attention and vigilance in 189 records are the most prevalent, indicating them as areas with the most HF/HP related safety concerns. This observation is based solely on the quantitative analysis of occurrence data and does not imply causation which may be due to various factors including, but not limited to, complexity of tasks, environment, operations, etc.



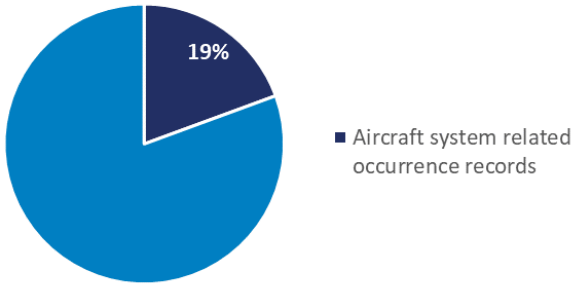
Appendix 2 Figure 7 Detailed HF/HP event codes by number of occurrences involving large aeroplanes and aeroplanes with a mass group greater than 5 700kg conducted NCC

Airworthiness

Airworthiness for large aeroplanes and aeroplanes with a mass group greater than 5 700kg operated in commercial air transport

There were more than 410 000 occurrence records involving CAT large aeroplanes and CAT aeroplanes with a mass group greater than 5 700kg over the period 2019-2023. The data was extracted from the ECR on April 27, 2024.

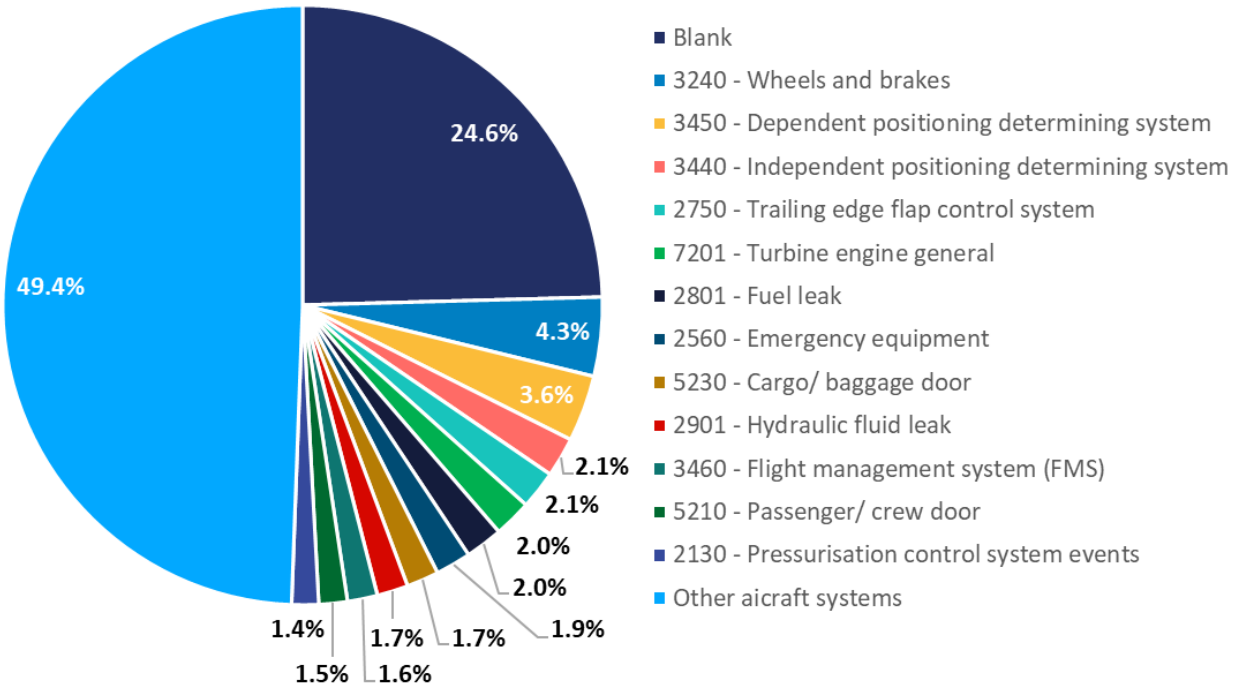
Appendix 2 Figure 8 provides the percentage of occurrences that were aircraft systems related. Around one record out of five identified that the loss or malfunction of an aircraft system contributed to the occurrence, corresponding to 81 913 occurrence records, including 32 accidents and 312 serious incidents. These numbers mainly include records where the loss or malfunction of the aircraft system is the cause of the occurrence (e.g., the uncontained release of intermediate pressure turbine blades). They may also include records where the aircraft system is adversely affected by another event (e.g., damage to the main landing gear tires resulting from hot braking induced by an overweight emergency landing).



Appendix 2 Figure 8 Aircraft system related occurrence records involving CAT large aeroplanes and CAT aeroplanes with a mass group greater than 5 700kg

Appendix 2 Figure 9 provides the list of the values for the event type 'equipment', excluding 'aircraft general explosions/fire/fumes/smoke events' and 'aircraft generic' and shows their relative distribution in terms of number of occurrence records. Affected aircraft systems with less than 1 000 occurrence records were grouped together in the value 'other aircraft systems'.

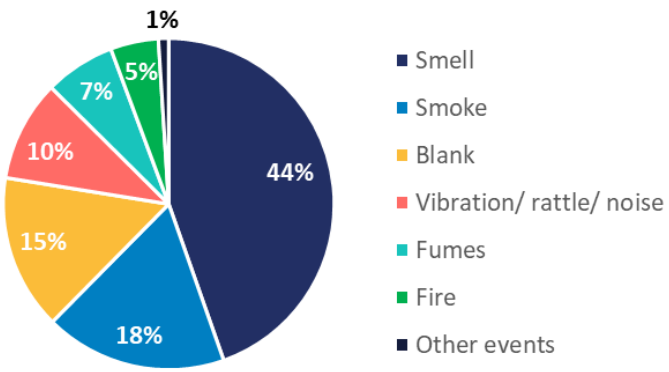
The main affected aircraft systems were wheels and brakes (3 206 records), dependent positioning determining system (2 698 records), independent positioning determining system (1 613 records), trailing edge flap control system (1 560 records), turbine engine general (1 530 records), fuel leak (1 523 records), emergency equipment (1 437 records), cargo/baggage door (1 310 records), hydraulic fluid leak (1 263 records), flight management system (1 220 records), passenger/crew door (1 157 records) and pressurisation control system (1 090 records).



Appendix 2 Figure 9 Aircraft system related occurrence records per ATA chapter involving CAT large aeroplanes and CAT aeroplanes with a mass group greater than 5 700kg

Appendix 2 Figure 10 provides the list of values for the event types 'aircraft general explosions/fire/fumes/smoke events' and 'aircraft generic' and shows their relative distribution in terms of number of occurrence records. Event types with less than 50 occurrence records were grouped together in the value 'other event types'.

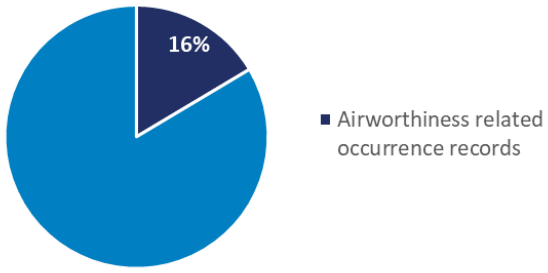
The value 'smell' was coded in 3 434 instances, while the values 'smoke', 'fumes' and 'fire' were respectively coded in 1 371, 530 and 361 instances. The value 'vibration/rattle/noise' was coded in 760 instances.



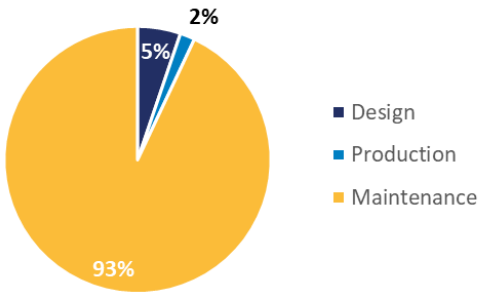
Appendix 2 Figure 10 Aircraft generic event related occurrence records involving CAT large aeroplanes and CAT aeroplanes with a mass group greater than 5 700kg

From the 81 913 occurrence records where the loss or malfunction of an aircraft system was identified in the occurrence, 13 464 occurrence records were attributed to an airworthiness issue, distributed in 12 581 records to aircraft maintenance, 705 records to aircraft design and 243 records to aircraft production[1].

Appendix 2 Figure 11 provides the percentage of aircraft system related occurrence records where the occurrence was attributed to an airworthiness issue, while **Appendix 2 Figure 12** shows occurrence distribution between aircraft design, aircraft production and aircraft maintenance.



Appendix 2 Figure 11 Airworthiness related occurrence records involving CAT large aeroplanes and CAT aeroplanes with a mass group greater than 5 700kg



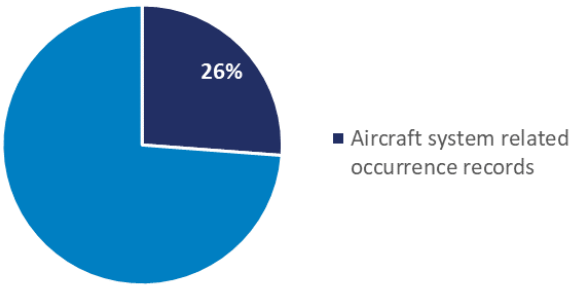
Appendix 2 Figure 12 Airworthiness related occurrence records per airworthiness domain involving CAT large aeroplanes and CAT aeroplanes with a mass group greater than 5 700kg

Airworthiness for large aeroplanes and aeroplanes with a mass group greater than 5 700kg conducted NCC

There were about 4 900 occurrence records involving large aeroplanes and aeroplanes with a mass group greater than 5 700kg conducting NCC over the period 2019-2023. The data was extracted from the ECR on April 27, 2024.

Appendix 2 Figure 13 provides the percentage of occurrences that were aircraft systems related. Around one record out of four identified that the loss or malfunction of an aircraft system contributed to the occurrence, corresponding to 1 289 occurrence records, including four accidents and 17 serious incidents. These numbers mainly include records where the loss or malfunction of the aircraft system is the cause of the occurrence (e.g., the uncontained release of intermediate pressure turbine blades). They may also include records where the aircraft system is adversely affected by another event (e.g., damage to the main landing gear tires resulting from hot braking induced by an overweight emergency landing).

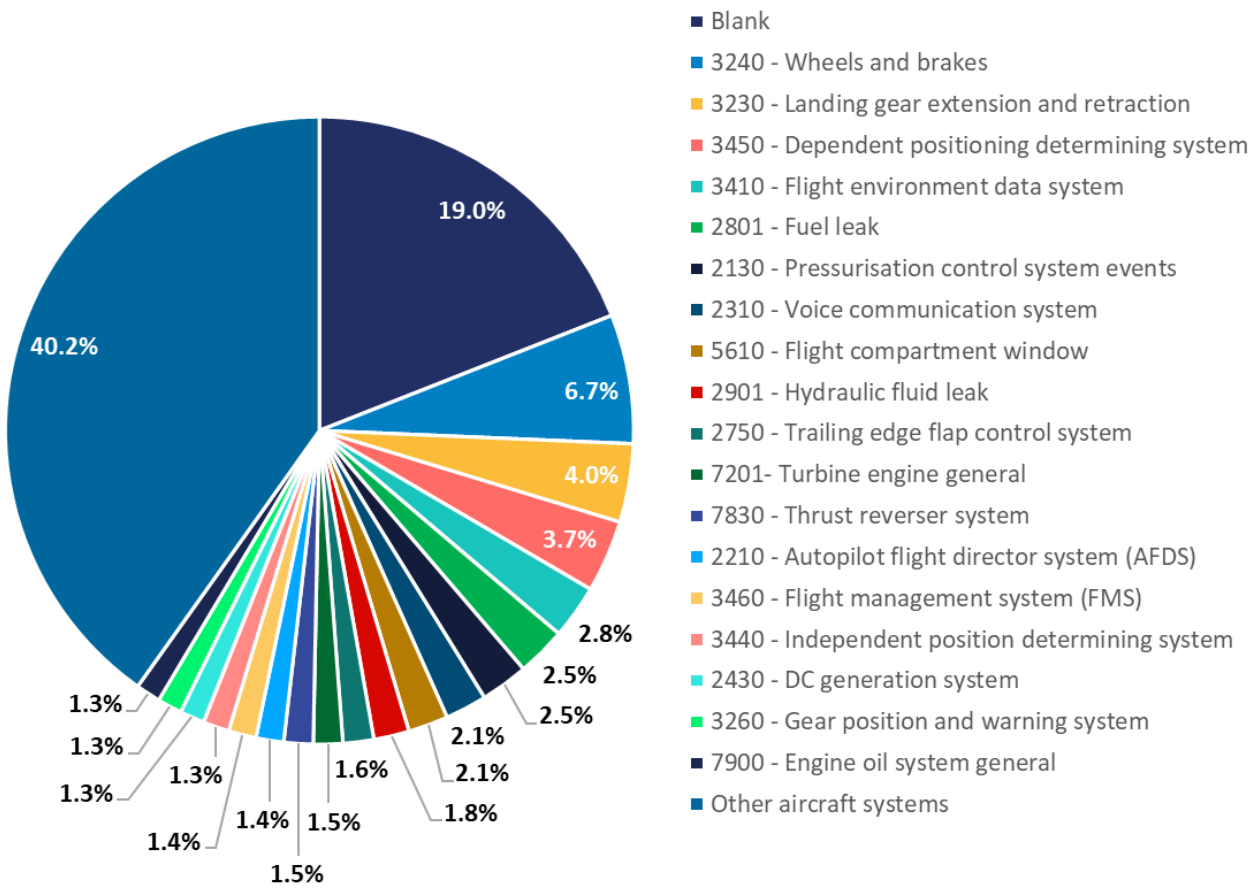
[1] One occurrence record may be attributed to one or more airworthiness domains.



Appendix 2 Figure 13 Aircraft system related occurrence records involving large aeroplanes and aeroplanes with a mass group greater than 5 700kg in NCC

Appendix 2 Figure 14 provides the list of the values for the event type 'equipment', excluding 'aircraft general explosions/fire/fumes/smoke events' and 'aircraft generic' and shows their relative distribution in terms of number of occurrence records. Affected aircraft systems with less than 15 occurrence records were grouped together in the value 'other aircraft systems'.

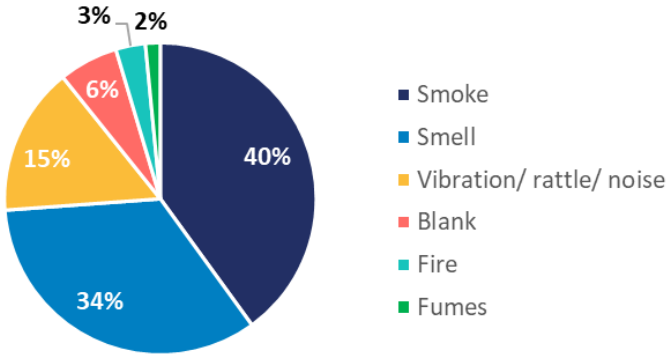
The main affected aircraft systems were wheels and brakes (243 records), landing gear extension and retraction (52 records), dependent positioning determining system (47 records), flight environment data system (35 records), fuel leak (32 records), pressurisation control system (31 records), voice communication system (27 records), flight compartment window (26 records), hydraulic fluid leak (23 records), trailing edge flap control system (20 records), turbine engine general (19 records), thrust reverser system (19 records), autopilot flight director system (AFDS) (18 records), flight management system (FMS) (18 records), independent position determining system (17 records), DC electrical power generation system (16 records), gear position and warning system (16 records) and engine oil system general (16 records).



Appendix 2 Figure 14 Aircraft system related occurrence records per ATA chapter involving large aeroplanes and aeroplanes with a mass group greater than 5 700kg in NCC

Appendix 2 Figure 15 provides the list of values for the event types 'aircraft general explosions/fire/fumes/smoke events' and 'aircraft generic' and shows their relative distribution in terms of number of occurrence records.

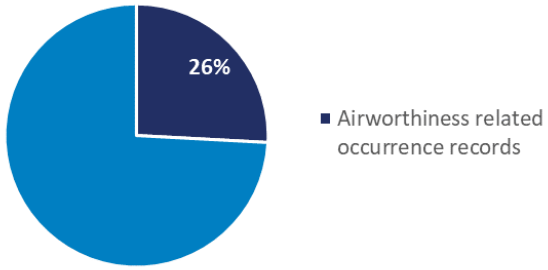
The value 'smoke' was coded in 26 instances, while the values 'smell', 'fire' and 'fumes' were respectively coded in 22, two and one instances. The value 'vibration rattle/noise' was coded in 10 instances.



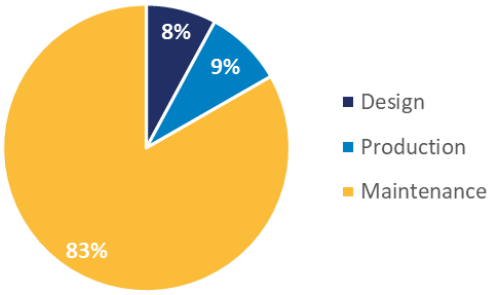
Appendix 2 Figure 15 Aircraft generic event related occurrence records involving large aeroplanes and aeroplanes with a mass group greater than 5 700kg in NCC

From the 1 289 occurrence records where the loss or malfunction of an aircraft system was identified in the occurrence, 336 occurrence records were attributed to an airworthiness issue, distributed in 283 records to aircraft maintenance, 30 records to aircraft production and 27 records to aircraft design[2].

Appendix 2 Figure 16 provides the percentage of aircraft system related occurrence records where the occurrence was attributed to an airworthiness issue, while **Appendix 2 Figure 17** shows occurrence distribution between aircraft design, aircraft production and aircraft maintenance.



Appendix 2 Figure 16 Airworthiness related occurrence records involving large aeroplanes and aeroplanes with a mass group greater than 5 700kg in NCC



Appendix 2 Figure 17 Airworthiness related occurrence records per airworthiness domain involving large aeroplanes and aeroplanes with a mass group greater than 5 700kg in NCC

[2] One occurrence record may be attributed to one or more airworthiness domains.

2 Advanced statistics for commercial air transport (CAT) other than complex aeroplanes

This chapter provides the safety risks, an overview of the HF/HP issues, as well as an overview of the airworthiness issues, for CAT operations involving aeroplanes other than complex.

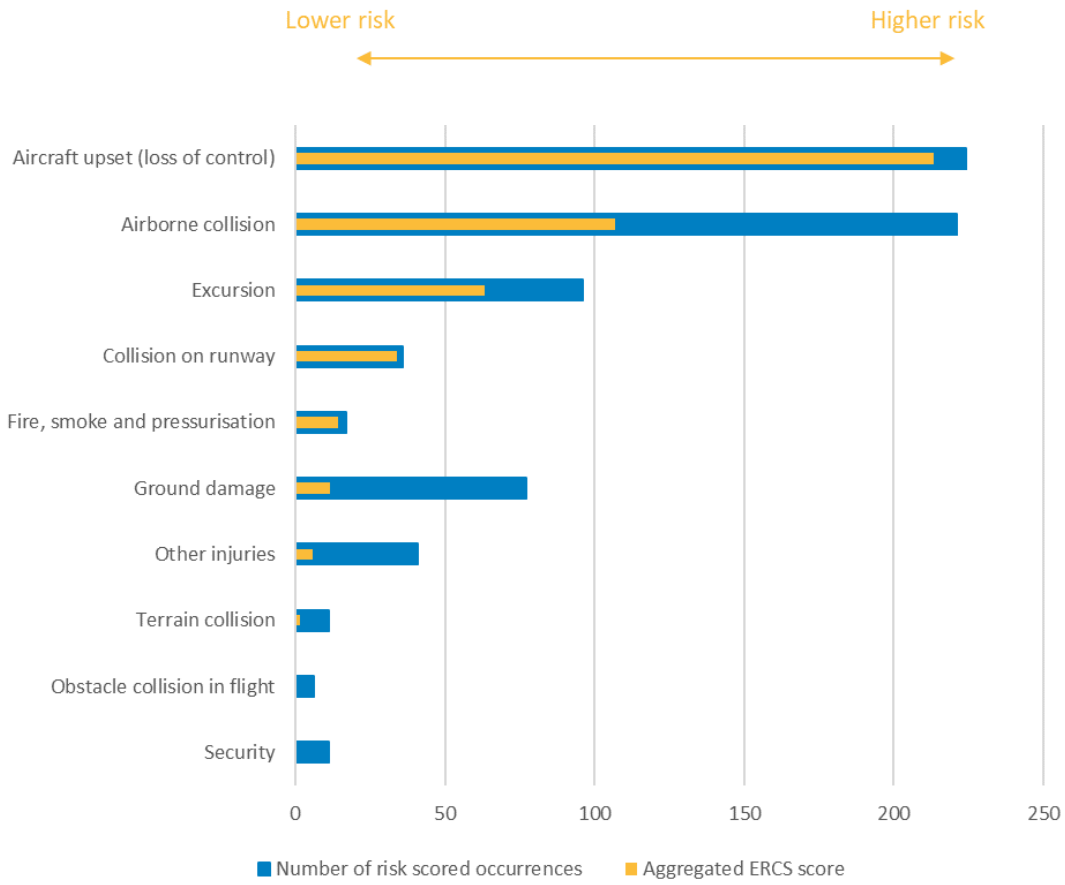
Safety risks

The safety risks identified hereafter are derived from occurrences data recorded in the ECR, covering the one-year period of 2023. From more than 1 422 occurrences in 2023, only 738 occurrences were completed with the KRA and ERCS safety risk score, representing an ERCS completion rate of 52% for the domain. The hereafter information is solely based on this restricted dataset.

The relative comparison between KRAs for this domain is highlighted in **Appendix 2 Figure 18**. KRAs and occurrence categories (refer to core document Figures 2.4 and 2.16) have different purposes. While occurrence categories describe actual factors and outcomes of an occurrence, KRAs describe the potential outcome of an occurrence. The KRA is defined by the most likely type of accident that an occurrence could have escalated to. Unlike occurrence categories, where multiple categories may be assigned to a single occurrence, there can only be one KRA per occurrence. The KRA is one element of the ERCS. This scheme is applied when determining the safety risk score of an occurrence and is further detailed in the ASR introduction.

As illustrated in **Appendix 2 Figure 18**, the higher-risk KRAs are:

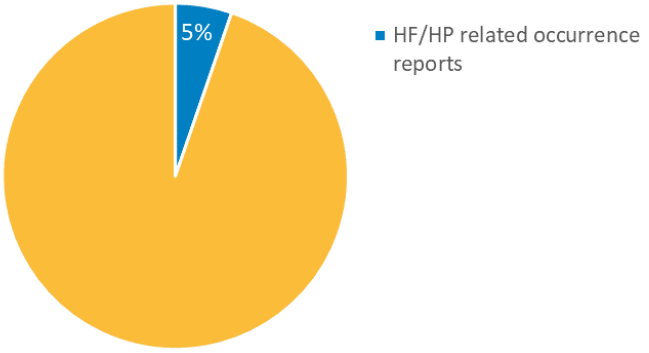
- **Aircraft upset** includes an undesired aircraft state characterised by unintentional divergences from parameters normally experienced during operations, which might ultimately lead to an uncontrolled impact with terrain. In 2023 the highest risk contributing occurrences were aircraft buffet/stall, high rate of climb/descent and reciprocating engine power loss related.
- **Airborne collision** includes all occurrences involving actual or potential airborne collisions between aircraft, while both aircraft are airborne and between aircraft and other airborne objects (excluding birds and wildlife). In 2023 the highest risk contributors were near collisions with aircraft, separation minima infringements, monitoring of other aircraft related. *This KRA is mainly managed through safety issues identified in the ATM/ANS safety risk portfolio.*
- **Excursion** includes an occurrence when an aircraft leaves the runway or movement area of an aerodrome or landing surface of any other predesignated landing area, without getting airborne. It includes high-impact vertical landings for rotorcraft or vertical take-off and landing aircraft and balloons or airships. In 2023 the highest risk contributors were occurrences involving runway side excursions, propeller strike, reciprocating engine power loss related. *This KRA is mainly managed through safety issues identified in the ATM/ANS and the Aerodromes and Ground handling safety risk portfolios.*



Appendix 2 Figure 18 KRAs by aggregated ERCS score and number of risk-scored occurrences involving CAT complex aeroplanes and NCC aeroplanes

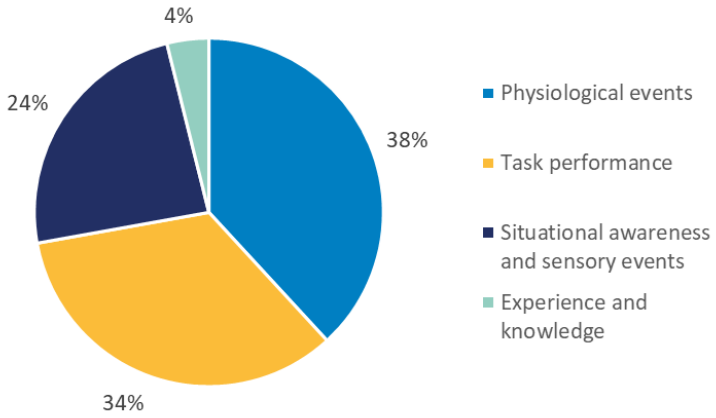
Human factors and human performance (HF/HP)

There were more than 370 000 occurrence records involving CAT other than large aeroplanes and CAT aeroplanes with a mass group equal or below 5 700kg over the period 2019-2023. From this dataset extracted from the ECR on April 15, 2024, 19 784 occurrence records identified HF/HP as a contributing factor, including 19 accidents and 85 serious incidents. These occurrences are labelled as personnel occurrences in the ECCAIRS taxonomy. It is important to highlight that HF/HP issues are often not recorded within the initial occurrence report and may become evident at a later date. In addition, there is often less data available to analysts/investigators owing to the lack of recording devices on board aircraft in this category. **Appendix 2 Figure 19** presents the percentage of HF/HP related occurrence records, relative to the total number of occurrence records from 2019 to 2023.



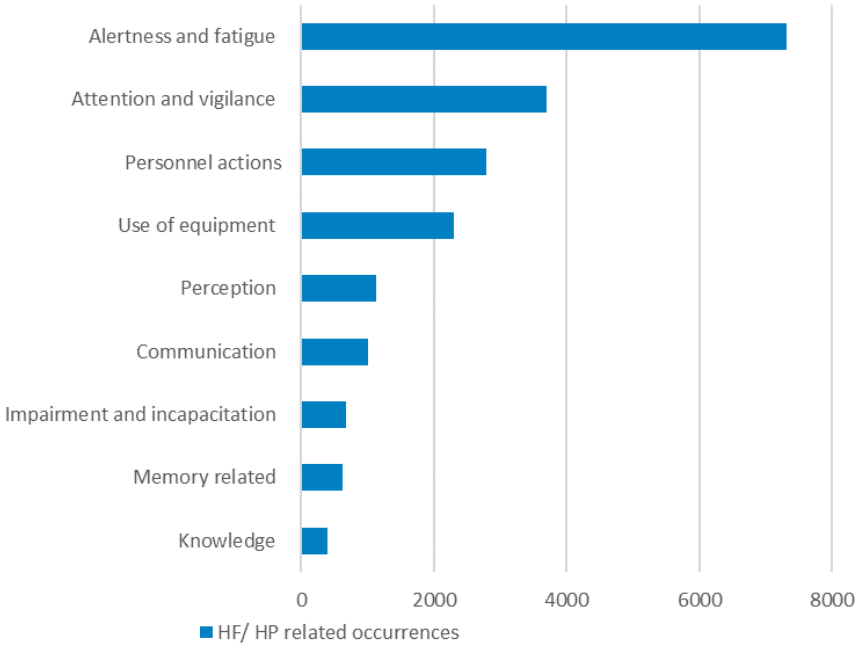
Appendix 2 Figure 19 HF/HP occurrences involving CAT other than large aeroplanes and CAT aeroplanes with a mass group equal or below 5 700kg

The application of the first level of HF/HP codes can be seen in **Appendix 2 Figure 20**. Out of the 19 784 HF/HP related occurrence records, 8 006 were coded under psychological events, 7 135 under task performance events, 5 026 under situational awareness events and 813 under experience and knowledge events. Note that one occurrence may indicate more than one HF/HP event. Comparably high number of reports that indicate issues related to physiological events (functioning or responses of the human body) and task performance (effectiveness and efficiency with which operator completes a designated task) were reported. Both may be caused by number of contributing factors, to mention only a few: complexity of environment, technological malfunctions, inadequate information or training, high workload, stress, or fatigue.



Appendix 2 Figure 20 High level HF/HP event codes applied to occurrences involving CAT other than large aeroplanes and CAT aeroplanes with a mass group equal or below 5 700kg

Appendix 2 Figure 21 provides the number of occurrences per detailed HF/HP event codes. Data shows that issues related to alertness and fatigue that have been reported in 7 318 occurrence records are the most prevalent, indicating it as an area with most HF/HP related safety concerns. This observation is based solely on the quantitative analysis of occurrence data and does not imply causation beyond the noted frequency of incidents in the specified areas.

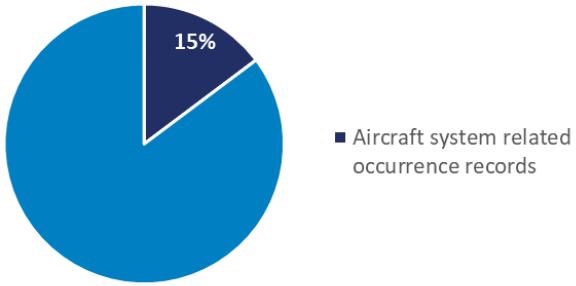


Appendix 2 Figure 21 Detailed HF/HP event codes by number of occurrences involving CAT other than large aeroplanes and CAT aeroplanes with a mass group equal or below 5 700kg

Airworthiness

There were about 375 000 occurrence records involving CAT other than large aeroplanes and CAT aeroplanes with a mass group equal or below 5 700kg over the period 2019-2023. The data was extracted from the ECR on April 27, 2024.

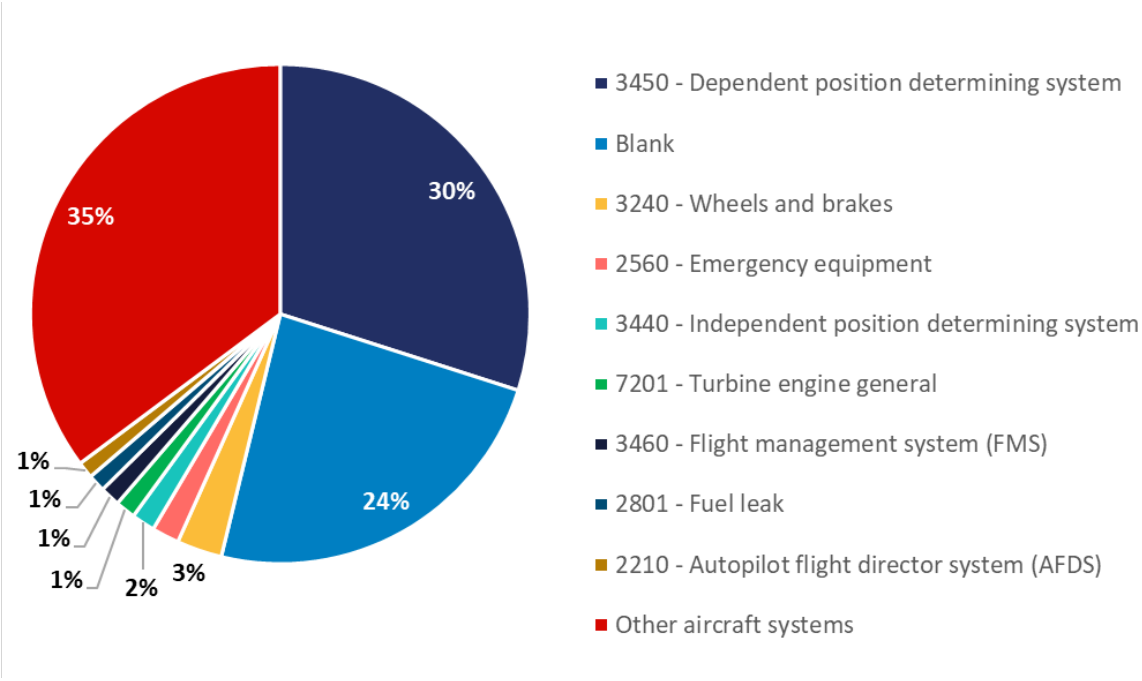
Appendix 2 Figure 22 provides the percentage of occurrences that were aircraft systems related. Around one record out of seven identified that the loss or malfunction of an aircraft system contributed to the occurrence, corresponding to 56 112 occurrence records, including 40 accidents and 194 serious incidents. These numbers mainly include records where the loss or malfunction of the aircraft system is the cause of the occurrence (e.g., engine overheating). They may also include records where the aircraft system is adversely affected by another event and reports where the aircraft system is adversely affected by another event (e.g., loss of engine due to lack of fuel).



Appendix 2 Figure 22 Aircraft system related occurrence records involving CAT other than large aeroplanes and CAT aeroplanes with a mass group equal or below 5 700kg

Appendix 2 Figure 23 provides the list of the values for the event type 'equipment', excluding 'aircraft general explosions/fire/fumes/smoke events' and 'aircraft generic' and shows their relative distribution in terms of number of occurrence records. Affected aircraft systems with less than 500 occurrence records were grouped together in the value 'other aircraft systems'.

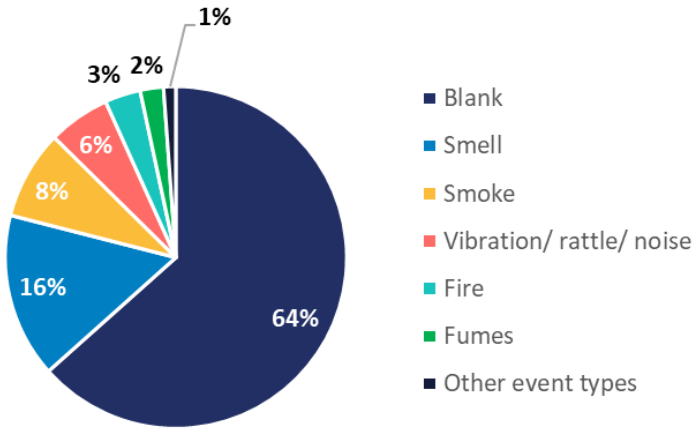
The main affected aircraft systems were dependent position determining system (14 242 records), wheels and brakes (1 393 records), emergency equipment (841 records), independent position determining system (718 records), turbine engine (620 records), flight management system (FMS) (614 records), fuel leak (533 records) and autopilot flight director system (AFDS) (510 records).



Appendix 2 Figure 23 Aircraft system related occurrence records per ATA chapter involving CAT other than large aeroplanes and CAT aeroplanes with a mass group equal or below 5 700kg

Appendix 2 Figure 24 provides the list of values for the event types 'aircraft general explosions/fire/fumes/smoke events' and 'aircraft generic' and shows their relative distribution in terms of number of occurrence records. Event types with less than 50 occurrence records were grouped together in the value 'other event types'.

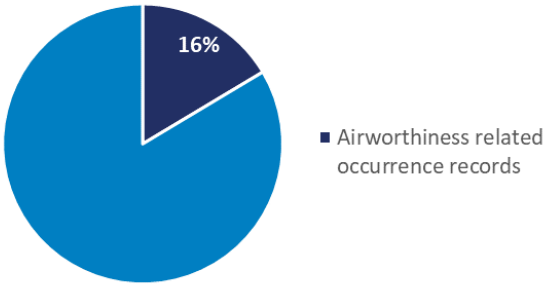
The value 'smell' was coded in 1 071 instances, followed by the value 'smoke' coded in 579 instances. The value 'vibration/rattle/noise' was coded in 403 instances. The values 'fire' and 'fumes' were respectively coded in 233 and 152 instances.



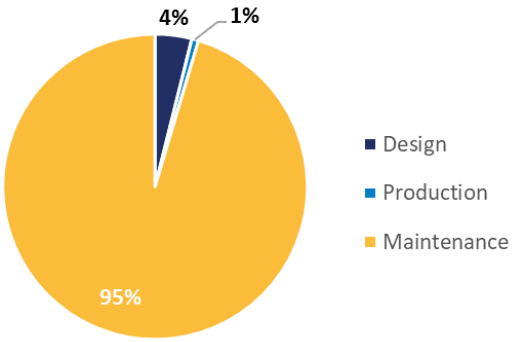
Appendix 2 Figure 24 Aircraft generic events occurrences involving CAT other than large aeroplanes and CAT aeroplanes with a mass group equal or below 5 700kg

From the 56 112 occurrence records where the loss or malfunction of an aircraft system was identified in the occurrence, 9 209 occurrence records were attributed to an airworthiness issue, distributed in 8 798 records to aircraft maintenance, 359 records to aircraft design and 66 records to aircraft production [3].

Appendix 2 Figure 25 provides the percentage of aircraft system related occurrence records where the occurrence was attributed to an airworthiness issue, while **Appendix 2 Figure 26** shows occurrence distribution between aircraft design, aircraft production and aircraft maintenance.



Appendix 2 Figure 25 Airworthiness related occurrence records involving CAT other than large aeroplanes and CAT aeroplanes with a mass group equal or below 5 700kg



Appendix 2 Figure 26 Airworthiness related occurrence records per airworthiness domain involving CAT other than large aeroplanes and CAT aeroplanes with a mass group equal or below 5 700kg

[3] One occurrence record may be attributed to one or more airworthiness domains.

3 Advanced statistics for specialised operations aeroplanes (SPO)

This chapter provides the safety risks, an overview of the HF and HP issues, as well as an overview of the airworthiness issues, for SPO aeroplanes.

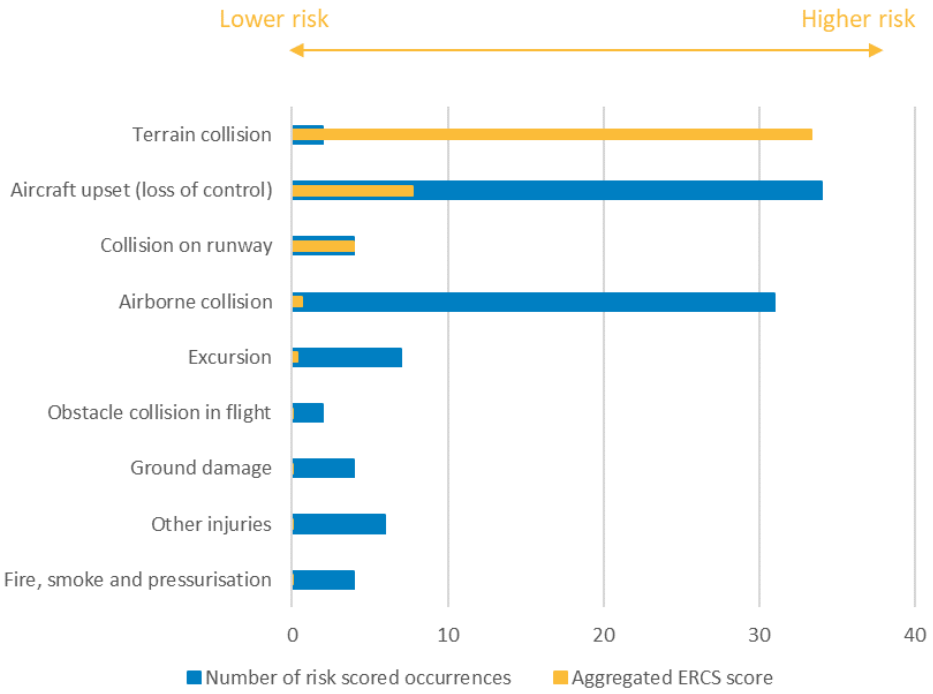
Safety risks

The safety risks for SPO aeroplanes are derived from occurrences data recorded in the ECR, covering the one-year period 2023. From the 276 occurrences in 2023, only 94 occurrences were completed with the KRA and ERCS safety risk score, representing an ERCS completion rate of 34% for the domain. The hereafter information is solely based on this restricted dataset.

The relative comparison between KRAs for this domain is highlighted in **Appendix 2 Figure 27**. KRAs and occurrence categories (refer to core document Figure 2.22) have different purposes. While occurrence categories describe actual factors and outcomes of an occurrence, KRAs describe the potential outcome of an occurrence. The KRA is defined by the most likely type of accident that an occurrence could have escalated to. Unlike occurrence categories, where multiple categories may be assigned to a single occurrence, there can only be one KRA per occurrence. The KRA is one element of the ERCS. This scheme is applied when determining the safety risk score of an occurrence and is further detailed in the ASR introduction.

As illustrated in **Appendix 2 Figure 27**, the higher-risk KRAs are:

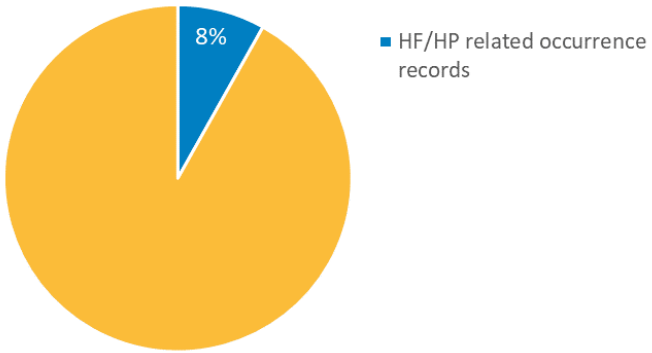
- **Terrain collision** includes an occurrence where an airborne aircraft collides with terrain, without indication that the flight crew was unable to control the aircraft. It includes instances when the flight crew is affected by visual illusions or degraded visual environment. In 2023 the highest risk contributors were altitude deviation, windshear/microburst encounters related.
- **Aircraft upset** includes an undesired aircraft state characterised by unintentional divergences from parameters normally experienced during operations, which might ultimately lead to an uncontrolled impact with terrain.
- **Collision on runway** includes occurrences involving collisions or near-collisions between an aircraft and another object (other aircraft, vehicles, etc.) or person that occurs on a runway of an aerodrome or other predesignated landing area. It does not include collisions with birds or wildlife. In 2023 the highest risk contributors were runway incursion by aircraft, no detection of possible conflicts related. *This KRA is mainly managed through safety issues identified in the ATM/ANS safety risk portfolio.*



Appendix 2 Figure 27 KRAs by aggregated ERCS score and number of risk-scored occurrences involving SPO aeroplanes

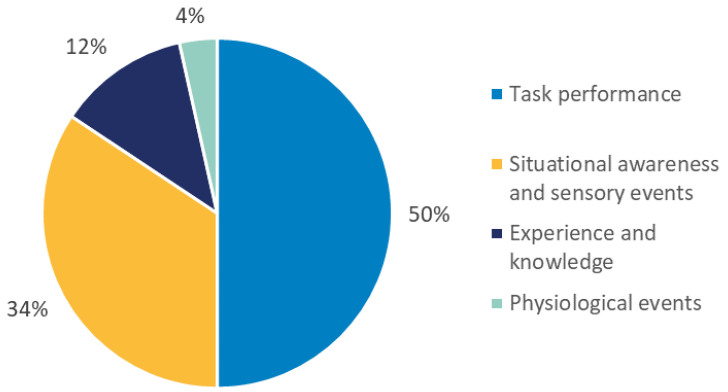
Human factors and human performance (HF/HP)

There were slightly below 2 400 occurrence records involving SPO aeroplanes over the period 2019-2023. From this dataset extracted from the ECR on April 15, 2024, 193 occurrence records identified HF/HP as a contributing factor, including 14 accidents and eight serious incidents. These occurrences are labelled as personnel occurrences in the ECCAIRS taxonomy. It is important to highlight that HF/HP issues are often not recorded within the initial occurrence report and may become evident at a later date. **Appendix 2 Figure 28** presents the percentage of HF/HP related occurrence records relative to the total number of occurrence records from 2019 to 2023.



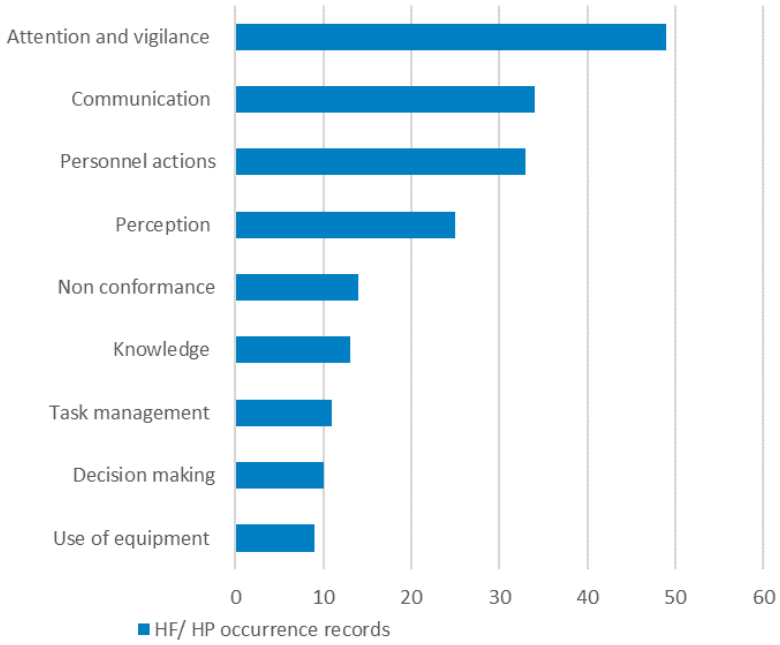
Appendix 2 Figure 28 HF/HP occurrences involving SPO aeroplanes

The application of the first level of HF/HP codes can be seen in **Appendix 2 Figure 29**. Out of the 193 HF/HP related occurrence records, 115 were coded under task performance events, 79 under situational awareness events, 28 under experience and knowledge events and 8 under psychological events. Note that one occurrence may indicate more than one HF/HP event. Clearly, events relating to task performance and situational awareness are easier to diagnose following an occurrence than the underlying factors relating to the performance success.



Appendix 2 Figure 29 High level HF/HP event codes applied to occurrences involving SPO aeroplanes

Appendix 2 Figure 30 compares the number of occurrences per detailed HF/HP event codes. Data shows that issues related to attention and vigilance that have been reported in 49 records are the most prevalent, indicating it as an area with most HF/HP related safety concerns. This observation is based solely on the quantitative analysis of occurrence data and does not imply causation which may be due to various factors including, but not limited to, complexity of tasks, environment, operations, etc.



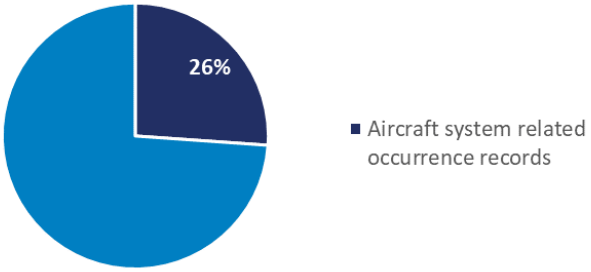
Appendix 2 Figure 30 Detailed HF/HP event codes by number of occurrences involving SPO aeroplanes

Airworthiness

There were almost 2 400 occurrence records involving SPO aeroplanes over the period 2019-2023. The data was extracted from the ECR on April 23, 2024.

Appendix 2 Figure 31 provides the percentage of occurrence records that were aircraft systems related. Around one record out of four identified that the loss or malfunction of an aircraft system contributed to the occurrence, corresponding to 618 occurrence records, including 39 accidents and 20 serious incidents. These numbers mainly

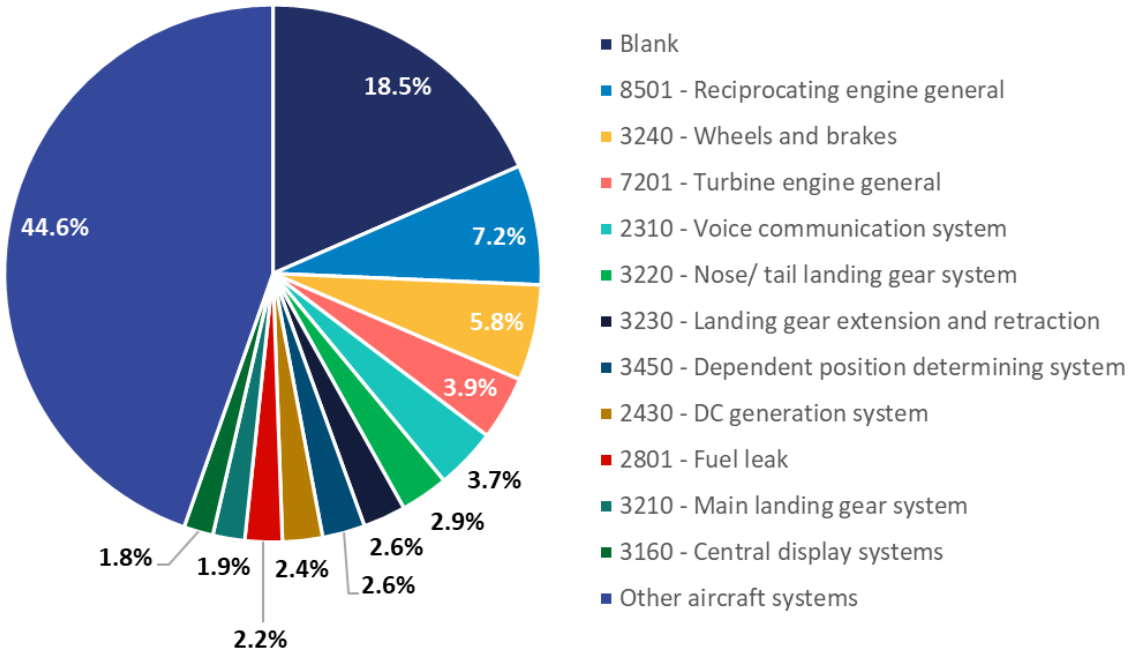
include records where the loss or malfunction of the aircraft system is the cause of the occurrence (e.g., rudder detachment in flight). They may also include records where the aircraft system is adversely affected by another event (e.g., elevator jammed after skydivers collided with the horizontal stabiliser).



Appendix 2 Figure 31 Aircraft system related occurrence records involving SPO aeroplanes

Appendix 2 Figure 32 provides the list of the values for the event type 'equipment', excluding 'aircraft general explosions/fire/fumes/smoke events' and 'aircraft generic' and shows their relative distribution in terms of number of occurrence records. Affected aircraft systems with less than 10 occurrence records were grouped together in the value 'other aircraft systems'.

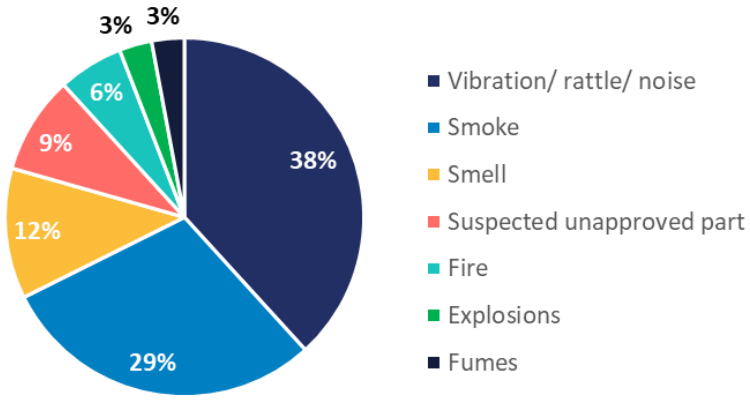
The main affected aircraft systems were reciprocating engine (45 records), wheels and brakes (36 records), turbine engine (24 records), voice communication system (23 records), nose/tail landing gear system (18 records), landing gear extension and retraction (16 records), dependent position determining system (16 records), DC electrical power generation system (15 records), fuel leak (14 records), main landing gear system (12 records) and central display systems (11 records).



Appendix 2 Figure 32 Aircraft system related occurrence records per ATA chapter involving SPO aeroplanes

Appendix 2 Figure 33 provides the list of values for the event types 'aircraft general explosions/fire/fumes/smoke events' and 'aircraft generic' and shows their relative distribution in terms of number of occurrence records.

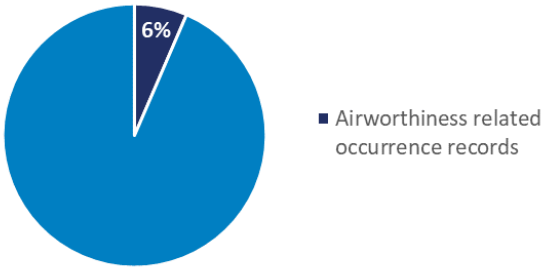
The value 'vibration/rattle/noise' was coded in 13 occurrence records, while the values 'smoke', 'smell', 'suspected unapproved part' and 'fire' were respectively coded in 10, four, three and two instances.



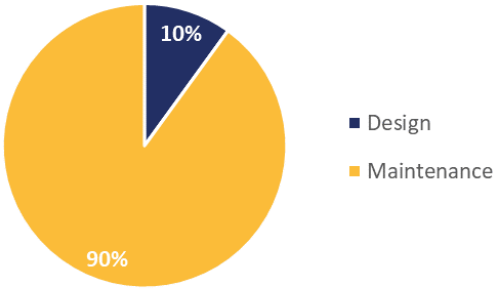
Appendix 2 Figure 33 Aircraft generic event related occurrence records involving SPO aeroplanes

From the 618 occurrence records where the loss or malfunction of an aircraft system was identified in the occurrence, 40 occurrence records were attributed to an airworthiness issue, distributed in 36 records to aircraft maintenance and 4 records to aircraft design.

Appendix 2 Figure 34 provides the percentage of aircraft system related occurrence records where the occurrence was attributed to an airworthiness issue, while **Appendix 2 Figure 35** shows the occurrence record distribution between aircraft design, aircraft production and aircraft maintenance.



Appendix 2 Figure 34 Airworthiness related occurrence records involving SPO aeroplanes



Appendix 2 Figure 35 Airworthiness related occurrence records per airworthiness domain involving SPO aeroplanes

4 Advanced statistics for non-commercial other than complex aeroplanes (NCO)

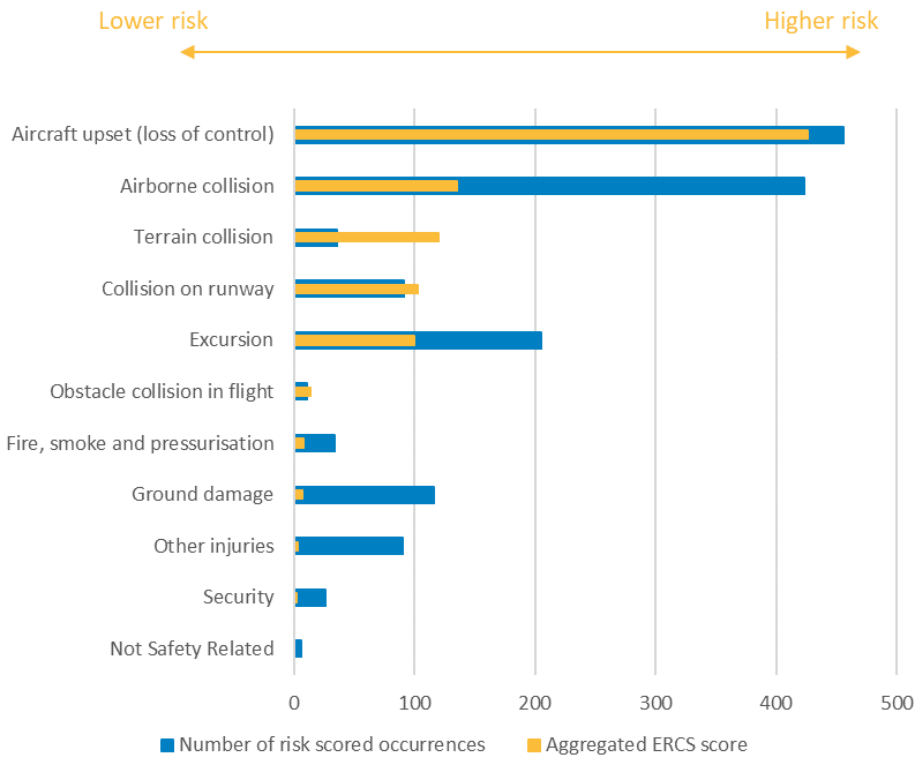
This chapter provides the safety risks, an overview of the HF/HP issues, as well as an overview of the airworthiness issues, for NCO aeroplanes.

Safety risks

The safety risks for the NCO aeroplanes are derived from occurrences data recorded in the ECR, covering the one-year period 2023. From the 4 688 occurrences in 2023, only 1 482 occurrences were completed with the KRA and ERCS safety risk score, representing an ERCS completion rate of 34% for the domain. The hereafter information is solely based on this restricted dataset.

The relative comparison between KRAs for this domain is highlighted in **Appendix 2 Figure 36**. KRAs and occurrence categories (refer to core document Figure 2.29) have different purposes. While occurrence categories describe actual factors and outcomes of an occurrence, KRAs describe the potential outcome of an occurrence. The KRA is defined by the most likely type of accident that an occurrence could have escalated to. Unlike occurrence categories, where multiple categories may be assigned to a single occurrence, there can only be one KRA per occurrence. The KRA is one element of the ERCS. This scheme is applied when determining the safety risk score of an occurrence and is further detailed in the ASR introduction.

The KRA with the highest risk is aircraft upset. This KRA has 456 occurrences over the year 2023 and it produces the highest risk score and is therefore the area where the greatest need for intervention lies. To contrast these figures, it can be observed that the KRA airborne collision has over 423 occurrences. The risk of fatalities or injuries is however significantly lower. The same goes for the KRA excursion. Other KRAs worth mentioning are terrain collision, collision on runway and obstacle collision in flight.

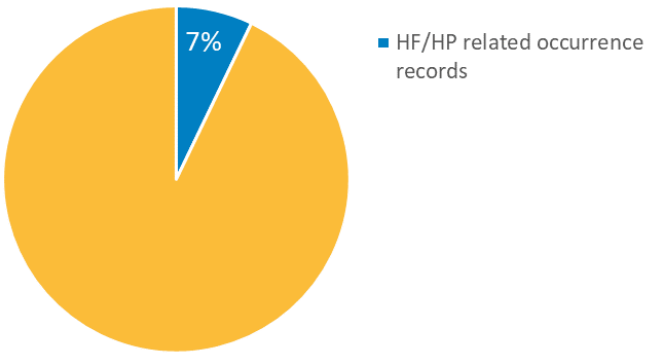


Appendix 2 Figure 36 KRAs by aggregated ERCS score and number of risk-scored occurrences involving NCO aeroplanes

Human factors and human performance (HF/HP)

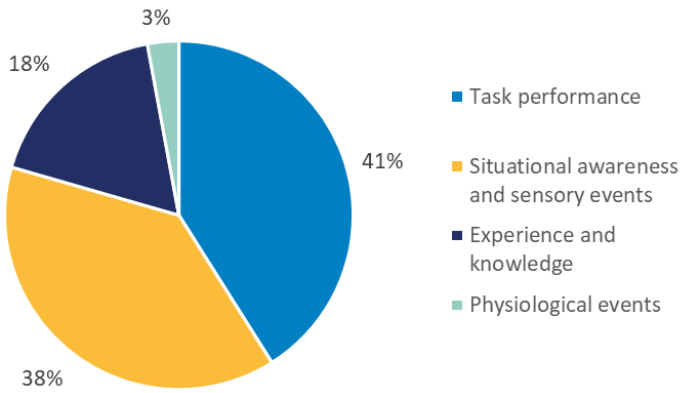
There were close to 23 000 occurrence records involving NCO aeroplanes over the period 2019-2023. From this dataset extracted from the ECR on April 15, 2024, 1 589 occurrence records identified HF/HP as a contributing factor, including

134 accidents and 92 serious incidents. These occurrences are labelled as personnel occurrences in the ECCAIRS taxonomy. It is important to highlight that HF/HP issues are often not recorded within the initial occurrence report and may become evident at a later date. Moreover, the dataset for NCO aeroplanes includes certified small aeroplanes as well as Light Sport Aeroplanes (LSA) and Very Light Aeroplanes (VLA). Ultralights, microlights and other aircraft not certified are excluded from this dataset. **Appendix 2 Figure 37** presents the percentage of HF/HP related occurrence records relative to the total number of occurrence records that concern NCO aeroplanes, from 2019 to 2023.



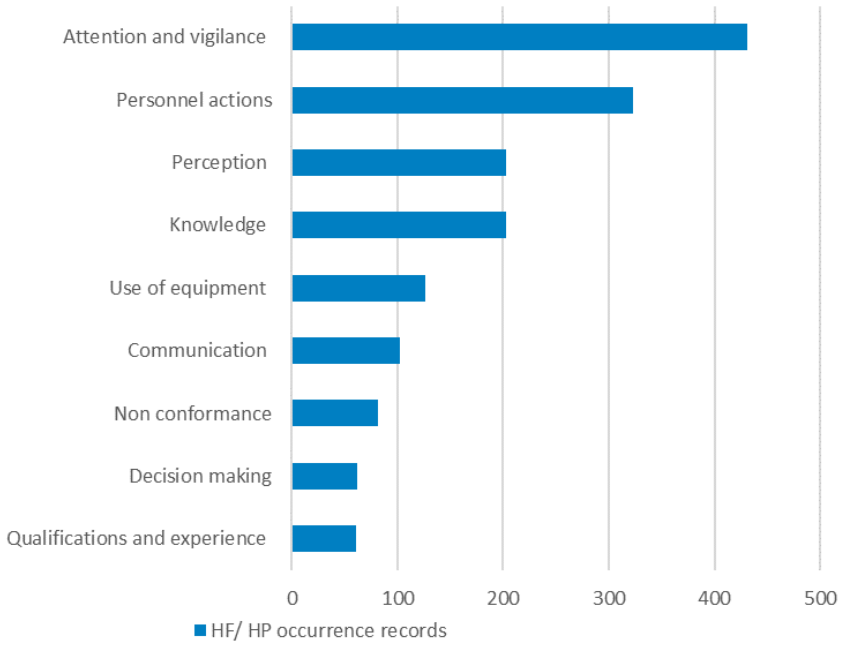
Appendix 2 Figure 37 HF/HP occurrences involving NCO aeroplanes

The application of the first level of HF/HP codes can be seen in **Appendix 2 Figure 38**. Out of the 1 589 HF/HP related occurrence records, 749 were coded under task performance events, 701 under situational awareness events, 322 under experience and knowledge events and 53 under psychological events. Note that one occurrence may indicate more than one HF/HP event. Clearly, events relating to task performance and situational awareness are easier to diagnose following an occurrence than the underlying factors relating to the performance success.



Appendix 2 Figure 38 High level HF/HP event codes applied to occurrences involving NCO aeroplanes

Appendix 2 Figure 39 compares the number of occurrences per detailed HF/HP event codes. Issues related to attention and vigilance that have been reported in 431 records are the most prevalent, indicating it as an area with most HF/HP related safety concerns. This observation is based solely on the quantitative analysis of occurrence data and does not imply causation which may be due to various factors including, but not limited to, complexity of tasks, environment, operations, etc.

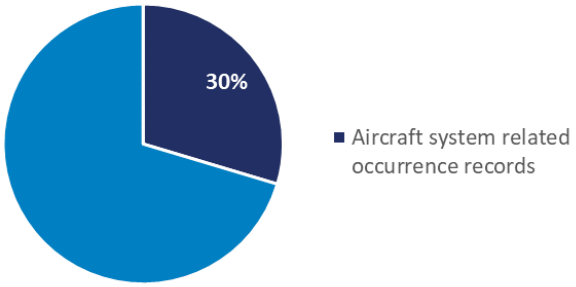


Appendix 2 Figure 39 Detailed HF/HP event codes by number of occurrences involving NCO aeroplanes

Airworthiness

There were around 22 500 occurrence records involving NCO aeroplanes over the period 2019-2023. The data was extracted the from the ECR on April 27, 2024.

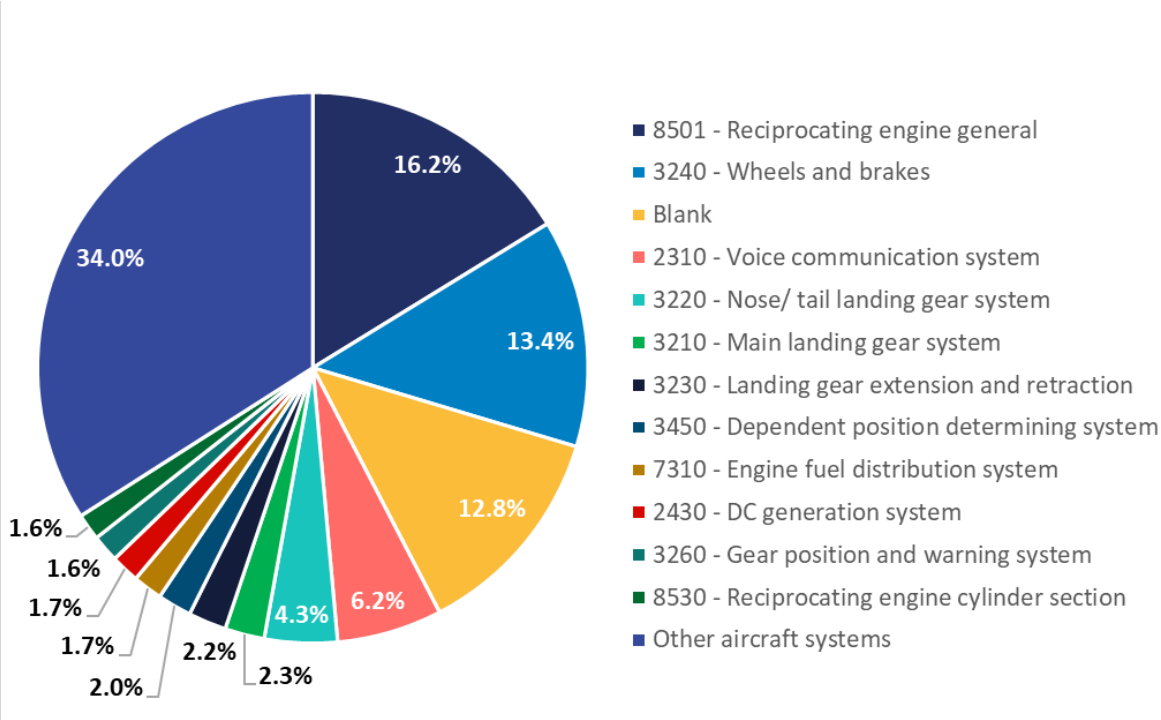
Appendix 2 Figure 40 provides the percentage of occurrence records that were aircraft systems related. Around one record out of three identified that the loss or malfunction of an aircraft system contributed to the occurrence, corresponding to 6 688 occurrence records, including 553 accidents and 216 serious incidents. These numbers mainly include records where the loss or malfunction of the aircraft system is the cause of the occurrence (e.g., engine fire) and reports where the aircraft system is adversely affected by another event (e.g., collapse of the nose landing gear after runway excursion as result of a brake malfunction).



Appendix 2 Figure 40 Aircraft system related occurrence records involving NCO aeroplanes

Appendix 2 Figure 41 provides the list of the values for the event type 'equipment', excluding 'aircraft general explosions/fire/fumes/smoke events' and 'aircraft generic' and shows their relative distribution in terms of number of occurrence records. Affected aircraft systems with less than 100 occurrence records were grouped together in the value 'other aircraft systems'.

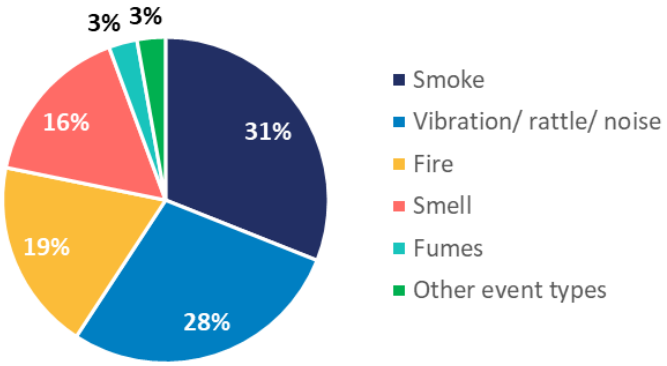
The main affected aircraft systems were reciprocating engine (1 105 records), wheels and brakes (910 records), voice communication system (420 records), nose/tail landing gear system (291 records), main landing gear system (158 records), landing gear extension and retraction (152 records), dependent position determining system (136 records), engine fuel distribution system (118 records), DC electrical power generation system (114 records), gear position and warning system (109 records) and reciprocating engine cylinder section (106 records).



Appendix 2 Figure 41 Aircraft system related occurrence records per ATA chapter involving NCO aeroplanes

Appendix 2 Figure 42 provides the list of values for the event types 'aircraft general explosions/fire/fumes/smoke events' and 'aircraft generic' and shows their relative distribution in terms of the number of occurrences. Event types with less than 10 occurrence records were grouped together in the value 'other event types'.

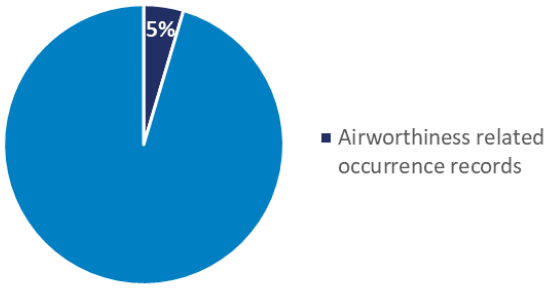
The value 'smoke' was coded in 124 instances, while the values 'fire' and 'smell' were respectively coded in 75 and 64 instances. The value 'vibration/rattle/noise' was coded in 113 instances.



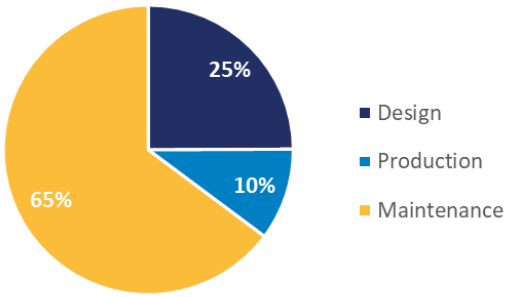
Appendix 2 Figure 42 Aircraft generic event related occurrence records involving NCO aeroplanes

From the 6 688 occurrence records where the loss or malfunction of an aircraft system was identified in the occurrence, 314 occurrence records were attributed to an airworthiness issue, distributed in 205 records to aircraft maintenance, 80 records to aircraft design and 33 records to aircraft production [4].

Appendix 2 Figure 43 provides the percentage of aircraft system related occurrence records where the occurrence was attributed to an airworthiness issue, while **Appendix 2 Figure 44** shows occurrence distribution between aircraft design, aircraft production and aircraft maintenance.



Appendix 2 Figure 43 Airworthiness related occurrence records involving NCO aeroplanes



Appendix 2 Figure 44 Airworthiness related occurrence records per airworthiness domain involving NCO aeroplanes

[4] One occurrence record may be attributed to one or more airworthiness domains.