



# EHEST ANALYSIS OF 2006 - 2010 EUROPEAN HELICOPTER ACCIDENTS



# European Helicopter Safety Team - EHEST

## *EHEST Analysis of 2006-2010 European Helicopter Accidents*

### *Final EHSAT Analysis Report*

## Report

Document ref.	Status	Date
	Final	2015-08-11
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#### Disclaimer:

The safety improvement analyses and recommendations produced by EHEST are based on expert judgement and are supplementary to the official reports of the accident investigation boards (AIB). Such recommendations, and the safety improvement actions that may follow, are solely aimed at improving helicopter safety, are not binding and under no circumstances should be considered to take precedence over the official AIB reports. The adoption of such safety improvement recommendations is subject to voluntary commitment, and engages only the responsibility of those who endorse these actions. The EHEST accepts no responsibility or liability whatsoever with regard to the content or for any actions resulting from the use of the information contained in these recommendations.

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## **Executive Summary**

This report covers the work performed by the European Helicopter Safety Analysis Team (EHSAT), a sub-group of the European Helicopter Safety Team (EHEST) – the rotorcraft pillar of the European Strategic Safety Initiative (ESSI) and the European component of the International Helicopter Safety Team (IHST).

This report is a follow-up on the first EHSAT report published in 2010 addressing 2000-2005 European Helicopter accidents. It covers the analyses performed by the EHSAT regional teams of accidents that occurred in the years 2006-2010. It also provides comparisons between the two time periods 2000-2005 and 2006-2010 as well as some deeper analysis of results covering the entire time period 2000-2010.

EHSAT Regional Teams were established in the following countries: Finland, France, Germany, Hungary, Ireland, Italy, the Netherlands, Norway, Spain, Sweden and the United Kingdom.

The analysis methodology used is the Standard Problem Statements (SPS) and Human Factors Analysis and Classification System (HFACS). This methodology was presented in detail in the first EHSAT report. For further information please consult that publication.

The continued analysis of Helicopter Accidents in the period 2006-2010 by the EHSAT Regional Teams and the comparison with the analysis of 200-2005 accidents have globally confirmed that the issues identified in this first period continue to be of concern and that the safety improvement actions decided and developed based on the first analysis period were still valid.

A few differences have been identified though and additional analyses have been conducted. These will help shaping up the future priorities of the European Helicopter Safety Implementation Team (EHSIT) and its three Specialist Teams on Training, Ops & SMS and Technology.

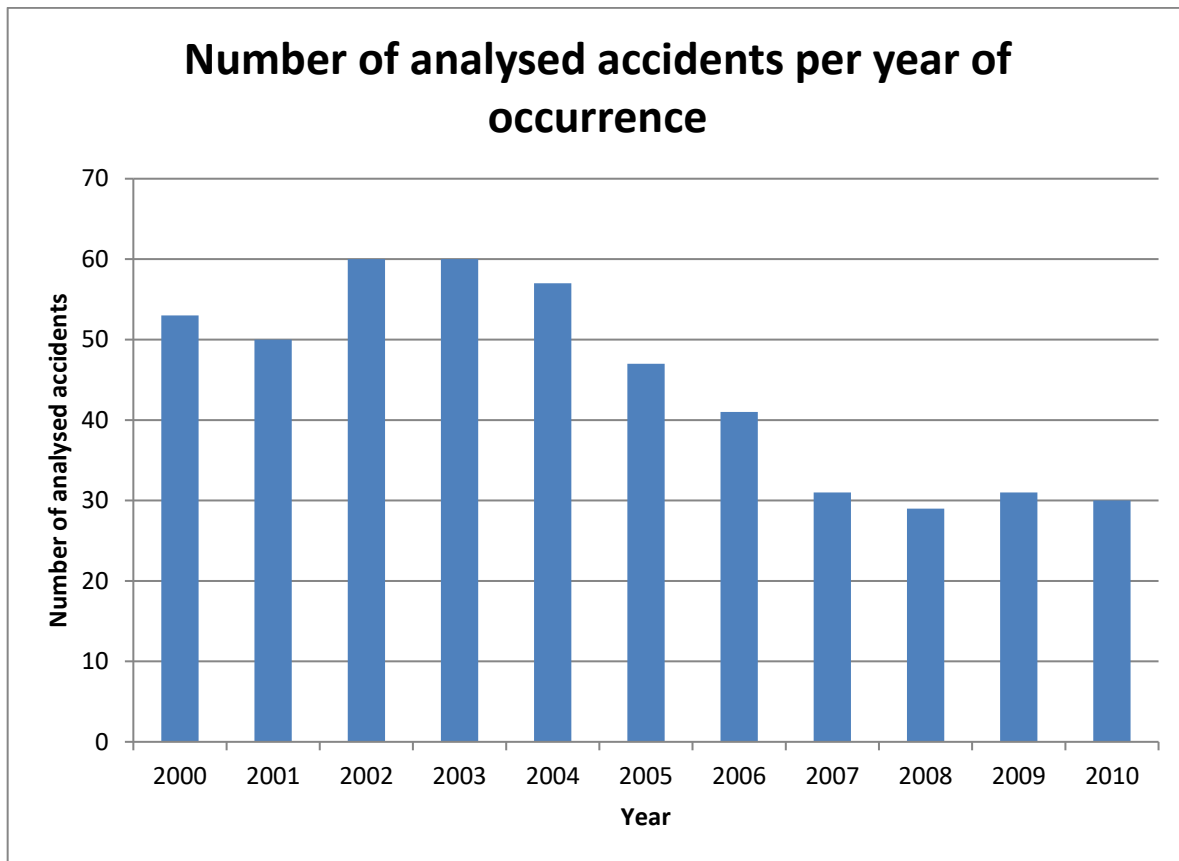
This report will also be communicated to EASA and contribute developing the helicopter Safety Risk Portfolio (SRP), which will help populating the helicopter section of the European Aviation Safety plan (EASp).

Additional data on helicopter safety in Europe can also be found in the EASA Annual Safety Reviews published annually on the EASA website.

# 1 Analysis Results

## 1.1 Basic Data

Figure 1 shows the number of accidents that were analysed by the EHSAT Teams, broken down by year of occurrence.



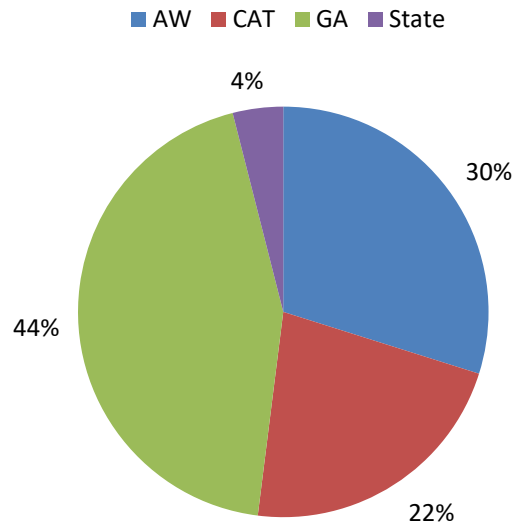
**Figure 1 – Number of analysed accidents per year of occurrence**

In the period 2000-2005, 325 accidents were analysed. Some national teams were unable to continue completing the analysis of accidents for the period 2006-2010, and therefore only 162 accidents were analysed in that period.

In the period 2006-2010, 537 helicopter accidents occurred in the EASA Member States (Source: EASA ADREP Database), which means that the EHSAT teams analysed 30% of all accidents that occurred in that time period. As not all of the 537 accidents have been investigated by an Accident Investigation Board, it would therefore not have been possible to analyse all those accidents using the EHSAT methodology. However, the most serious accidents in the participating states are likely to have been investigated by AIBs and analysed by the EHSAT Regional teams.

Figure 2 shows the distribution of top level Operation Types amongst the 487 analysed accidents.

## Operation type distribution - 2000-2010 accidents

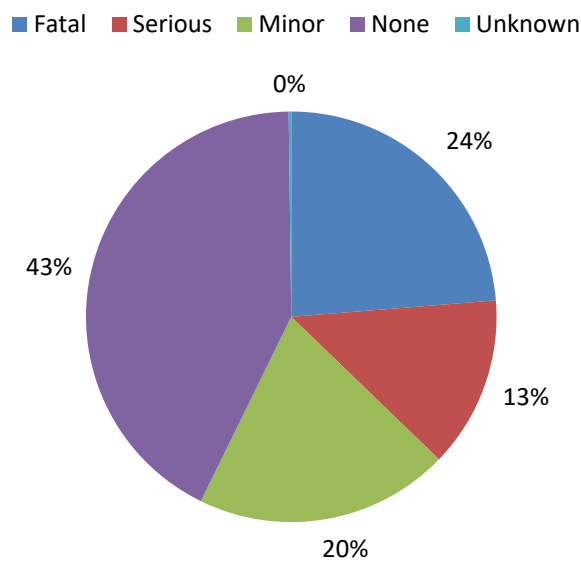


**Figure 2 – Operation Type distribution**

20% of the analysed accidents were Commercial Air Transport operations, 31% were Aerial Work, 45% were General Aviation and 4% were non-military State Flights. As fleet usage data per type of operation on a European Level is not available, it has not been possible to assess whether any type of operation has a differing share of accidents compared to, for example, number of take-offs.

Figure 3 shows the distribution of Highest Injury Level recorded for the 487 analysed accidents.

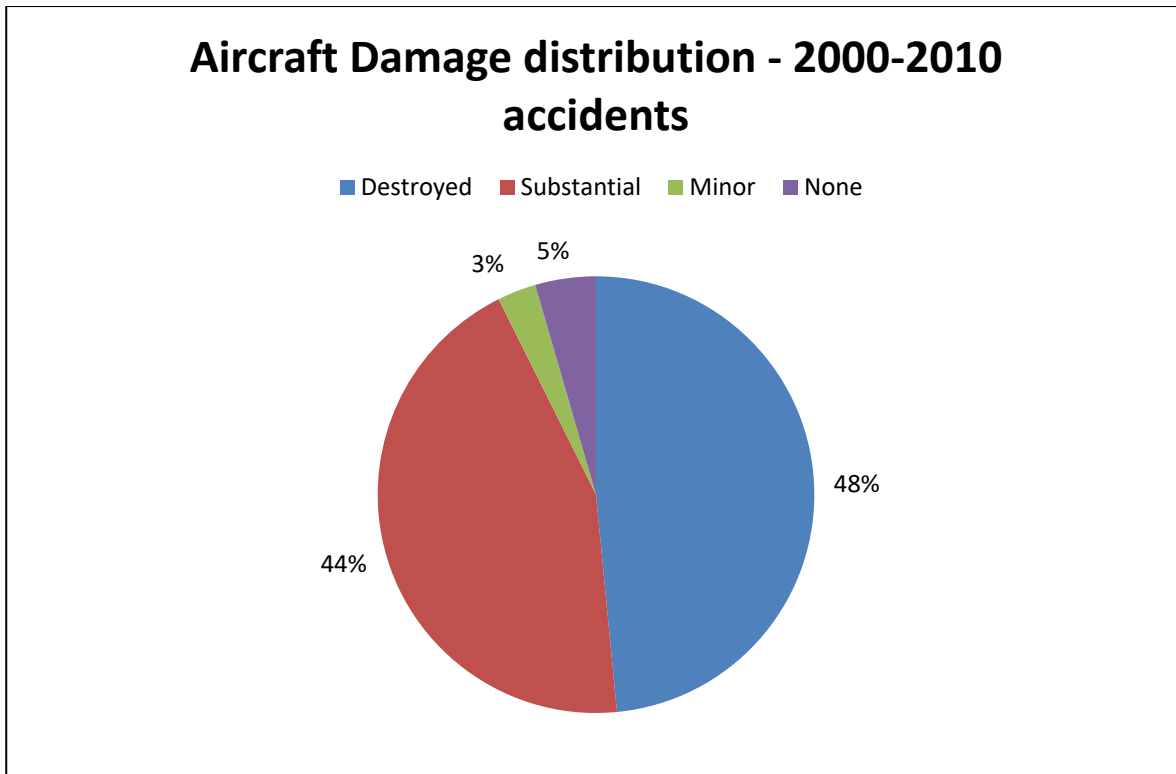
## Highest Injury Level distribution, 2000-2010 accidents



**Figure 3 – Highest Injury Level distribution**

24% of the analysed accidents were fatal, i.e. one or more persons involved in the accident died as a result of the injuries sustained in the accident. On the other hand, in 43% of the accidents there were no injuries. In 13% of the accidents the persons involved sustained serious injuries, and in 20% of the accidents minor injuries were sustained.

Figure 4 shows the distribution of aircraft damage levels in the 487 analysed accidents.



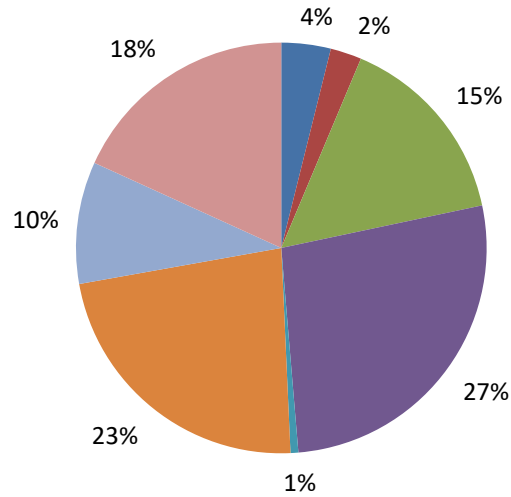
**Figure 4 – Aircraft damage distribution**

Damage levels are derived from the accident reports. It is worth noting that in 46% of the accidents where the aircraft was destroyed, one or more persons involved sustained fatal injuries.

Figure 5 shows the distribution of the phase of flight in which the accident occurred.

## Phase of Flight distribution, 2000-2010 accidents

■ Standing 
 ■ Taxi 
 ■ Take-off 
 ■ En route 
 ■ Hover 
 ■ Manoeuvring 
 ■ Approach 
 ■ Landing



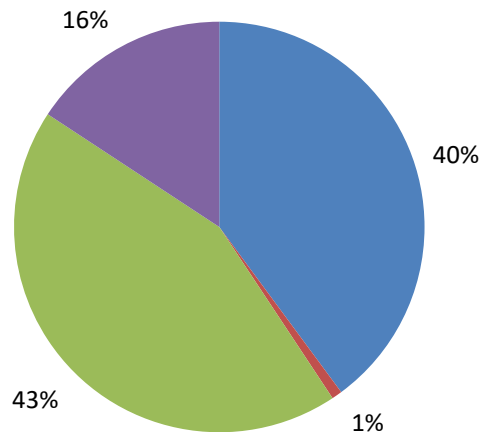
**Figure 5 – Phase of Flight distribution**

The Manoeuvring phase involves intentional low level, low speed flying in the vicinity of obstacles and is the phase where most of the Aerial Work accidents occurred (39%). Also noteworthy is that 61% of all fatal accidents occurred in the En-route phase, whilst most accidents with serious injuries occurred in the Manoeuvring phase (25%).

Figure 6 shows the distribution of engine configurations of the analysed accidents.

## Engine Configuration distribution - 2000-2010 accidents

■ Single Piston 
 ■ Multi Piston 
 ■ Single Turb. 
 ■ Multi Turb.



**Figure 6 – Engine configuration distribution**

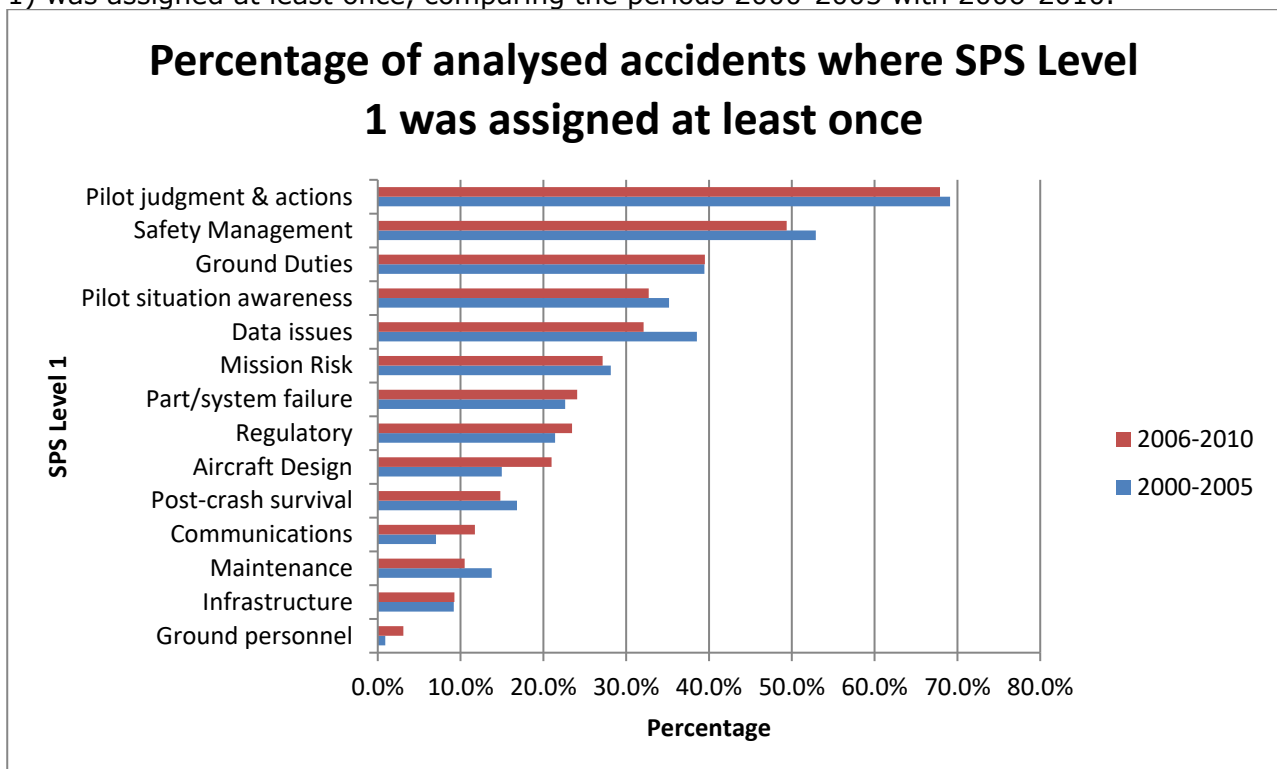


Most analysed accidents occurred to single engine helicopters, who also comprise the majority of the helicopter fleet in Europe.

## 1.2 SPS Analysis – Time Period Comparison

In this section, comparisons will be made between the initial time period of 2000-2005 and the second period of 2006-2010 to see whether there are any significant differences between the two time periods. In order to facilitate easy comparison and reduce the impact of differing implementation of the coding instructions, the percentage of accidents where the SPS/HFACS codes on Level 1 have been assigned at least once will be used in this section, as was the case in the previous report.

Figure 7 shows the percentage of analysed accidents where SPS codes on the top level (Level 1) was assigned at least once, comparing the periods 2000-2005 with 2006-2010.

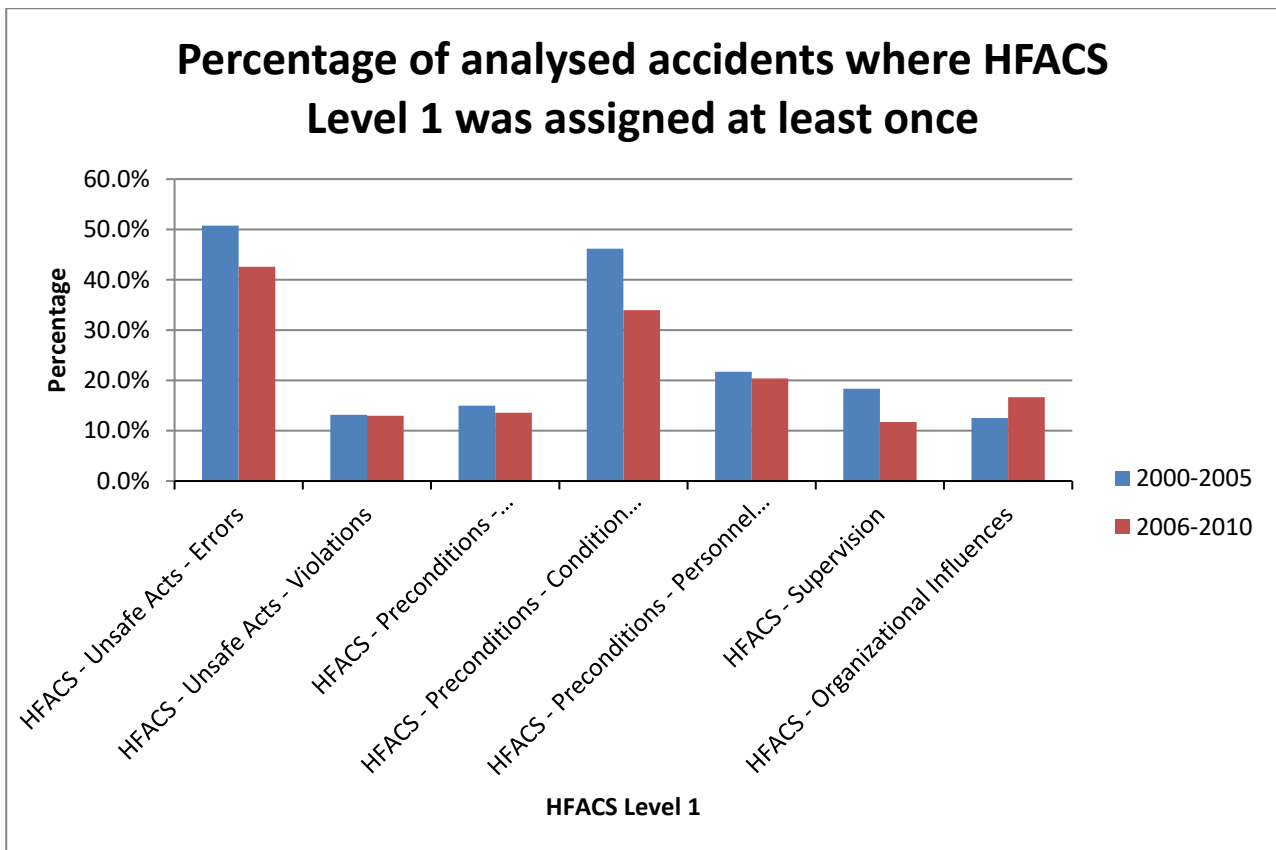


**Figure 7 – Percentage of analysed accidents where SPS Level 1 was assigned at least once**

Figure 7 shows that there is a close correlation between the two analysed time periods; the same areas are still of concern and the issues that were identified in the analysis of the 2000-2005 accidents continue to be significant and the proposed mitigations are still valid.

The highest level of Standard Problem Statements, level 1, only provides information on a general level. To better understand what kind of factors played a role in the accident data set one must look at a deeper level in the taxonomy, which will be done later in this report.

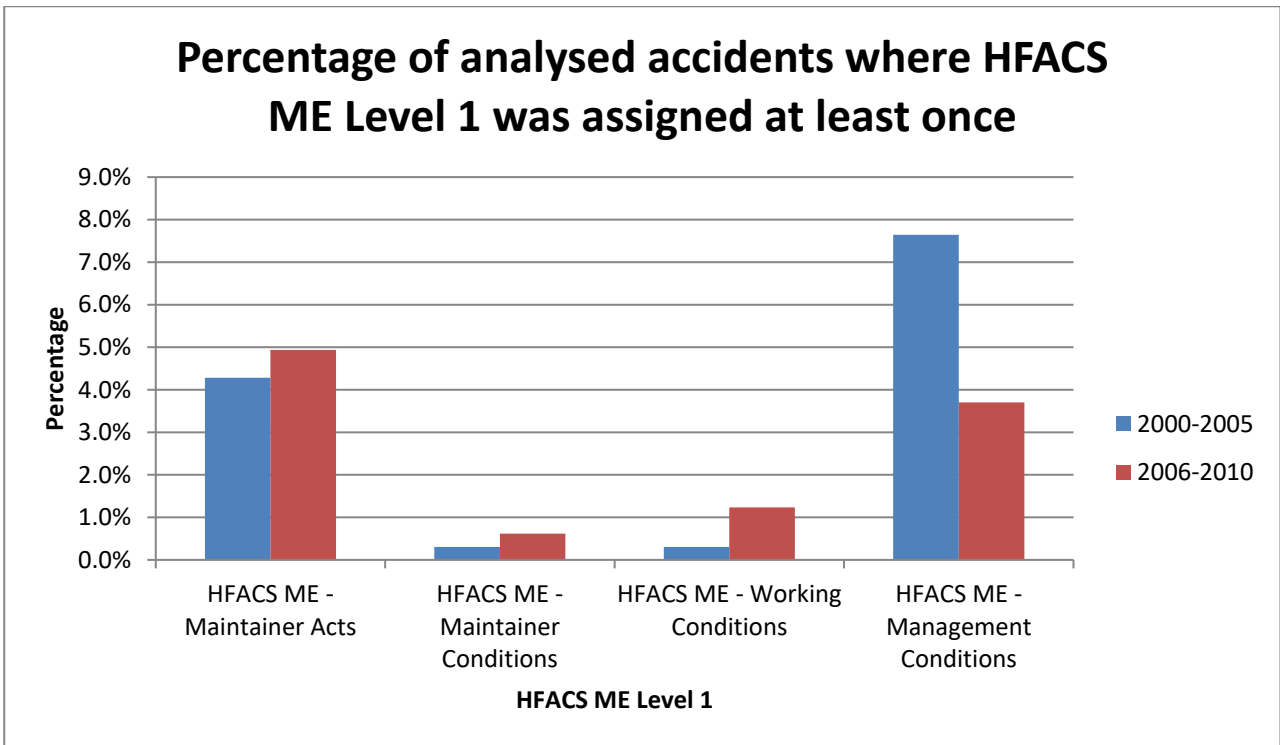
Figure 8 shows the distribution of the percentage of analysed accidents where the top level HFACS codes have been assigned at least once.



**Figure 8 - Percentage of analysed accidents where HFACS Level 1 was assigned at least once**

Also in Figure 8 the magnitude of the HFACS Level 1 codes correlate between the two periods. This is an indication that the problem areas and proposed mitigations identified in the first time period are still valid.

Figure 9 shows the percentage of analysed accidents where HFACS Maintenance Extension (ME) Level 1 codes were assigned at least once.



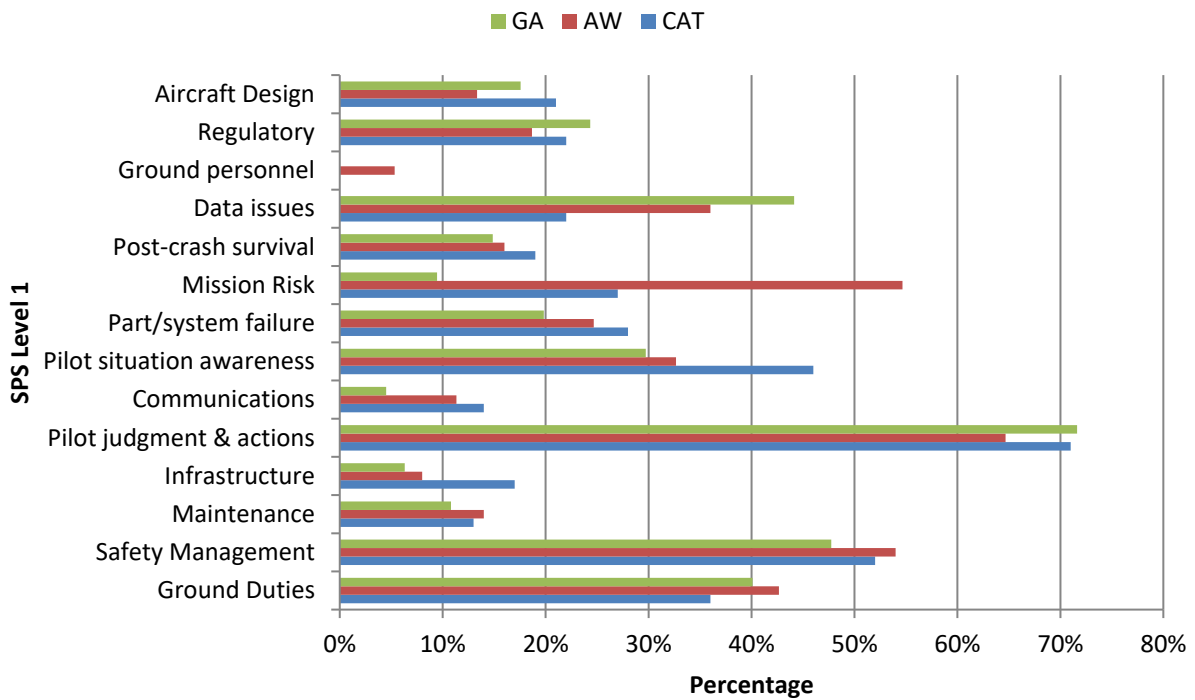
**Figure 9 - Percentage of analysed accidents where HFACS ME Level 1 was assigned at least once**

It should be noted that the number of accidents where Human Factors issues in maintenance were identified is small, slightly less than 10% of the analysed accidents had an HFACS ME code assigned. Also noteworthy is the fact that accident investigations seldom go into the depth of identifying and analysing Human Factor issues in maintenance operations.

### **1.3 SPS Analysis – Type of Operation Comparison**

Figure 10 shows the percentage of accidents where SPS Level 1 has been assigned at least once, split into types of operation (General Aviation, Aerial Work, Commercial Air Transport) for the whole time period 2000-2010.

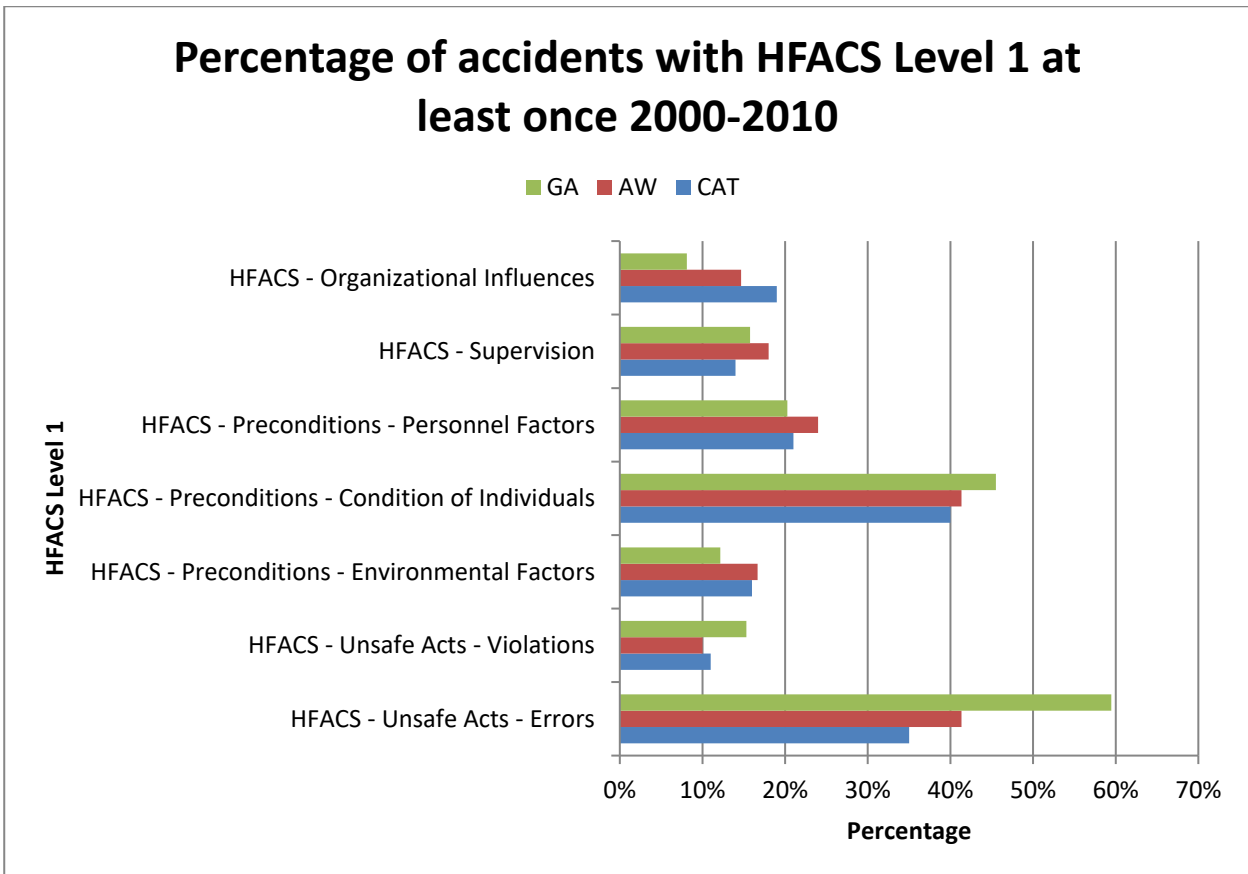
## Percentage of accidents with SPS Level 1 at least once 2000-2010



**Figure 10 - Percentage of analysed accidents per type of operation where SPS Level 1 was assigned at least once**

Noteworthy is that Pilot Situation Awareness is featured most frequently in Commercial Air Transport accidents. Mission Risks shows the biggest difference between the three types of operation. The high presence of Mission Risk SPS in Aerial Work is normal considering that Aerial Work operations are often complex, higher risk missions. The high presence of Data Issues in General Aviation is also not surprising since Accident Investigations into General Aviation accidents normally don't go into as deep detail as for other accidents.

Figure 11 shows the percentage of accidents where HFACS Level 1 codes were assigned at least once, split by types of operation.



**Figure 11 - Percentage of analysed accidents per type of operation where HFACS Level 1 was assigned at least once**

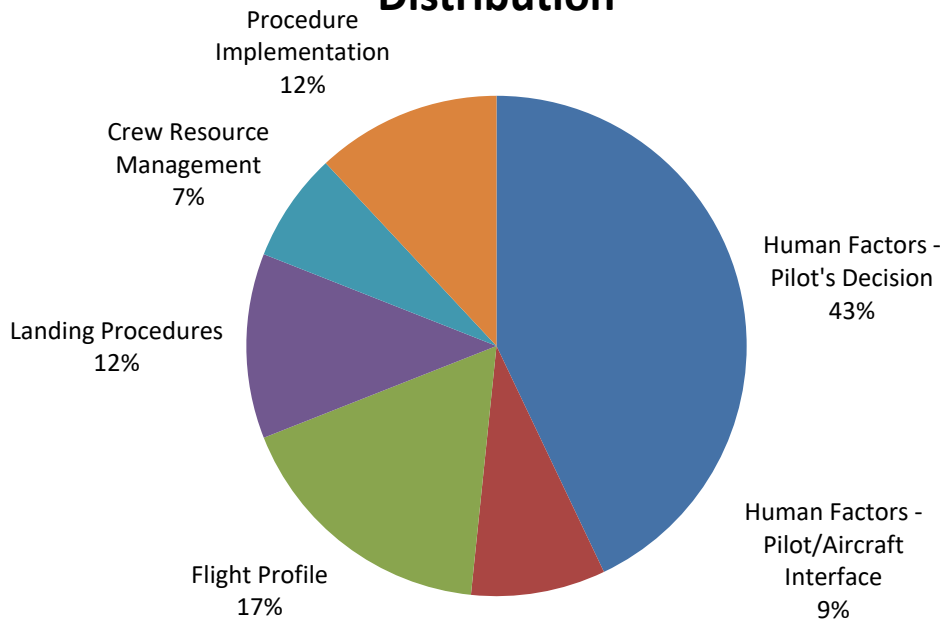
The number of accidents where HFACS ME were identified is so small that it is deemed insignificant and is not further analysed in this report.

#### **1.4 SPS Level 2 Analysis – Commercial Air Transport**

The analysis in this and the following sections are based on total number of SPS assigned and is split by type of operation. A selection of SPS on Level 1 have been analysed deeper into Level 2 to highlight areas of concern.

The Level 2 distribution for the Level 1 SPS "Pilot Judgement & Actions" is shown in Figure 12.

## CAT SPS "Pilot Judgement & Actions" SPS Level 2 Distribution

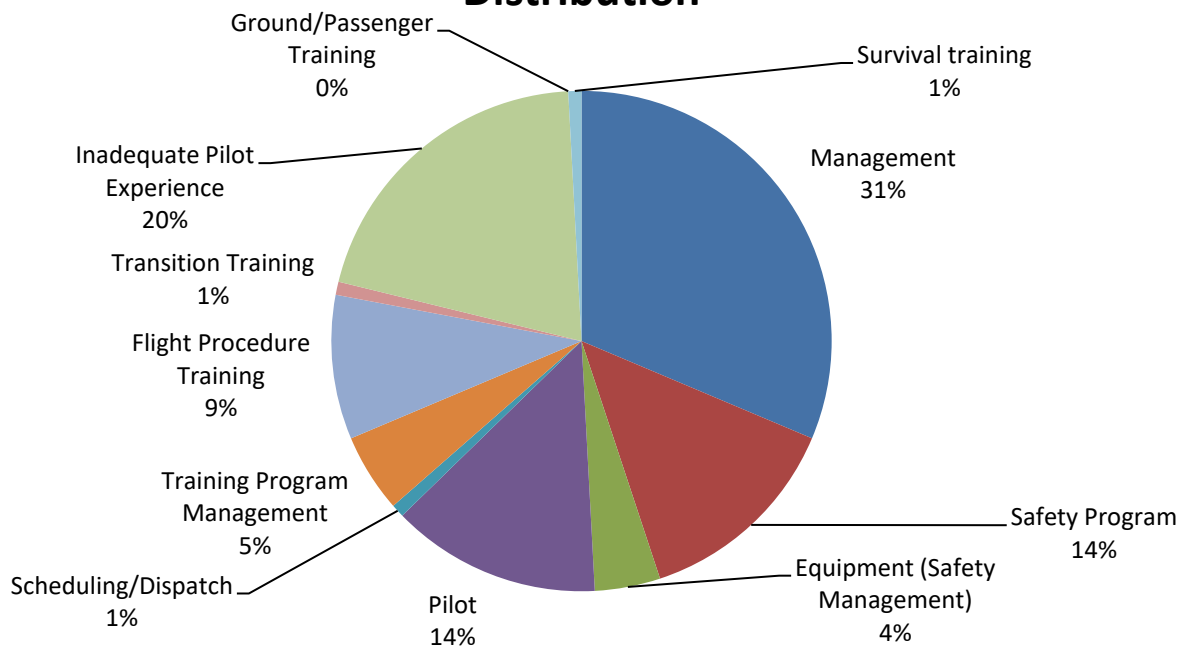


**Figure 12 – CAT SPS "Pilot Judgement & Actions" SPS Level 2 Distribution**

Pilot decision making is the largest concern in this area. It should be noted that the relatively small share of Crew Resource Management (CRM) issues is probably influenced by the majority of flights being flown in a single-pilot environment, approximately 70% of the analysed CAT accidents were flown in a single-pilot environment.

The Level 2 distribution of the SPS Level 1 "Safety Management" is shown in Figure 13.

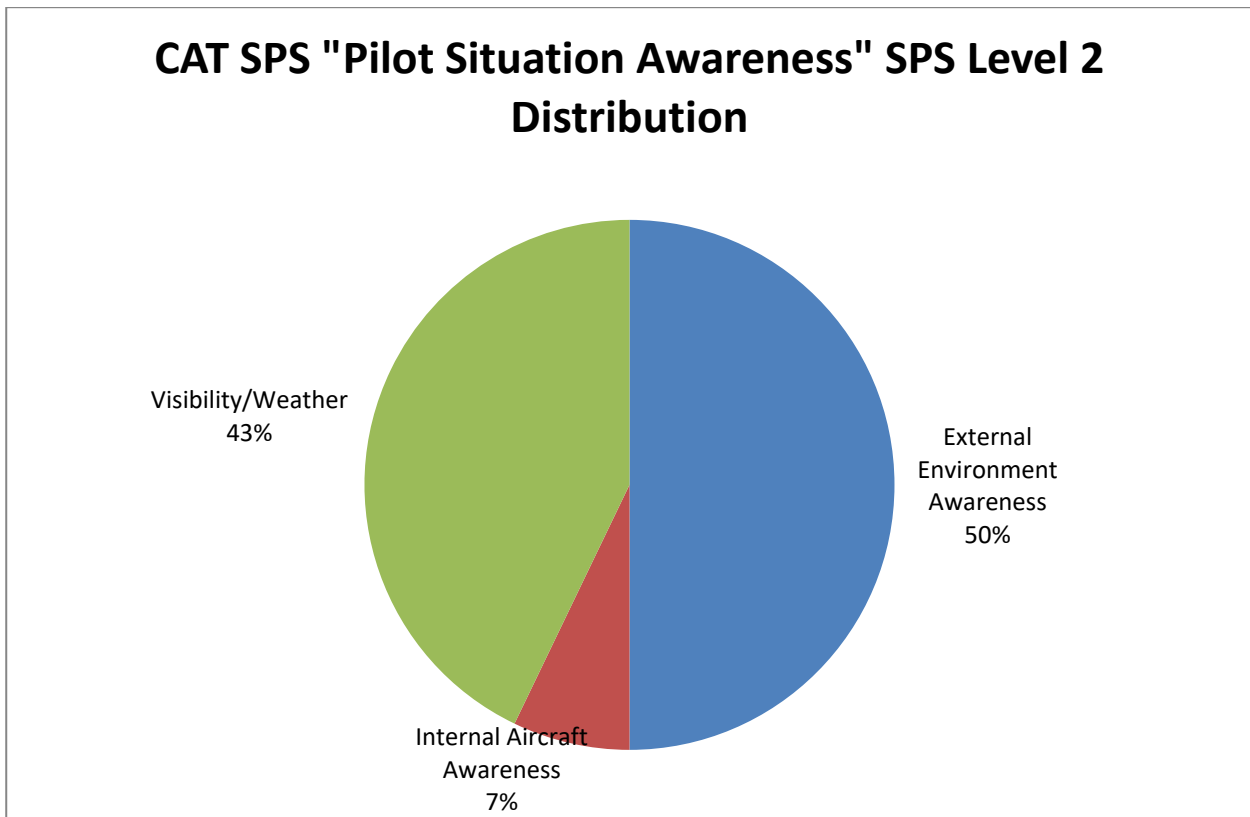
## CAT SPS "Safety Management" SPS Level 2 Distribution



**Figure 13 – CAT SPS "Safety Management" SPS Level 2 Distribution**

The Management of the operations and the assignment of inexperienced pilots to difficult missions are the most prominent concerns in this area.

The Level 2 distribution of the SPS Level 1 "Pilot Situation awareness" is shown in Figure 14.

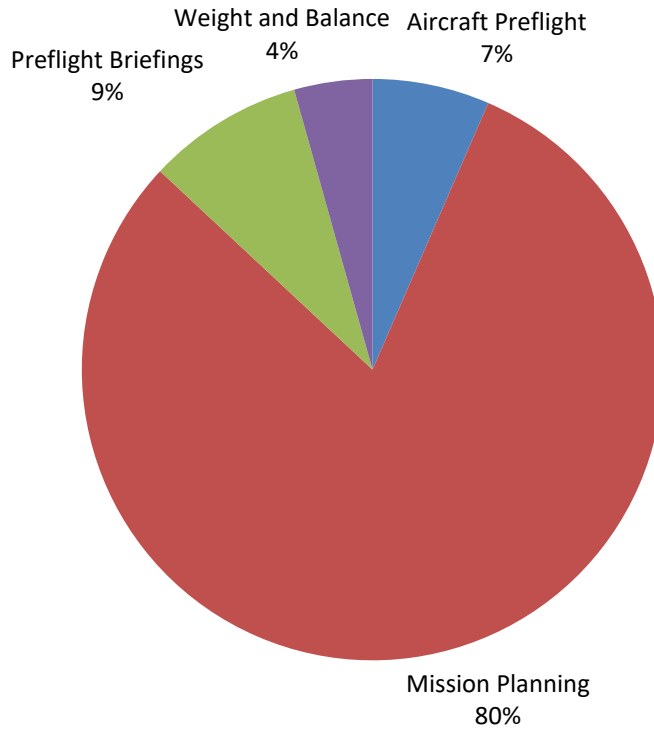


**Figure 14 – CAT SPS "Pilot Situation Awareness" SPS Level 2 Distribution**

The two most prominent concerns in this area are the External Environment Awareness and the Weather and Visibility.

The Level 2 distribution of the Level 1 SPS "Ground Duties" is shown in Figure 15.

## CAT SPS "Ground Duties" SPS Level 2 Distribution

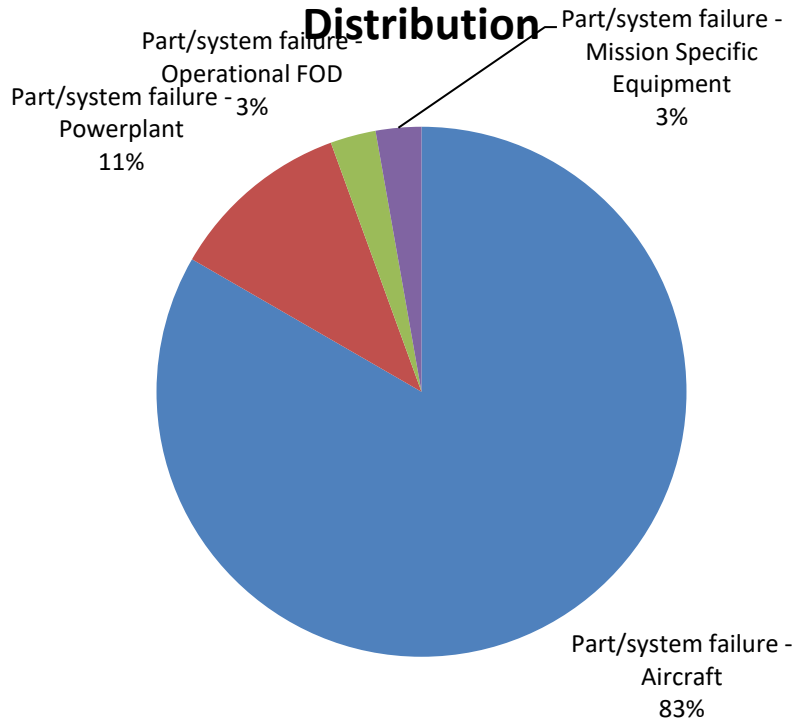


**Figure 15 – CAT SPS "Ground Duties" SPS Level 2 Distribution**

Mission Planning is the area in which most Ground Duties SPS have been identified.

The Level 2 distribution of the SPS Level 1 "Part/System failure" is shown in Figure 16.

## CAT SPS "Part/System Failure" SPS Level 2 Distribution



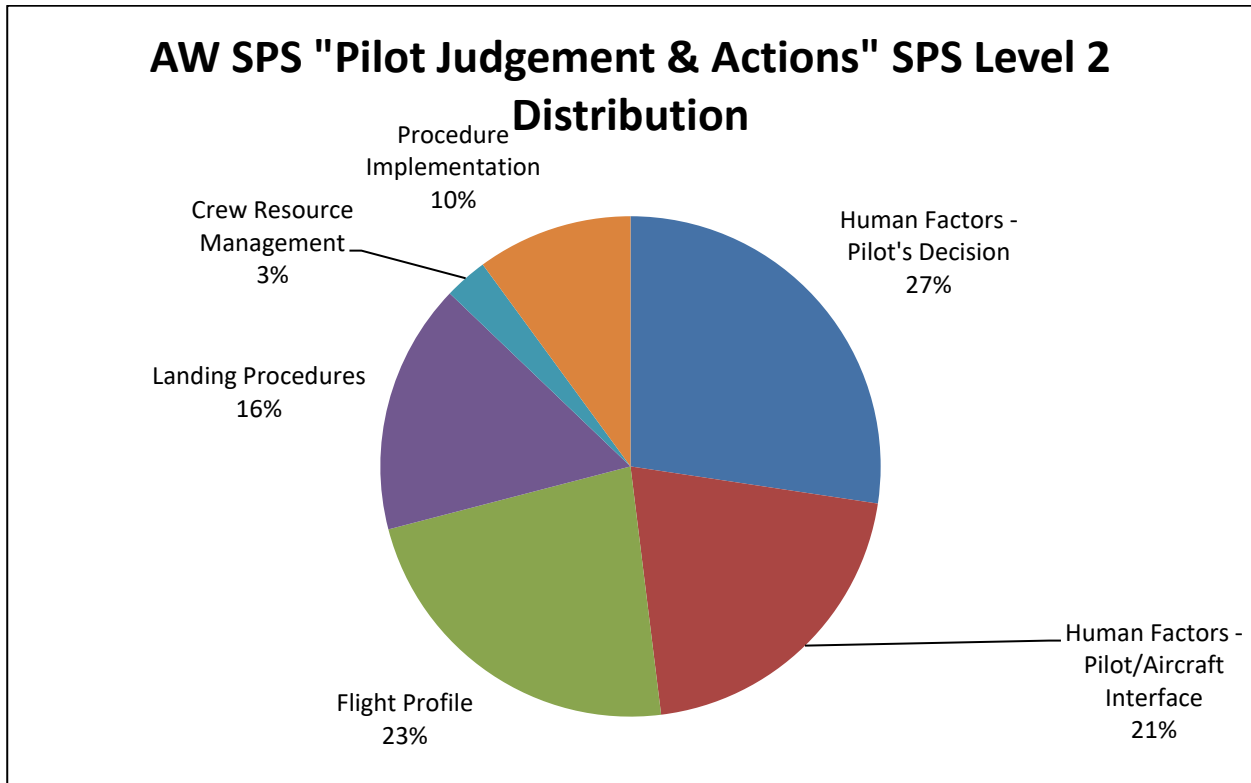
**Figure 16 – CAT SPS "Part/System Failure" SPS Level 2 Distribution**



Failures of the airframe (rather than powerplant/engine failures) are the highest number identified in this area.

### 1.5 SPS Level 2 Analysis – Aerial Work

This section deals with the SPS on Level 2 for Aerial Work, for selected Level 1 SPS. Figure 17 shows the Level 2 distribution of the Level 1 SPS "Pilot Judgement and Actions".

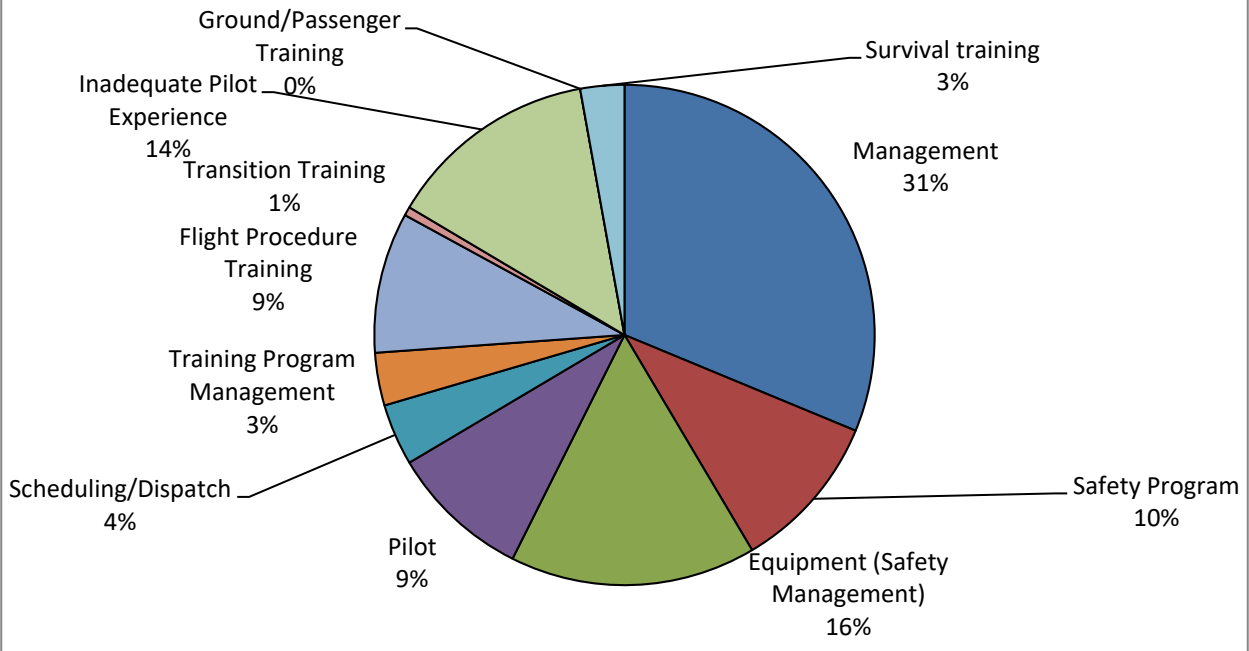


**Figure 17 – AW SPS "Pilot Judgement & Actions" SPS Level 2 Distribution**

The top 3 issues identified in this area are Pilot's Decision, Flight Profile and Pilot/Aircraft Interface, with the latter noticeably higher than for CAT and GA.

Figure 18 shows the Level 2 distribution of the Level 1 SPS "Safety Management" for Aerial Work.

## AW SPS "Safety Management" SPS Level 2 Distribution

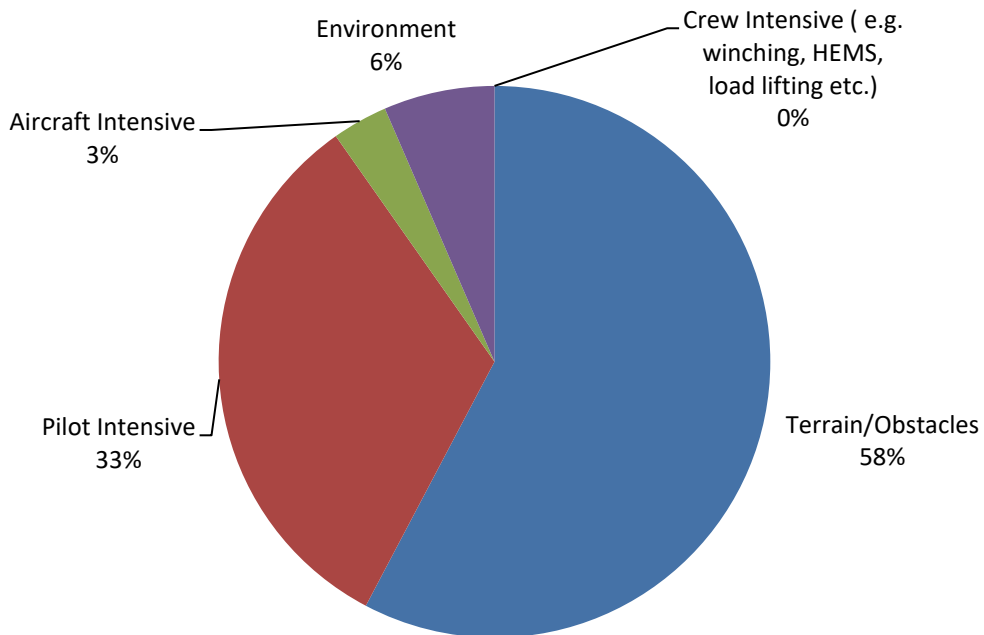


**Figure 18 – AW SPS "Safety Management" SPS Level 2 Distribution**

In this area, the top 3 identified issues are Management, Equipment (Helicopters not adequately equipped for mission purposes and/or Personal protective equipment inadequate or unavailable) and Safety Program. Management is overall the third highest SPS Level 2 for Aerial Work.

Figure 19 shows the Level 2 distribution of the Level 1 SPS "Mission Risk".

## AW SPS "Mission Risk" SPS Level 2 Distribution



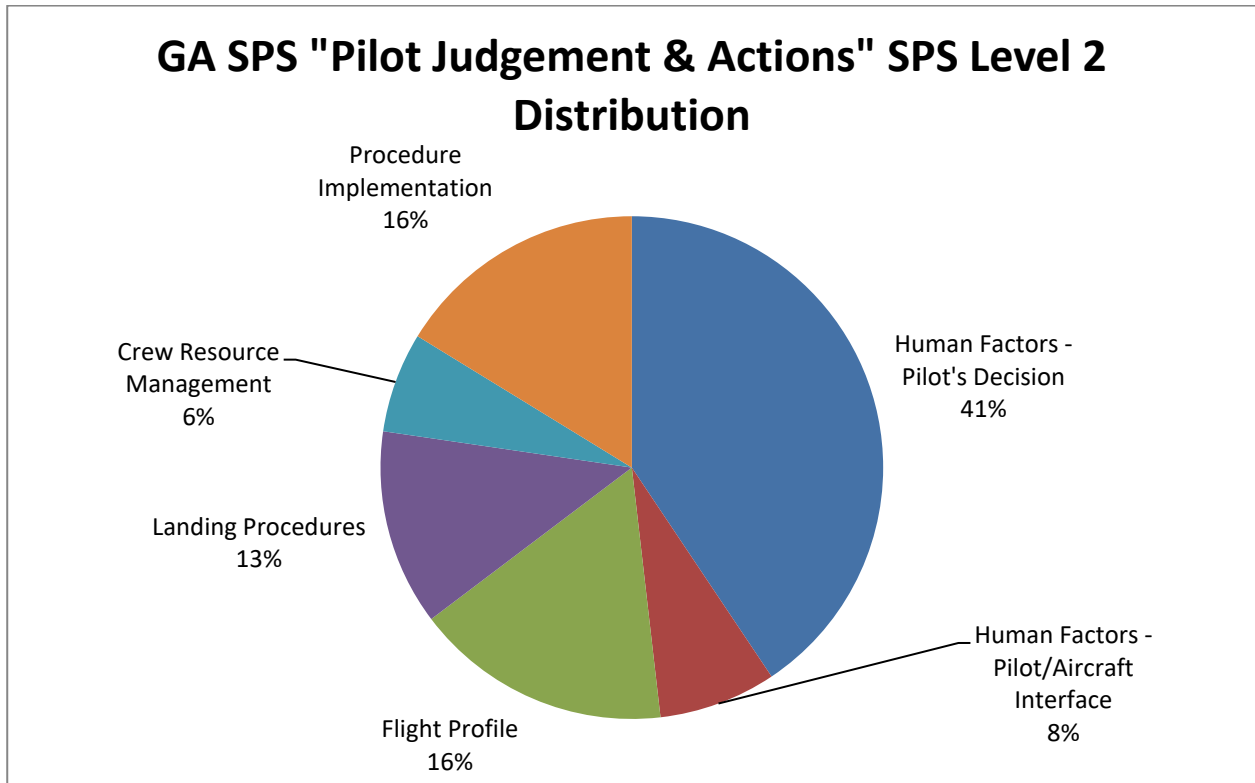
**Figure 19 – AW SPS "Mission Risk" SPS Level 2 Distribution**

Not surprisingly, the proximity to terrain and obstacles are the highest areas of concerns for Aerial Work missions. Many Aerial Work missions are conducted at low height, for example Power line inspections, Reindeer herding and firefighting.

### 1.6 SPS Level 2 Analysis – General Aviation

This section deals with the SPS on Level 2 for General Aviation, for selected Level 1 SPS.

Figure 20 shows the Level 2 distribution of the Level 1 SPS "Pilot Judgement & Actions".

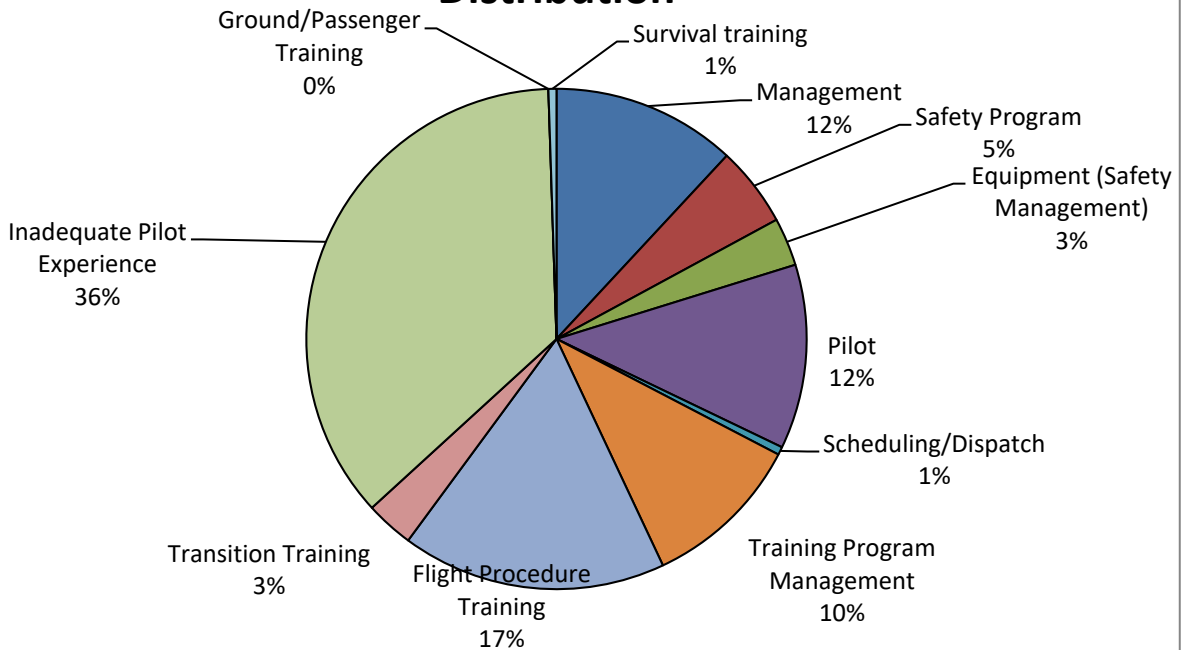


**Figure 20 – GA SPS "Pilot Judgement & Actions" SPS Level 2 Distribution**

In this area, the top 3 issues are Pilot's decision, Flight Profile and Procedure Implementation.

Figure 21 shows the Level 2 distribution of the Level 1 SPS "Safety Management".

## GA SPS "Safety Management" SPS Level 2 Distribution

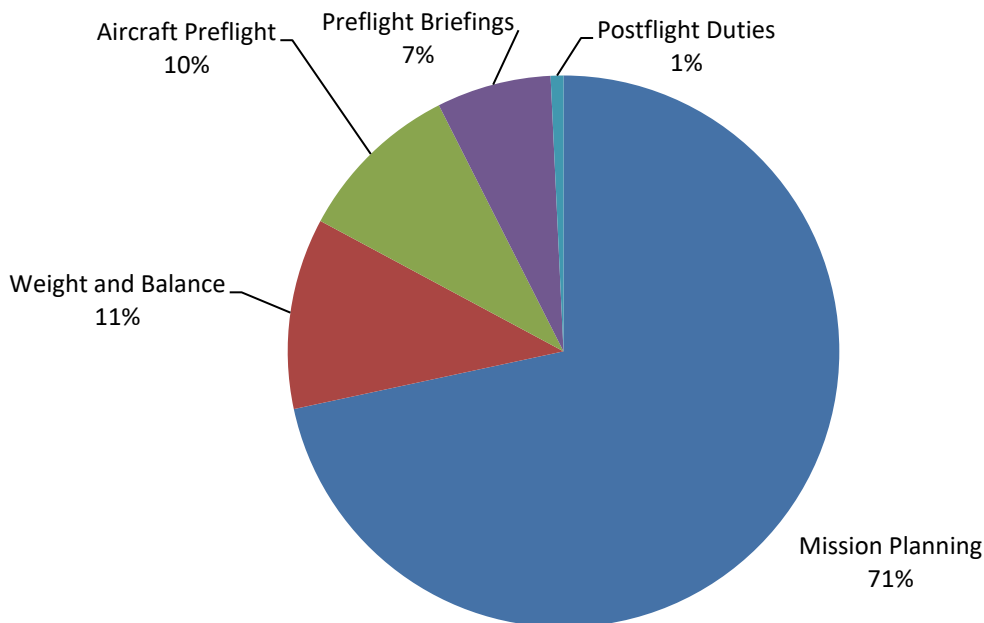


**Figure 21 – GA SPS "Safety Management" SPS Level 2 Distribution**

In this area, the top 3 issues are Inadequate Pilot Experience, Flight Procedure Training and Pilot (disregard of known safety risk/self-induced pressure), with, as to be expected, less management issues in GA.

Figure 22 shows the Level 2 distribution of the Level 1 SPS "Ground Duties".

## GA SPS "Ground duties" SPS Level 2 Distribution



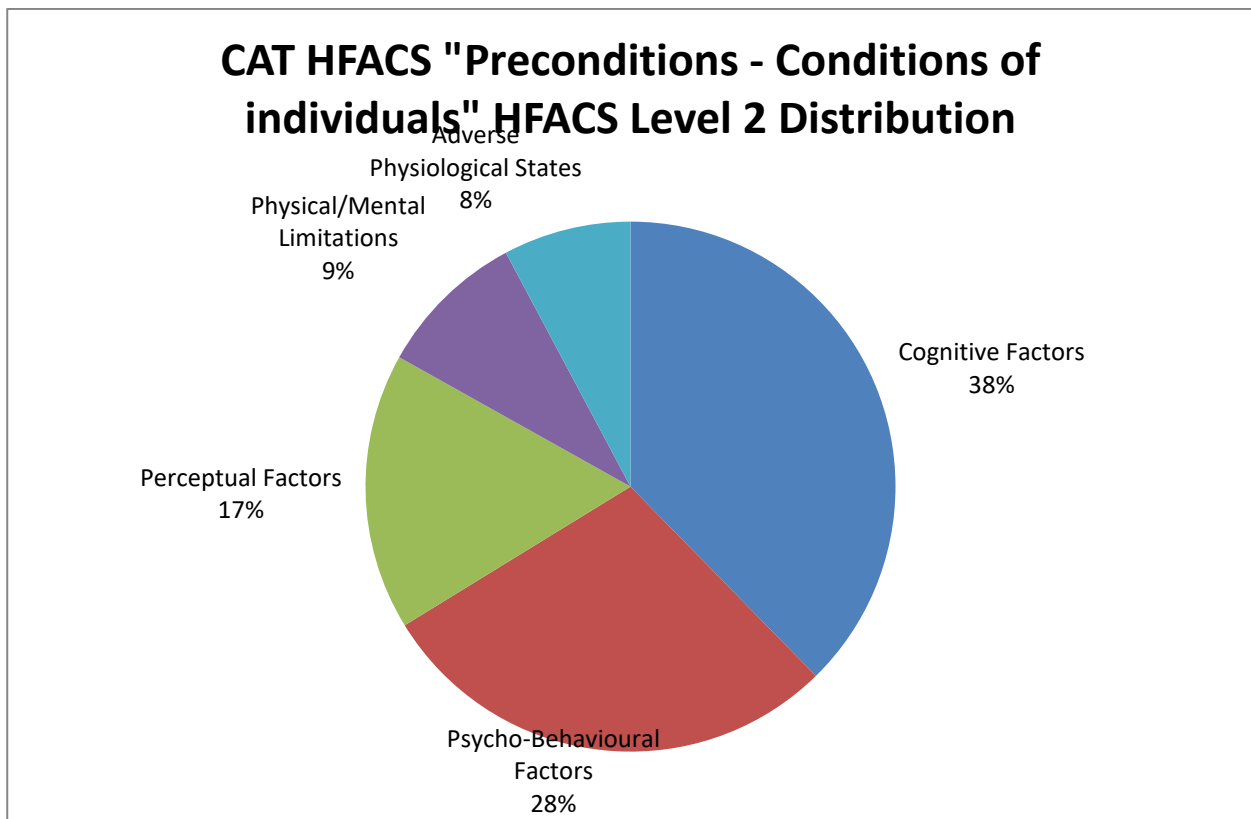
**Figure 22 – GA SPS "Ground Duties" SPS Level 2 Distribution**

Mission Planning is the main issue in this area, followed by Weight and Balance and Aircraft preflight.

### 1.7 HFACS Level 2 Analysis – Commercial Air Transport

This section highlights the HFACS analysis performed by the regional teams on Commercial Air Transport accidents.

Figure 23 shows the Level 2 distribution of the Level 1 HFACS "Preconditions – Conditions of Individuals".

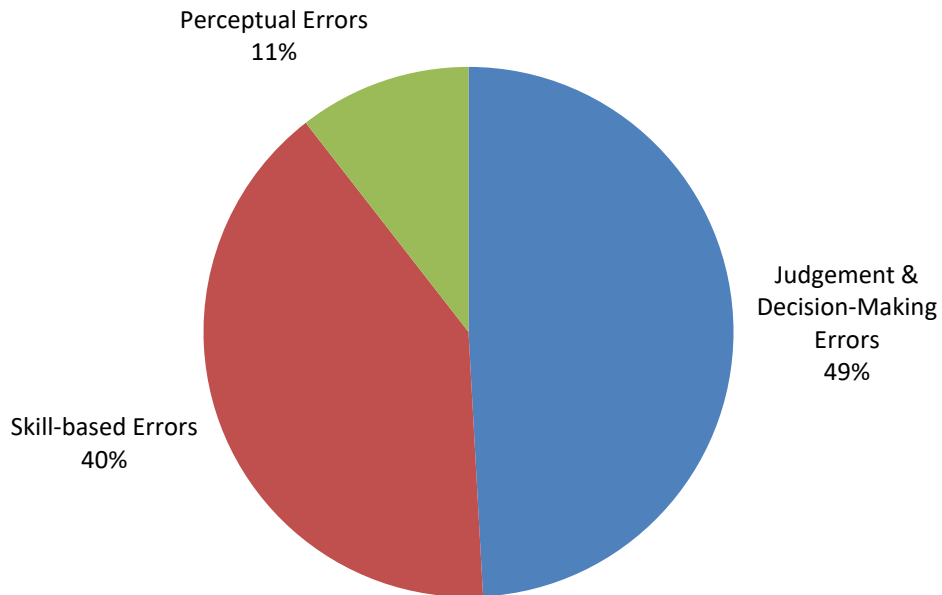


**Figure 23 – CAT HFACS "Preconditions – Conditions of individuals" HFACS Level 2 Distribution**

Cognitive Factors, Psycho-Behavioural Factors and Perceptual Factors are the 3 main issues in this area.

Figure 24 shows the Level 2 distribution of the Level 1 HFACS "Unsafe acts – Errors".

## CAT HFACS "Unsafe acts - Errors" HFACS Level 2 Distribution

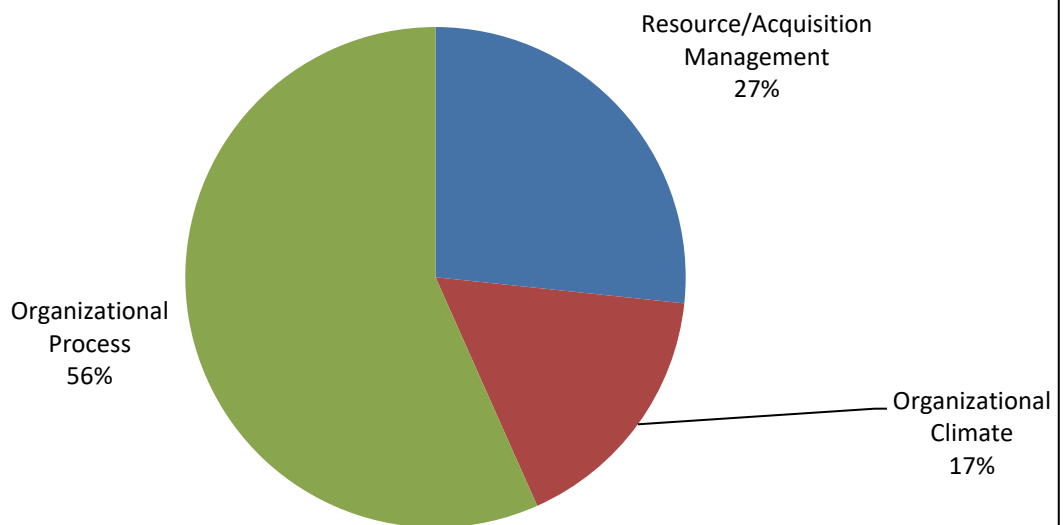


**Figure 24 – CAT HFACS "Unsafe acts – Errors" HFACS Level 2 Distribution**

The Judgement and Decision-making Errors are the main issues in this area, followed by the Skill-Based Errors.

Figure 25 shows the Level 2 distribution of the Level 1 HFACS "Organisational Influences".

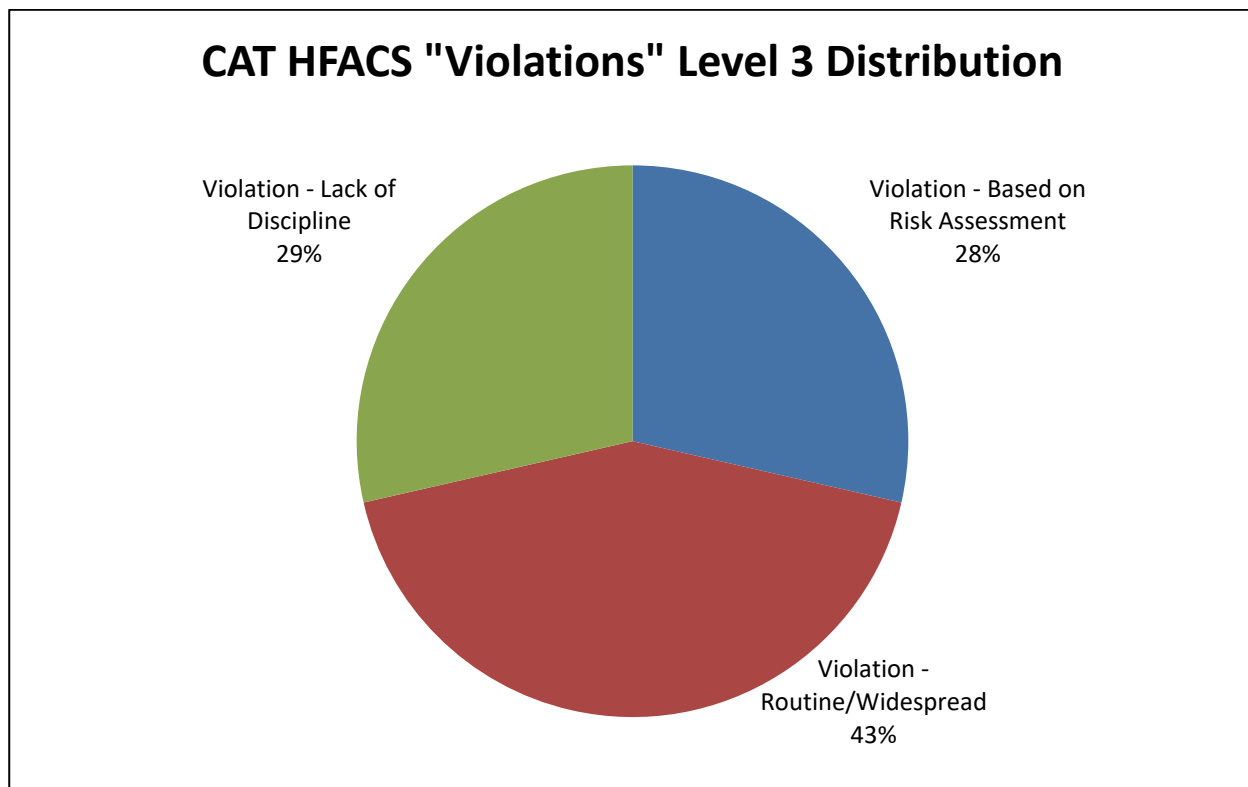
## CAT HFACS "Organisational Influences" Level 2 Distribution



**Figure 25 – CAT HFACS "Organisational influences" Level 2 Distribution**

The Organisational Process, which includes Workload issues, is the top issue of concern in this area.

Figure 26 shows the Level 3 distribution of the Level 1 and Level 2 HFACS "Violations". There is no Level 2 HFACS categorisation under "Violations".

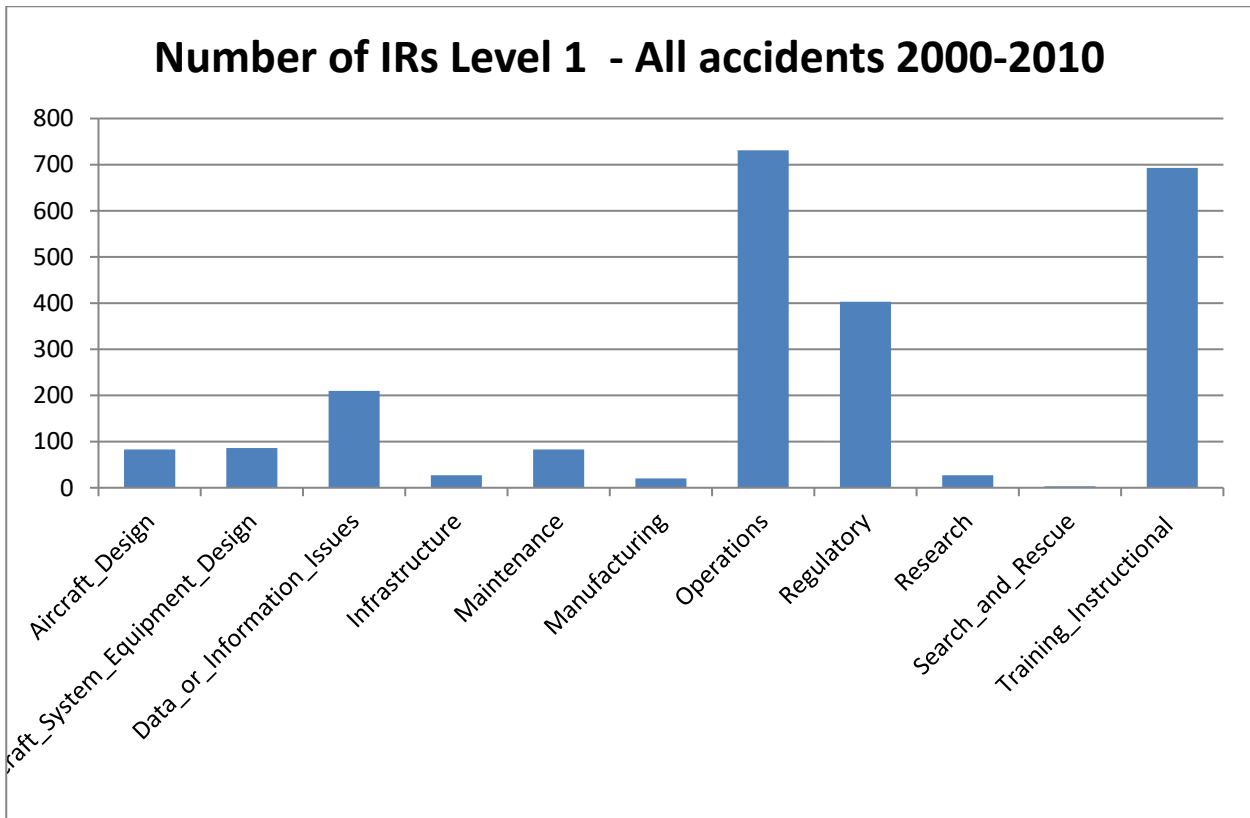


**Figure 26 – CAT HFACS "Violations" Level 3 Distribution**

### ***1.8 Intervention Recommendations Analysis***

This section reviews the Intervention Recommendations (IRs) assigned by the EHSAT national teams. All IRs that have been assigned in the analysis of the 2006-2010 accidents have been collected and sent to the respective EHSIT implementation teams for further processing.

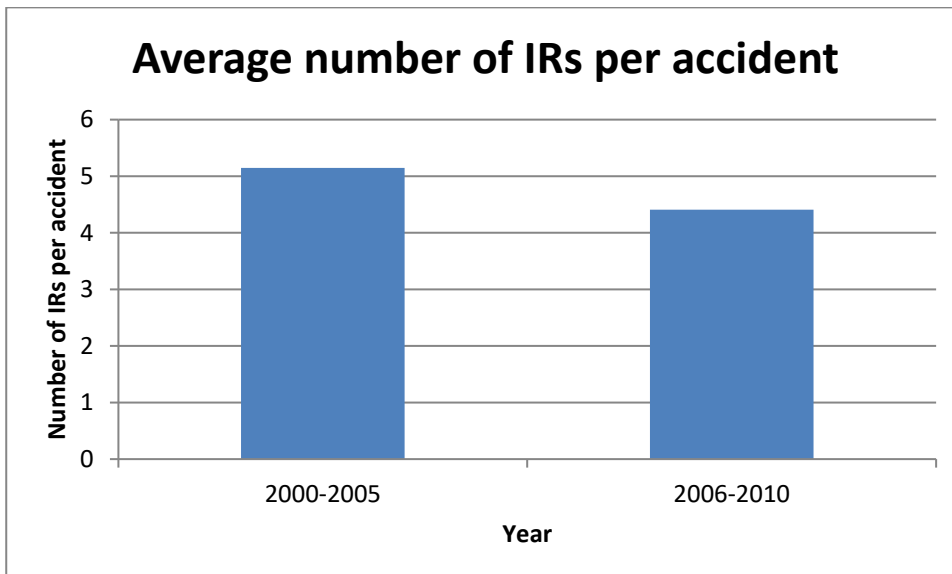
This section covers IRs assigned to accidents in the time period 2000-2010. IRs are categorised in two levels, and Figure 27 shows the number of IRs per Level 1 category.



**Figure 27 – Number of IRs Level 1 – All accidents 2000-2010**

The top 3 categories of Intervention Recommendations are Operations, Training/Instructional and Regulatory. This was already seen in the analysis of the 2000-2005 accidents and the EHSIT teams were formed accordingly.

Figure 28 shows a time period comparison on the average number of IRs assigned per accident. The average has decreased slightly in the 2006-2010 period.

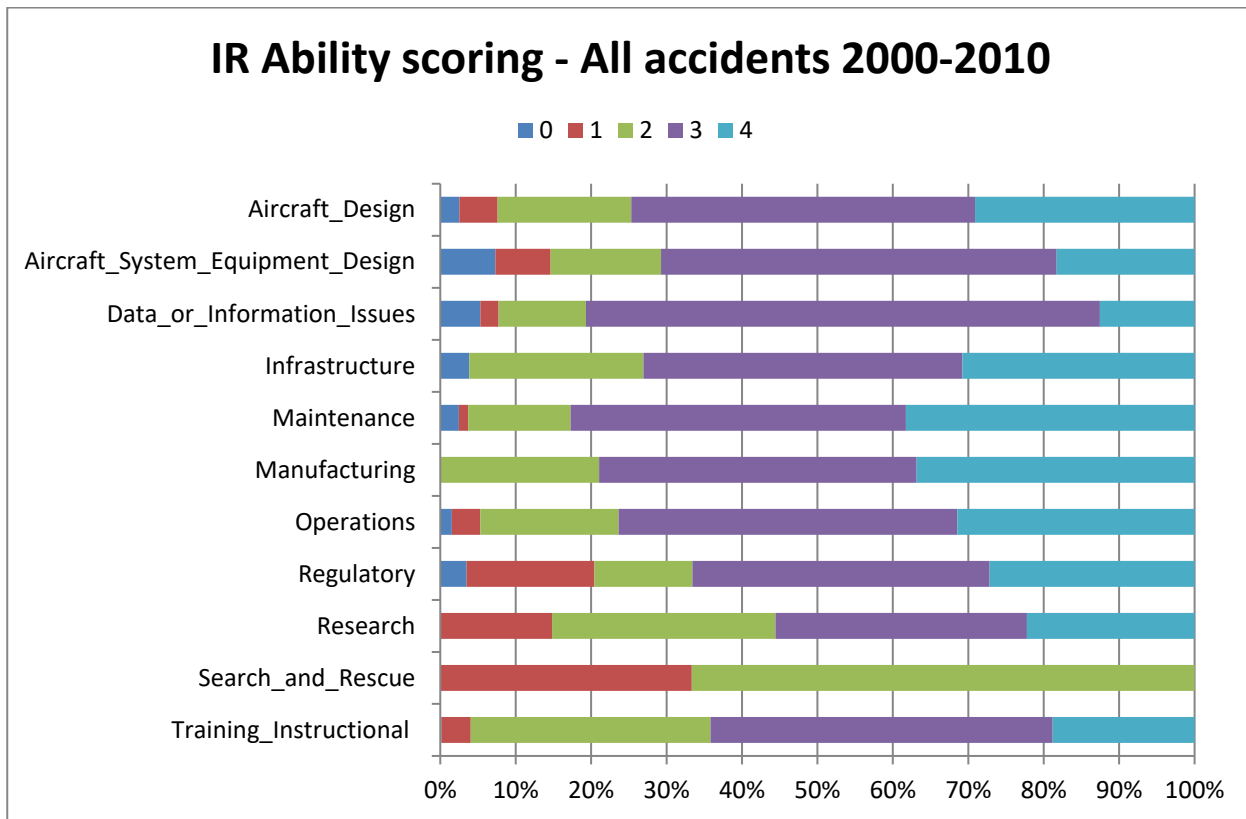


**Figure 28 – Time period comparison – Average number of IRs per accident**

The Intervention Recommendations are scored, based on the judgement of the EHSAT Analysis Team performing the analysis, on their Ability and Usage. Ability being how effective the proposed intervention would be in mitigating the problem, and Usage being the how probable it is that the proposed intervention will be implemented. Both Ability and Usage are



scored from 0 to 4. Figure 29 shows the percentage distribution of the Ability scoring for each IR Level 1 category.

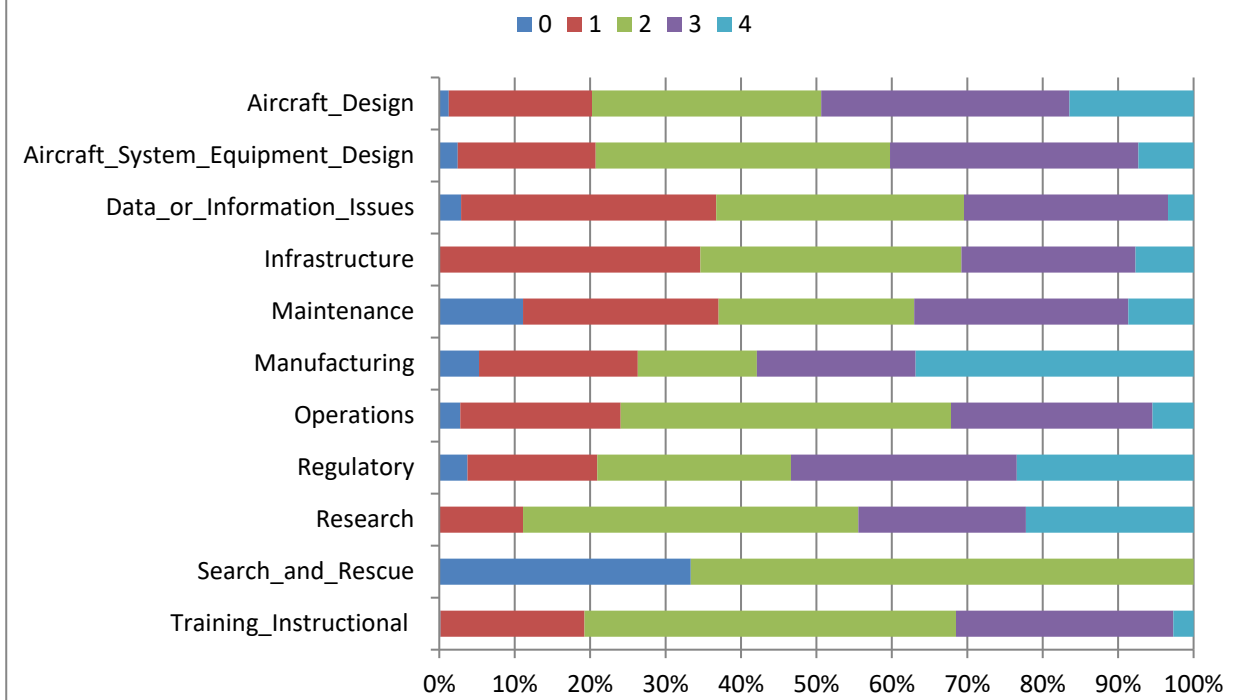


**Figure 29 – Distribution of IR Ability scoring per IR Level 1 category – All accidents 2000-2010**

The highest Ability IRs have been given in the Maintenance category, with more than 80% of those IRs scoring 3 or 4. Data or Information issues, which mainly covers the availability of data to accident investigators, also have more than 80% scoring 3 or 4. The lowest Ability IR category is the Search and Rescue, with no IRs scoring 3 or 4. It should however be noted that only 3 Search and Rescue IRs were proposed.

Figure 30 shows the percentage distribution of the Usage scoring for each IR Level 1 category.

## IR Usage scoring - All accidents 2000-2010



**Figure 30 – Distribution of IR Usage scoring per IR Level 1 category – All accidents 2000-2010**

The Usage scoring is generally lower than the Ability scoring. Infrastructure IRs (Search and Rescue excluded) have the lowest usage scoring, with only just over 30% scoring 3 or 4. Many IR categories, for example Operations, Training/Instructional and Data/Information Issues also have just over 30% scoring 3 or 4. The highest usage scorings are in the Manufacturing and Regulatory categories with over 50% scoring 3 or 4.

## **2 Concluding Remarks and Way Forward**

The continued analysis of Helicopter Accidents in the period 2006-2010 by the EHSAT Teams and the comparison with the analysis of 2000-2005 accidents have confirmed that the issues identified in this first period continue to be of concern and that the safety improvement actions decided based on the first analysis period are still valid.

Since this first analysis report was published, the EHSIT Specialist Teams Training, Ops & SMS and Technology have produced a number of safety promotion material in the form of leaflets, videos, toolkits, manuals and reports. That material addresses and provides ways to mitigate the top safety issues and intervention recommendations identified in the analysis of the 2000-2005 accidents.

This work continues and the results of the analysis of the 2006-2010 accidents will be communicated to the EHSIT STs and will contribute to shaping the future priorities and actions of the EHIST Specialist Teams.

Results will also be shared within EASA and contribute to defining the helicopter Safety Risk Portfolio, which will serve as a basis to develop the helicopter section of the European Aviation Safety plan (EASp).