European Aviation Safety Agency

# Study on single-engined helicopter operations over a hostile environment

## Data Gathering Report

ALG TRANSPORTATION INFRASTRUCTURE & LOGISTICS europraxis *in consortium with* SGI AVIATION

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# Table of Contents

## Index of tables

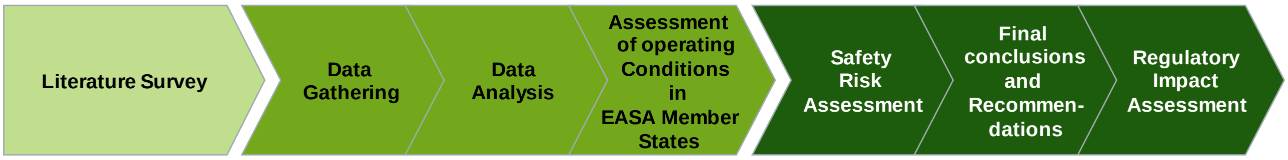


## Index of figures

# 1 Introduction

## 1.1 Introduction

The study on the single-engined helicopter operations over a hostile environment consists of the following tasks:




The first task of the study, the literature survey, was achieved and the relevant report was approved by EASA. This task encompassed a survey and appraisal of the relevant, currently available publications pertinent to the scope of this study including reference documents, report, general publications and databases on helicopter operations, as well as on the helicopter operators, their fleets and aircraft usage and the associated accident and incident databases necessary for the subsequent tasks of the study.

The Literature Survey identified the databases official and unofficial from a multiplicity of sources necessary for the data gathering and analysis.

In reviewing them it was concluded that no single source can provide the completeness and quality of data necessary to produce a meaningful analysis. It was proposed therefore to adopt a “multiple-source” approach to data collection both for safety occurrences and for identifying the operators and their fleets as depicted in the table below:

| Info type | Source | Suitability for the Study |
|---|---|---|
| Occurrences | Accident/Incident Data Reporting (ADREP) | Medium |
| | European Central Repository (ECR) | Medium |
| | European Helicopter Safety Analysis Team (EHSAT) | Medium |
| | EUROCOPTER Occurrence Data | High |
| | Turbomeca | High |
| | World Aircraft Accident Summary (WAAS) | Medium |
| | Aviation Safety Net (ASN) | High |
| | Helihub | Medium |
| | Griffin | Low |
| | Helis | Low |
| Helicopter Usage | Civil Aviation Authorities | High |
| | EUROCOPTER database | High |
| | Bell | High |
| Fleet and operator information | Single-Engined Helicopter Fleet EASA database | Medium |
| | EUROCOPTER database | High |
| | International Register of Civil Aviation (IRCA) | Medium |
| | JP Airlines Fleets International | Low |
| | Helicopter Blue Book | Medium |
| | Rotor Roster Business Class Helicopters | High |
| | Rotorspot | Medium |
| | Helihub | Medium |

Table 1: Information sources

The second task of the study is the **Data Gathering.** The **Data Gathering** is the first subtask (2a) of the second task of the study named **Data Gathering and Analysis.** The aim of the data gathering is to collect and collate extensive data about the usage of single-engined helicopters in all types of operations over hostile and non-hostile environment in EASA Member States from the above-mentioned source of information. This includes:

- the current identity and status of all known helicopter operators in the Member States and the composition of their helicopter fleets,
- the scope of their operations and proportion of different types of operation in the overall business model of the operators,
- the types of helicopter operated and their average age,
- the total accumulated flight time for all operators and by helicopter type over the most recent ten-year period (01/01/2003 to 31/12/2012)
- the number and severity of those helicopter accidents occurred during the same period characterised by the date of the event, operator, type and age of helicopter and the number and type (piston or turboshaft) of engines, location, numbers of occupants (passengers and crew), number of serious injuries and/or fatalities and overall severity of accidents. This item and above mentioned at this paragraph will form the basis of the single-engined helicopter accident analysis.
- the current and past numbers of professional pilots and maintenance staff involved in the operations (full and part-time),
- the total numbers of transported passengers,
- the total number of flights operated on services provided to customers,
- the identification of operating environment (hostile or non-hostile) and,
- total annual revenue for at least the last three years.

Using all of the above data as appropriate a detailed analysis of accidents and serious incidents in the most recent ten year period (01/01/2003 to 31/12/2012) will be conducted, shown compared to the accumulated flight hours of single-engined helicopter types in EASA Member States for the same period.

This is then the “Second Interim/progress report” of the Study and reflects the results for the **Data Gathering.**

# 2 Executive Summary

This section of the report highlights the tasks undertaken as part of the data gathering together with the main outcomes raised during this process.

Our approach to the data gathering has been to establish three (3) “multisource” databases to be able to collect and collate the expected data. The three (3) databases, their sources and the data that can be obtained from are depicted in the figure below. This figure also states on the progress of the data gathering process from the different sources.

For the sake of clarity, the scope of the final output of the data gathering is for civil single-engined helicopter registered in EASA member states in all types of operations over hostile and non-hostile environment over the most recent ten-year period (01/01/2003 to 31/12/2012) operated in EASA member states.

We have been progressing quite well in the collection of accident/incident data and helicopter fleet data, we faced difficulties to collect the helicopter usage data (FH/FC). Indeed, we enquired all the 31 Civil Aviation Authorities of EASA member states. In our enquiry we joined the EASA letter.

It may well be that the contacts available in IRCA (International Register of Civil Aviation) used for the enquiries are not the most appropriate. The Consortium would appreciate the support from EASA to obtain an updated list of contacts.

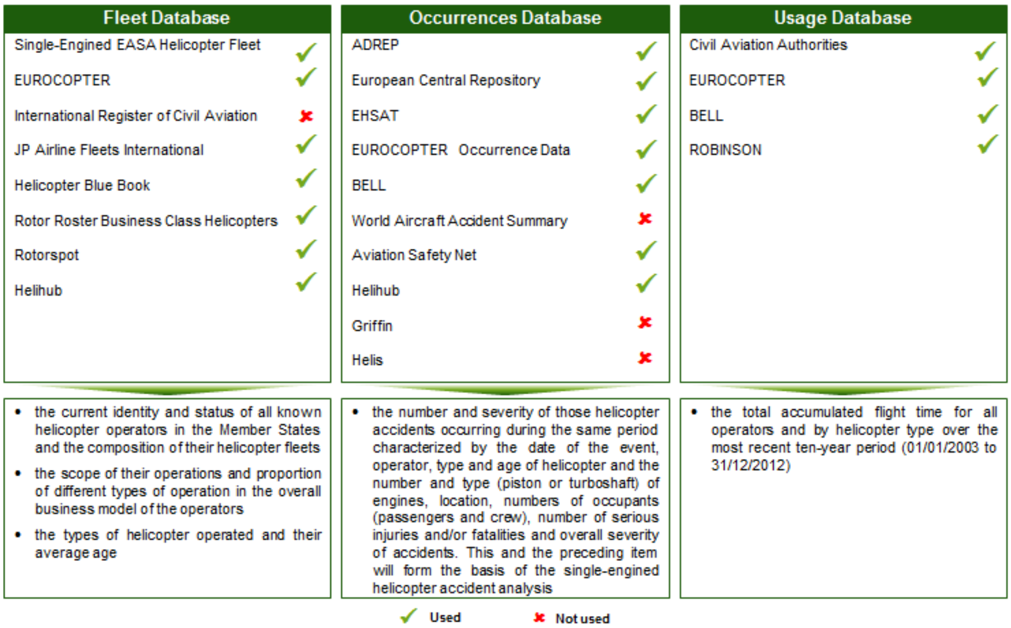



Figure 1: Fleet database building scheme

Additionally, the data gathering process was particularly challenging and time-consuming, more so than initially expected and the following information has not yet been gathered:

- the current and past numbers of professional pilots and maintenance staff involved in the operations (full and part-time),
- the total numbers of transported passengers,
- the total number of flights operated on services provided to customers,
- the identification of operating environment (hostile or non-hostile) and,
- total annual revenue for at least the last three years.

However this lack of data does not prevent to continue the study and proceed with the data analysis since the core of the single-engined helicopter accident analysis will be based on the data related to helicopter usage for all operators and by helicopter type over the most recent ten-year period (01/01/2003 to 31/12/2012) and the occurrence data. The collection of this missing data shall be conducted in parallel.

In the following sections of the report we describe the process to consolidate each database:

- **Section 1** "Introduction and Executive Summary" is the Presentation of the Report and of the main outcomes of the data gathering.
- **Section 2** "Fleet Database" describes the raw data of the sources of information identified and details the merging process of the "multisource" database and its final consolidation for single-engined helicopter fleet related data**.**
- **Section 3 "**Occurrence Database" describes the raw data of the sources of information identified and details the merging process of the "multisource" database and its final consolidation for single-engined helicopter occurrences related data**.**
- **Section 4** "Usage Database" describes the raw data of the sources of information identified and details the merging process of the "multisource" database and its final consolidation for single-engined helicopter usage related data**.**.

This report is supported by the two (2) files consolidating the data gathering for the Occurrence Database and the Fleet Database. These two (2) files are provided separately. We do not consider these to be static databases. They will continue to be updated so as to ensure the databases are duly completed before proceeding with the Safety Risk Assessment foreseen for this study.

# 3 Fleet Database

The target of this phase is to consolidate a single helicopter fleet database that pictures the current fleet in EASA member states, with as much information as possible about its ownership and operators, as well as supplementary information that may be useful in further steps of the study.

The procedure to obtain the database includes the gathering, treatment, merging, and polishing of the raw data obtained from the different sources identified in the first task of the project, the literature survey.

The following scheme summarizes the process followed for the consolidation of the single database:

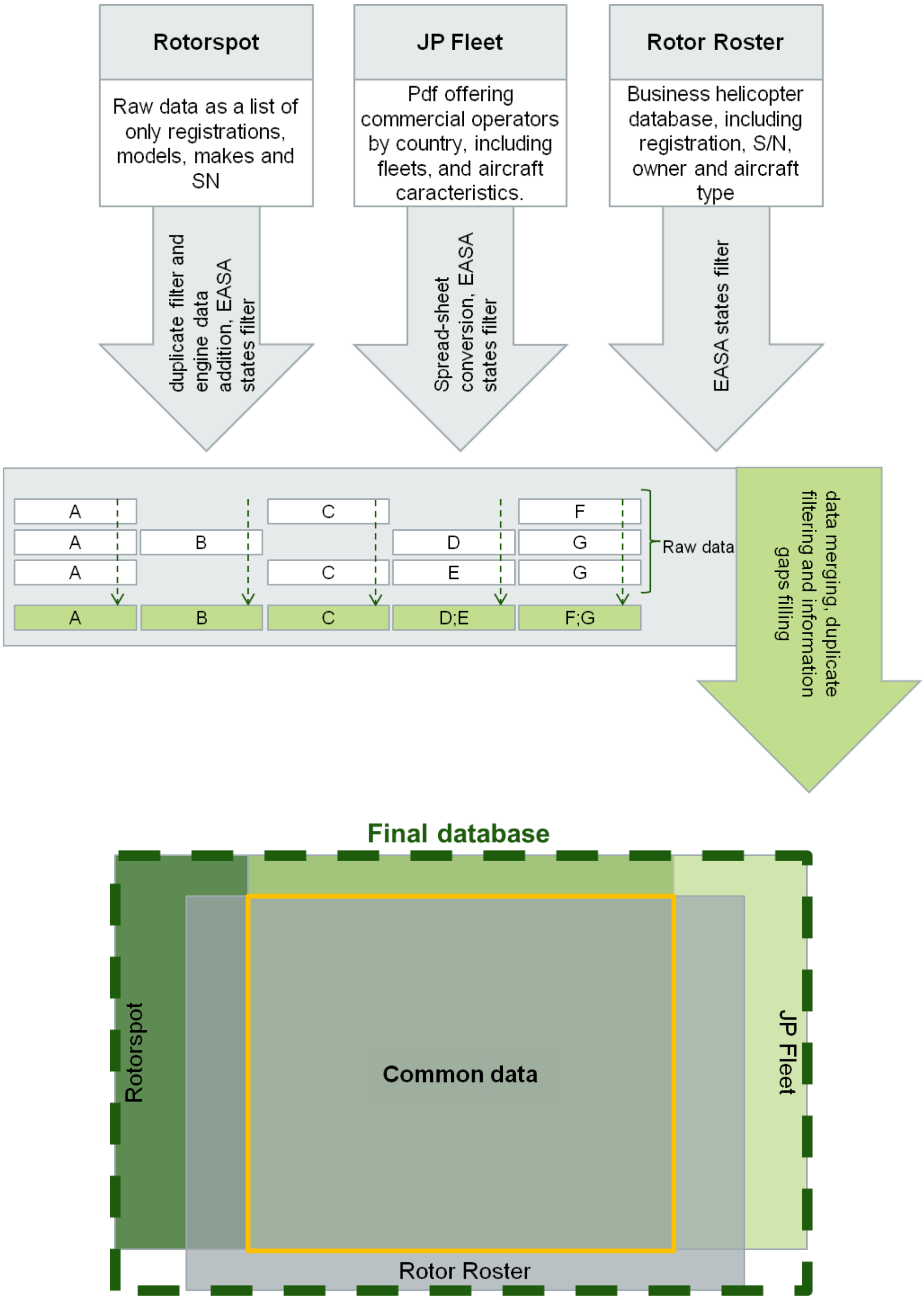



Figure 2: Fleet database building scheme

## 3.1 Raw data

The data to build up the fleet database comes from three (3) independent sources, each of which having its own singularities. The choice of these three (3) sources is made based on their suitability for the study, their complementarity and their ease of data treatment.

### 3.1.1 Rotorspot

Rotorspot is a simple database that compiles rotorcraft registrations, makes, models and in most cases serial numbers.

Its format is a plain text file on the website, separated by countries. The sources used to compile this information vary from national registries, to spots by aviation professionals. An example of the data is as follows:

| Registration | Make & model | Constructors no |
|---|---|---|
| F-BGOS | Bell 47D1 | 609 |
| F-BGXR | Bell 47D1 | 158 |
| F-BGXY | Bell 47G > 47G-2 | 690 |

Figure 3: Rotorspot registration example

Some of the registrations include changes in the helicopter certification (such as upgrades), and previous registrations of the same rotorcraft.

The treatment of this data, when imported to spreadsheet, consists only in a separation by columns of the registration, make, model, and SN. From the EASA member states, the resulting spreadsheet includes **7.660** different registrations.

### 3.1.1 JP Airline Fleets International (JP Fleets)

The JP Fleets, identifies the fleet of most of the known commercial aircraft operators. As identified in the first interim report, it classifies the main civilian commercial operators and their fleets with some exceptions. It excludes privately-owned aircraft and those under 2.0 tonnes of maximum take-off weight, for single engine aircraft. Even if the database only includes relevant operators, the information delivered about them is very complete and it has been considered very relevant to the study and therefore has been is merged o the other available information about each registration.

The data in JP Fleets is presented in only in portable document format (pdf), in the following structure:

**Helijet Aviation** (Yorkshire Helicopters Ltd dba) **Leeds/Bradford**
Leeds Heliport, Harrogate Road, Leeds West Yorkshire LS19 7XS, UK Tel: +44 1132500588 Fax: +44 1132508161 Email: info@helijet.co.uk SITA: n/a
F: 1996 Emps: 8 Head: Mike Thorpe Web: www.helijet.co.uk

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ☐ | G-RAMI | Bell 206B JetRanger III | 2955 | N1080N | 0380 | 1096 | 1 RR 250-C20B | 1451 | Utility | 4032DF | |
| 300 | registration | type of aircraft | cn/fn | exreg | mfd | del | powered by | mtow kg | configuration | hexcode | name/fin/specialities/remarks |

Figure 4: JP Airline Fleets information example

This format of data, presents difficulties accessing it for treatment in a spreadsheet, as it is not directly recognizable in this format. In addition, the database includes aircraft and rotorcraft, only identifiable by the make and model. To overcome this, a data processing algorithm in Excel has to be used, extracting only the data required.

This source includes **15.602** aircraft, from which **2.295** are single and twin engined helicopters from the **26** EASA states having helicopter companies listed in this database. The information has to be extracted and treated. Twin-engined helicopters will be filtered and excluded from the consolidated Fleet Database.Rotor Roster

The Rotor Roster is mainly a spreadsheet of worldwide fleets, identified as “business class” helicopter, but including commercial aviation and general aviation helicopters information.

The information, classified by registrations, presents at least the make and model of each registration, and in the majority of the registrations is complemented by the ownership, serial number, and some miscellaneous details. An example row of the data that can be pulled is as follows:

| Manufactur | Designati | Serial Numb | Registratic | Country of Registratio | Year Bu | Engine Type | Owner | Owner First Name | Owner Last Name | Owner Address 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| Aerospatiale | 3160 | 1524 | D-HOSI | Germany | 1968 | Turboshaft Helicopter | Heli Cargo Helicopter Service GmbH | | | Kirchgasse 20 |
| Aerospatiale | AS 350 B | 1322 | D-HFEM | Germany | 1980 | Turboshaft Helicopter | Canarian Island Helicopter Service | Dietmar | Walhutter | C/San Borondon 12, Sar |
| Aerospatiale | AS 350 B | 1601 | D-HCOR | Germany | 1982 | Turboshaft Helicopter | | Rudolf | Seuffer | Ferdinand-Lassall-Str.40 |
| Aerospatiale | AS 350 B | 1708 | D-HHGB | Germany | 1983 | Turboshaft Helicopter | Bauhaus GmbH & Co | | | Gutenbergstr. 21 |
| Aerospatiale | AS 350 B | 1781 | D-HENA | Germany | 1984 | Turboshaft Helicopter | FJS-Helicopter Lufttransport GmbH | F. J. | Strathausen | Benediktstr. 17 |

Figure 5: Rotor Roster Sample Data

The data that can be extracted includes **31.031**, of which **5.654** are from EASA states.

## 3.2 Merging process

To consolidate a single database including all the available registrations, compiling as much information as possible from the different sources, the merging process has been fully computerized, using algorithms that identified each registration and all the related information, keeping track of all the information sources used, and minimizing human error.

The methodology followed a linear scheme in three steps::

1. Extraction of data
2. Standardization of data
3. Merge of data

### 3.2.1 Methodology

Step 1:

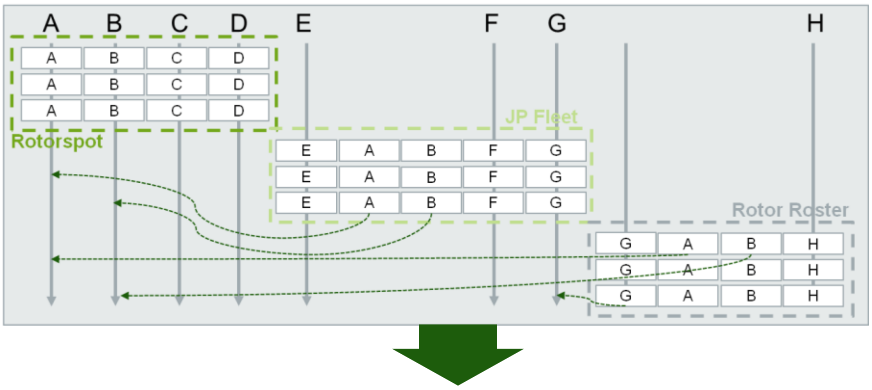
The first step is the treatment of the data in order to obtain a uniform set of rows in a spreadsheet that can be comparable by the merging algorithm.

- To extract the data in Rotorspot, available as plain text in the website, the information has been converted into rows in a spreadsheet, selecting only helicopters registered in EASA member states. For each helicopter, all the information was contained in one single cell. This information has then been split in different columns of the spreadsheet: Registration, helicopter make and model, and possibly a subsequent row of additional information such as previous registrations of the same helicopter. Finally, the single and multi-engine helicopters have been identified, and a simple duplicate check algorithm has been executed.
- To extract the data in JP Fleets, the whole pdf information for each EASA state has been pasted in a spreadsheet, and treated and filtered to obtain a row of cells for every helicopter, identifying its registration and main characteristics.
- The Rotor Roster was already presented as a spreadsheet, needing only to be filtered by EASA states.

The outputs of this step are three different spreadsheets in xls format for each source.

Step 2:

To standardize the data before the merging, the three matrixes have been compiled in a same spreadsheet. The columns of each database containing the same information have been aligned in the same column:



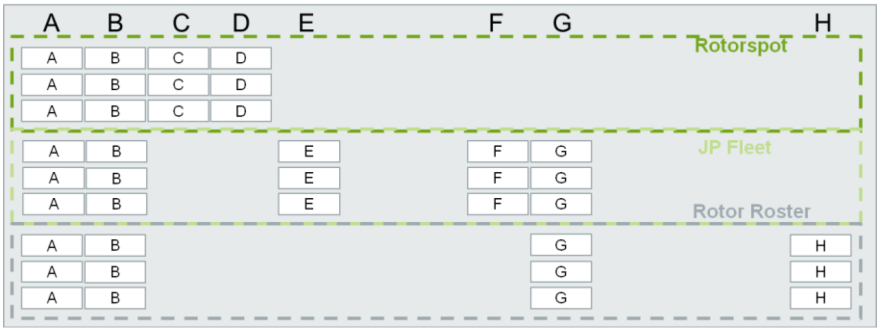



Figure 6: Matrix standardization

The output is a spreadsheet with all the data of three sources classified in columns containing the same type of information:

From this output, it is noticeable that same registration for the same aircraft appear is present in different rows such as in the case of aircraft leased between two operators. For these cases the duplicated rows need to be merged to avoid redundancies and to have an accurate database.

| | Make | Model | EASA Country | Registration | MSN | Year built | Owner | Operator | Miscellaneous |
|---|---|---|---|---|---|---|---|---|---|
| Rotor Roster → | Eurocopter | AS350 | Romania | YR-XXX | 1845 | 1994 | Owner X | | ################ |
| JP Fleet → | Eurocopter | AS350 | Romania | YR-XXX | | 1994 | | Operator Y | ################ |
| Rotorspot → | Aerospatiale | AS350 | Romania | YR-XXX | 1845 | | | | |

Figure 7: Standardized data redundancy for the three sources

In addition, some conflicts with different data for the same registration were expected to be present, needing a meticulous merging algorithm that avoids misinterpretations of the information.

Step 3:

The next step used an algorithm that merged the rows with the same registration code, and identified each of the conflicts between different data for a same registration, while completing the gaps where possible.

This has been done using an SQL database query that identified each registration, and compared the information available in each duplicate row. The single rows have been kept and the gaps between two duplicate registrations have been filled, while the different cells in duplicate registrations have been concatenated adding a tracking character, in order to identify information conflicts.

Subsequently, the spreadsheet only contained rows with single registration numbers, and the conflicts identified by the tracking character have been solved, separated, or cleared, depending on the case. Most of the conflicts were merely typing differences, for example in serial numbers, while some unusual conflicts consisted in helicopters that have been de-registered, and the same registration code has been used in a new unit

The merging resulted in a spreadsheet that contained **6.880 single engine helicopters registered in all 31 EASA member states:**

- **12%** of the helicopters common by the three databases
- **35%** present in at least two databases
- **67%** from JP Fleets or Rotor Roster, considered with complete data
- **33%** only present in Rotorspot, and therefore with few data

## 3.3 Final Consolidation

The final consolidation of the fleet database lied on the fine tuning of the data. This phase had three basic procedures:

1. Standardization of the whole database
2. Comparison against other available sources
3. Addition of supplementary data fields

### 3.3.1 Methodology

To standardize the database, every column having common fields such as Makes, Models, Engines. It has been checked in order to have the same type of identifier, for statistics purposes.

As an example, all the helicopters that are currently under Eurocopter name, have been updated to this manufacturer, even if the design and construction was under MBB, Sud-Aviation or Bolkow for some cases.

The aircraft model field presented some variations in the identification of helicopter models, depending on the origin of the information. The inconsistencies originated by typing differences or different name configurations have been standardized as well.

After the standardization, the database has been compared against other available sources to assess its accuracy. These sources are:

- The database provided by EASA containing the following information:

| | |
|---|---|
| Aircraft Registration | Serial Number |
| Make | Year Built |
| Model | Engine |
| Series | Count of Number of Aircraft |

Table 2: EASA data fields

- The fleet database provided by the Civil Aviation Authorities. At the time of this report, only the authorities of United Kingdom, Poland and Luxembourg have provided such information.

These sources allowed completing the merged data base with additional **526** entries from the following sources:

- Single-Engined Helicopter Fleet EASA database: **502** additional single-engined helicopters (84 % common entries with multisource merged database)
- United Kingdom CAA: **19** additional single-engined helicopters (98,3 % common entries with multisource merged database)
- Poland CAA: **5** additional single-engined helicopters (**94,4%** common entries with multisource merged database)

The low number of inconsistencies found between the merged database and both the UK CAA and Poland CAA data for single-engined helicopters indicates a high level of completeness of the database resulting from the merging process.

However, the Consortium is investigating the additional **502** entries provided by Single-Engined Helicopter Fleet EASA database.

Finally, the database has been enhanced with the addition of supplementary fields to complement the data available. These fields contain general data about the helicopters, and may be used for pulling out statistics. Some information that has been considered useful, such as weights, performance data, size, capacity, has been extracted for each model available on the Helicopter Blue Book, and complemented with the OEMs information. As some helicopter types usually have few models or variations, and therefore different performances and characteristics, these variations will be reflected in the database when considered relevant.

The information for the supplementary fields such as engine information, weights, or sizes has been extracted from different sources:

- The Helicopter Blue Book, containing specifications for the majority of the helicopters identified
- OEMs information about helicopter models available in internet

Each of the rows of the merged database could then be supplemented by this type of data, distributed in a pivot-table friendly structure.

### 3.3.2 Final output

The final output of this phase is a row-based spreadsheet with **10.245** total entries containing the main fields to identify each of the helicopters registered in EASA member states.

The database contains each single registration of an EASA state, and all the non-EASA registrations identified operating in an EASA state, from the three sources identified.

In addition, the final output integrated the fleet information made available by EASA. The merge has used the comparing algorithm, to find common registrations and/or serial numbers, adding the non-duplicate helicopters to the final database.

The whole process resulted in a spreadsheet in which each registration has associated, when available, the following information:

- Make
- Model
- Year of manufacture
- Year of registration
- Number of engines
- Engine model
- Operator
- Operator Country
- Owner
- Miscellaneous information about owner and operator

In addition, the database has been treated to be easily supplemented with any of the specifications available for the majority of the models in a helicopter specifications database. The fields that may supplement the fleet database include:

- Dimensions
- Weights
- Performance data
- …

Any statistics of the mentioned initial fields, and the supplementing data, can be further treated with pivot table software that will allow pulling statistics of each field considered important.

## 3.4 Information gaps

Although quite complete, the final output after the merging process contains some information gaps.

Concerning only the single engine data, the database includes 6.880 single entries, including 57% of piston engine registrations and 43% of turbine powered helicopters.

The most relevant and for which it will be necessary to reasonably try to find the missing information delivered the following percentages:

- **2%** entries with no registration number
- **4%** without MSN
- **9%** without year of manufacture (but could be deducted from MSN)
- **40%** with owner and operator both unknown from which 39% are Robinson’s, 11% are ultralights, and nearly 50% are other helicopters

The Owner and Operator field has a very high percentage of uncertainty; however the information expected from the Civil Aviation Authorities, as well as the OEMs may lower this number. In addition, at a further stage of the study, most of the small piston helicopters, and generally all kit helicopters, could be considered operated in general aviation category and therefore out of the scope for subtask 2c “Assessment of operating conditions allowed by EASA member states

# 4 Occurrence Database

The aim of this phase is to obtain an occurrence (accident/incident) database that covers the 10-year period between 01/01/2003 and 31/12/2012.

The procedure to obtain this database includes the gathering, treatment, merging and polishing of the data obtained from each of the sources identified in the first phase of the project.

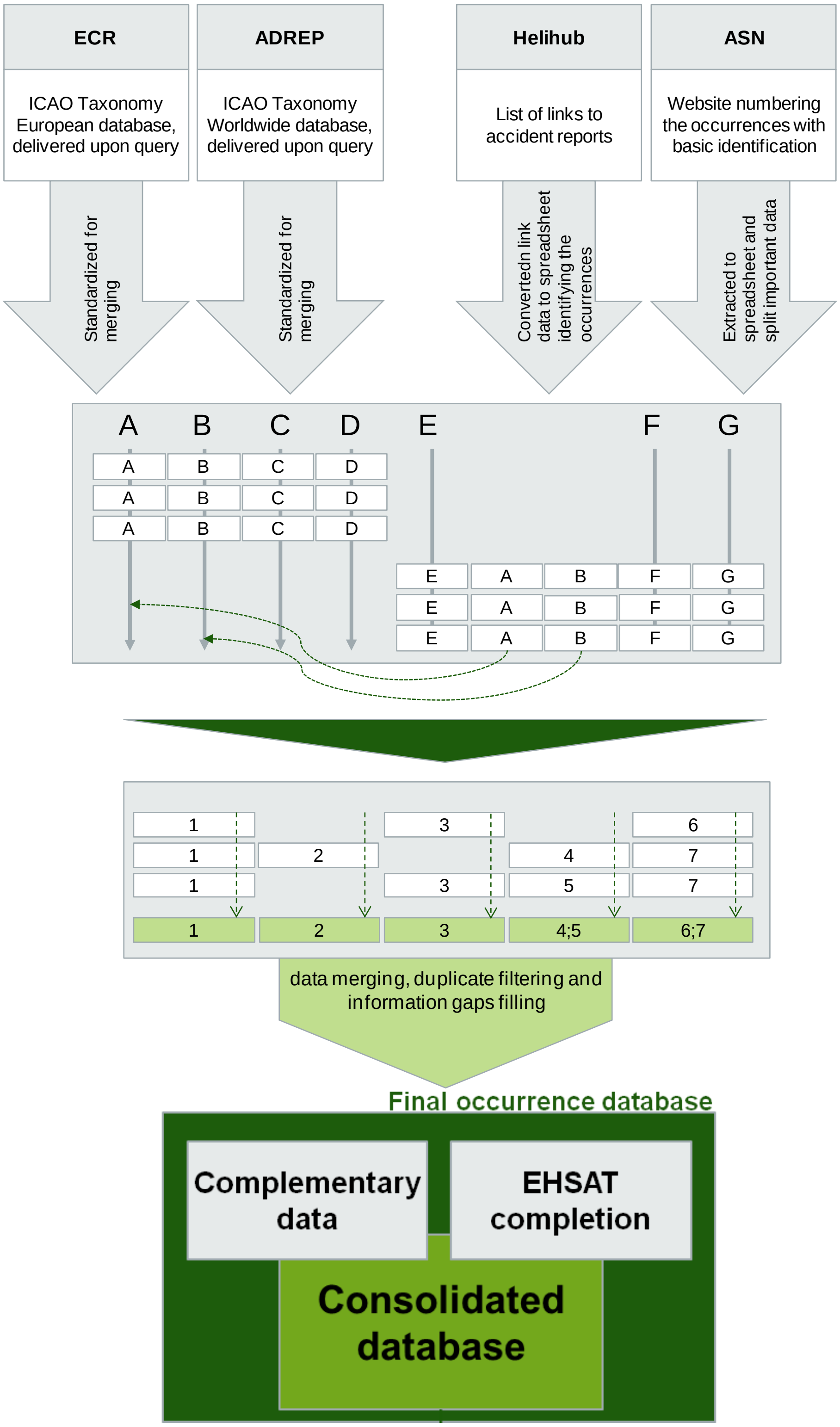



Figure 8: Occurrence database building scheme

## 4.1 Raw data

The data to build up the occurrence database comes from seven (7) independent sources, each of which having its own singularities. The choice of these seven sources is made based on their suitability for the study, their complementarity and their ease data treatment.

### 4.1.1 European Central Repository (ECR)

The European Central Repository compiles the information provided by the national aviation authorities of the EASA Member States, stored by the ECCAIRS system.

The data available is mainly from 2005 onward, but does not include non-serious incidents. It includes many serious incidents in addition to accidents and contains also details of fixed wing aircraft involved in helicopter occurrences, military occurrences and events involving non-EASA registered aircraft where these have been the subject of an EASA state accident investigation.

The data has been made available by EASA upon request of the Consortium. After an online demonstration of the capabilities of the ECCAIRS system, and after several tests, the final query included the following fields:

| | |
|---|---|
| Aircraft Registration | Location |
| Make | Occurrence Class |
| Model | Occurrence Category |
| Year Built | Injury Level |
| Serial Number | Damage Level |
| Number of Engines | Flight Rules |
| Engine Make | Flight Phase |
| Engine Model | Number of Occurrences |
| Type of Operation | Fatalities |
| UTC Date (Year) | Serious Injuries    Minor Injuries |
| UTC Date | No Injuries |
| Local Date (Year) | Total POB (People On Board) |
| Local Date | File Number |
| State of Occurrence | LatLong |

Table 3: ECR data fields

Depending on the origin of the data and the type of occurrence, some fields are more populated than other, while some other (i.e. helicopter/engine characteristics) need to be completed. We have used our skills and experience to extend the data population, but some significant errors and many omissions remain needing correction.

### 4.1.2 Accident/Incident Data Reporting (ADREP)

The ADREP database is similar to the ECR database, but includes worldwide information reported by the ICAO member states. It has the particularity that the occurrences are only included if an aircraft/rotorcraft of more than 2 250 kg of maximum certificated take-off mass, and that excludes most of the small single engine piston helicopters.

The accessing, as for ECR, is through ECCAIRS, belonging to ICAO and delivered upon request by EASA.

Looking after the merging of the data, and knowing that the output will have the same format, the request included the following fields:

| | |
|---|---|
| Aircraft Registration | Location |
| Make | Occurrence Class |
| Model | Occurrence Category |
| Year Built | Injury Level |
| Serial Number | Damage Level |
| Number of Engines | Flight Rules |
| Engine Make | Flight Phase |
| Engine Model | Number of Occurrences |
| Type of Operation | Fatalities |
| Year | Serious Injuries Minor Injuries |
| UTC Date | No Injuries |
| Local Date (Year) | Total POB |
| Local Date | Total on Board |
| State of Occurrence | File Number |

Table 4: ADREP data fields

As for the data from ECR, some of the missing or erroneous data fields have been completed by us using external data, especially the ones relating to aircraft characteristics.

### 4.1.3 Aviation Safety Net (ASN)

Supported by the Flight Safety Foundation, the ASN wiki database compiles information about accidents, mainly based on the information from official sources.

The database is website based, and has been extracted in table format to a spreadsheet, delivering the following fields:

| | |
|---|---|
| Date (LINK) | Operator |
| Type | Fatalities |
| Registration | Location |

Table 5: ASN data fields

### 4.1.4 Helihub

The Helihub database is presented as a list of accidents, presenting links to an accident report. As reported on the first phase of the study, even if most of the accidents are not complete, some other apparently are not reported elsewhere.

While extracted from the website to a spreadsheet, and splitting the link, the following fields have been covered:

| | |
|---|---|
| Date of occurrence | Model |
| Registration | Location |
| Make | Country |

Table 6: Helihub data fields

### 4.1.5 Eurocopter

Eurocopter agreed to deliver aggregated data upon query for the purpose of this study. An online demonstration of the capabilities of its database was organized.

The queries defined by the Consortium for the provision of aggregated data and transmitted to Eurocopter are:

1. For 31 EASA member states from 01/2003 to 12/2012:
   - Number of events for each type of occurrence (as defined in ICAO annex 13) and for each Eurocopter model family
2. For all other states from 01/2003 to 12/2012:
   - Number of events for each type of occurrence (as defined in ICAO annex 13) and for each Eurocopter model family
3. For 31 EASA member states and all other states from 01/2003 to 12/2012:
   - Number of events for each type of occurrence (as defined in ICAO annex 13) and for each Eurocopter model family

It has also been considered positive for the study to be able to cross-check Eurocopter data with the other databases available. For this purpose, a list of all occurrences from 01/2003 to 12/2012 with the following data has been requested:

- Type of occurrence
- Date
- Registration

The data received from Eurocopter included a list of occurrences, sorted by date and helicopter registration.

### 4.1.6 Bell

Bell agreed to deliver aggregated data upon query for the purpose of this study.

The queries defined by the Consortium for the provision of aggregated data and transmitted to Bell are:

1. For 31 EASA member states from 01/2003 to 12/2012:
   - Number of events for each type of occurrence (as defined in ICAO annex 13) and for each Bell model family
2. For all other states from 01/2003 to 12/2012:
   - Number of events for each type of occurrence (as defined in ICAO annex 13) and for each Bell model family
3. For 31 EASA member states and all other states from 01/2003 to 12/2012:
   - Number of events for each type of occurrence (as defined in ICAO annex 13) and for each Bell model family

It has also been considered positive for the study to be able to cross-check Bell data with the other databases available. For this purpose, a list of all occurrences from 01/2003 to 12/2012 with the following data has been requested:

- Type of occurrence
- Date
- Registration

The data provided by Bell includes a list of accidents and serious incidents, sorted by Country, and including Family, Model, Registration, Date, Location and type of occurrence..

### 4.1.7 European Helicopter Safety Analysis Team (EHSAT)

The EHSAT database has been delivered by EASA, being a set of spreadsheets that include the following fields:

| | |
|---|---|
| Analysis? | VMC/IMC |
| Year | Light conditions |
| Ops Type level 1 | Engine config. |
| Analysis completed? | Aircraft Certification basis |
| Analysis assigned to | Pressure altitude MSL (in ft) |
| Filenumber or Ref. | Height AGL (in ft) |

| | |
|---|---|
| Occ. Date (Excel date format) | Pilot-in-command experience on ALL AIRCRAFT types (total hrs) |
| Occurrence Class | Pilot-in-command experience on ALL HELI types (total hrs) |
| State of occurrence | Pilot-in-command experience on THIS HELI type (total hrs) |
| Aircraft Registration | Co-pilot experience on ALL AIRCRAFT types (total hrs) |
| Aircraft Make | Co-pilot experience on ALL HELI types (total hrs) |
| Aircraft Model | Co-pilot experience on THIS HELI type (total hrs) |
| Type of operation | AIB Safety Recommendation #1 |
| Aircraft Damage | AIB Safety Recommendation #2 |
| Injury Level | AIB Safety Recommendation #3 |
| Number of fatalities | AIB Safety Recommendation #4 |
| Total number of persons on board | AIB Safety Recommendation#5 |
| Phase of flight | AIB … |
| In Hover? | |

Table 7: EHSAT data fields

## 4.2 Merging process

The process to consolidate a single database that includes the information of accidents and incidents from each of the sources available follows a pyramidal scheme. The first step is to merge and filter similar databases as depicted in the figure below, in order to get as much events and information as possible in several databases, that will allow an exhaustive duplicate identification while merging to the final database.

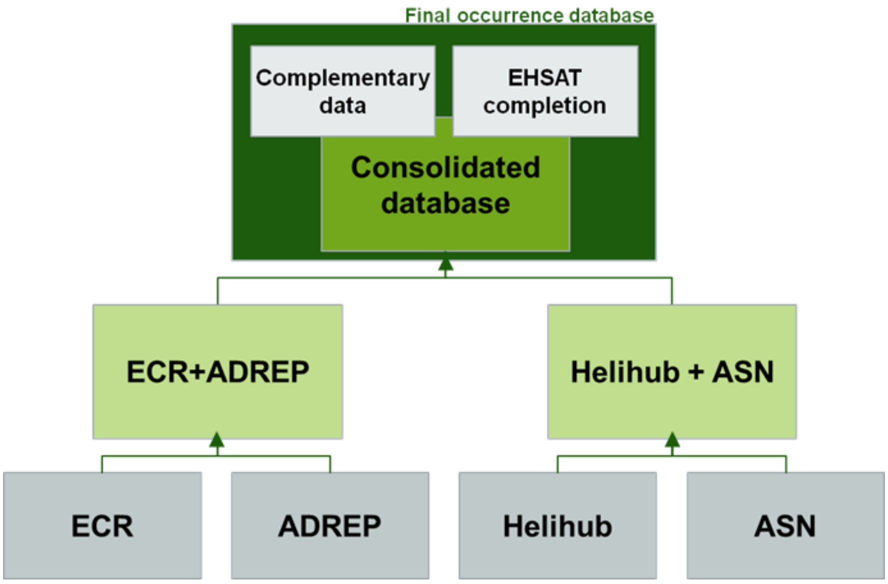



Figure 9: Pyramidal scheme

The process followed these steps, in each of the iterations of the merging:

1. Gathering of data

2. Standardization of data
3. Merge of data

### 4.2.1 Merge of ECR with ADREP

ECR and ADREP are two databases with the same software platform, the European Co-ordination Centre for Aviation Incident Reporting System (ECCAIRS). The extractions requested included the same fields for each of the registers, leading to a fast process of merging. However, most of the fields were filled differently in each of the databases and many conflicts appeared during the merging process, needing an accurate post-processing labour of filtering.

The detailed process has been as follows:

1. Query of data to EASA
2. Standardization of data
3. Merge of data

#### 4.2.1.1 Methodology

Step 1:

The data gathering process has been fully done by EASA upon request. After having an online demonstration of the capabilities of the ECCAIRS system, and a first extraction that has been analysed and studied, a final request of data has been sent to obtain extractions from each of the repositories.

The first problem encountered has been on the extraction format, as each accident/incident could be registered in several rows depending on the information contained in the database. In addition, if the same helicopter had more than one accident/incident in the same day, a filtering and merging of the data by dates of occurrence would give a wrong result. This has been solved adding the field “File Number” included in ECCAIRS system that, even if not present in every single occurrence, allowed the identification of the rows belonging to the same occurrence. Furthermore, the events that had more than one helicopter/aircraft involved could be easily identified.

Step 2:

The standardization of data in the merging of ECR and ADREP, as the fields were mainly the same, included two parts:

- Date of occurrence standardization: The raw data included the fields “Local date” and “UTC date”, not always filled up. To standardize the dates, the “UTC date” has been taken as a base, and the “Local date” has been used when the other field was blank.
- EASA states selection: While ECR is a Europe based repository, ADREP includes loads of foreign occurrences that needed to be filtered in order to shorten and enhance the merging process. An “EASA state” field has been added.

Step 3:

The last step of the ADREP and ECR merging has been the superposition of the two databases already standardized.

The process used an algorithm that merged the information under the same file number, concatenating and adding a tracking character when two fields of the same file number included different information.

This has been done using an SQL database query that identified each different file number and comparing the information contained under the repeated ones.

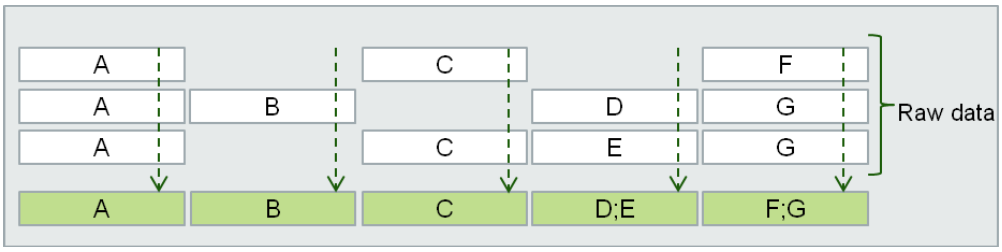



Figure 10: Merging process

After this first merge, based in file numbers, all the information under non-identified file numbers has been checked based on the date, registration and location fields, in order to identify other potential rows containing information about the same occurrence.

The merging resulted in a spread sheet that contained **15.559** single events, all related to helicopters and involving **951** fixed wing aircraft and UAVs.

### 4.2.2 Merge of ASN with Helihub

The merging process between ASN and Helihub databases used a merging algorithm that compared important accident data, in order to identify duplicated events between the two databases, and complement the accident data between the two sources.

The process followed this scheme:

1. Data collection
2. Standardization of the data
3. Merging

#### 4.2.2.1 Methodology

Step 1:

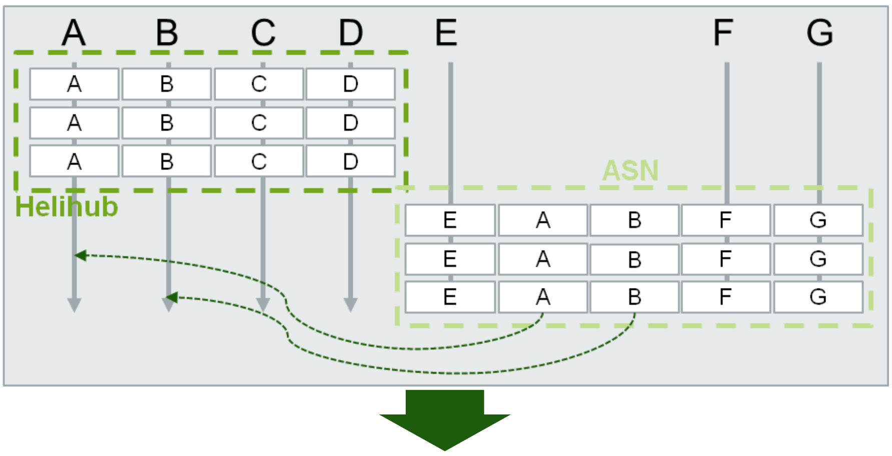
Each of the websites has a particular presentation of the occurrence data that, when extracted into spreadsheets, delivered a list of rows that included a link to the full report, the date of the occurrence, the make and model, the registration, location and few other details.

Both spreadsheets needed a meticulous standardization of the data, in order to be compared and merged.

Step 2:

To standardize the data and find common fields, the two data matrixes have been combined in the same spreadsheet. Some columns contained similar information, but needed to be in the same format prior to the merger. As an example, most of the occurrence dates were not in the same format, and needed to be corrected to be compared later. The same happened with makes and models.

Once all the similar information has been corrected, the columns containing the same type of information, but from different sources, have been arranged to be aligned in the same column:



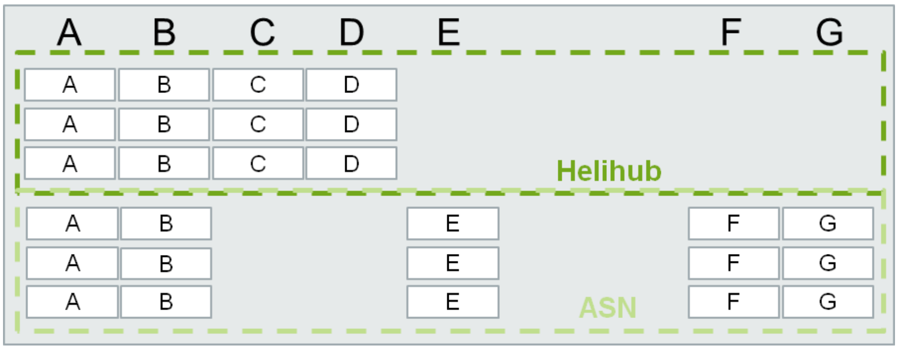



Figure 11: Matrix standardization

After the alignment, the spreadsheet contained all the information from both databases and could be re-arranged by the date of occurrence, to facilitate the merging algorithm work.

Step 3:

The merging of the data used an algorithm that compared the date of occurrence, helicopter, and location, identifying common occurrences between both sources. These duplicated occurrences when merged, complemented each other data offering a more accurate description of the incident/accident. When the data in the same field is different, it is concatenated with a tracking character.

The algorithm used in the merging had the following scheme:

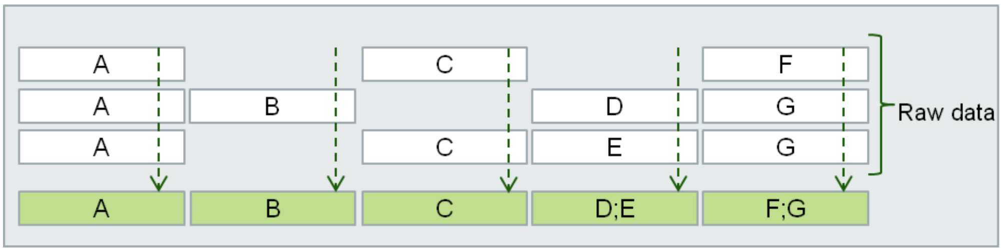



Figure 12: Merging process

The output of this step resulted in a single database of combined data, offering:

- **1.010** common accidents, that have been complemented
- **1.543** accidents only in Helihub
- **1.942** accidents only in ASN

### 4.2.3 Whole database

After the first two mergers, the data was split into two databases having as much information as possible about the occurrences, but with considerably different layouts. Additionally, it has been considered relevant to crosscheck the final output with the EHSAT data, which delivers the data from a few accidents, but it is considered the most accurate and extensive about each occurrence.

Again, to obtain a single database, the following process has been applied:

1. Standardization of the data
2. Merging of the data
3. EHSAT data addition

#### 4.2.3.1 Methodology

Step 1:

To standardize the data, it has been used the usual procedure that leads to a spreadsheet that can be treated by the merging algorithm. Again, the columns containing similar information have been identified, corrected in order to have it in the same format, and re-arranged by aligning the same information into the same columns.

Step 2:

The final merge followed the same algorithm previously used, but with some modifications that allowed the identification of events that were fairly complete, depending on its source database.

The parameters compared in order to identify common events between the two spreadsheets have been:

- Date of occurrence
- Make and model (when available)
- Registration (when available)
- Location of the occurrence (when available)

While the merging following these parameters has been fully computerized, and delivered a good approach to the final database, the data had to be rechecked focusing on particularities like events registered in a 2-3 day interval that could potentially be the same event from the different sources.

Step 3:

The last step of the merging process used the information available in the EHSAT analysis tool, which included several selected accidents with much detail about them, completing some of the accidents in the compiled spreadsheet.

Similarly to the previous step, to identify the accidents the following parameters have been used:

- Date of occurrence
- Make and model (when available)
- Registration (when available)
- Location of the occurrence (when available)

And finally, a manual check of the remaining unidentified accidents has been done, delivering the fully compiled database that included all the accidents in every database available.

The final completion of the database with the information from EHSAT showed only **8** occurrences not recorded in the consolidated database while the rest of occurrences in EHSAT were registered.

## 4.3 Final consolidation

The final consolidation of the database consisted on the addition of supplementary data that will deliver valuable statistics in the data analysis phase.

This data has mainly been obtained linking the occurrence database to the fleet database, which in its latest stage included many details for each type of helicopter. The specifications added to the occurrence database, considered useful for the study have been:

- MTOW
- Passenger capacity
- etc

The last treatment to the database consisted in the identification of the available locations for each occurrence, obtaining the coordinates of the identifying field. This will allow the location of the areas through a GIS software, while obtaining altitude statistics, climate characteristics of the area, and areas of high occurrence concentration.

In this final stage, we discovered on the Eurocopter website a list of 145 of their helicopters described as “potentially destroyed Eurocopter aircraft awaiting government report”.

We have cross-checked the list with the final consolidated database and identified all the single-engine aircraft already recorded.

The output of the final consolidation delivered an occurrence database that includes **4.606 single occurrences** registered between 01/01/2003 and 31/12/2012.

Selecting only Accidents and Serious Incidents registered in this period, the number gets lowered to **920 occurences.**

The data provided by Bell and Eurocopter has been used to evaluate the completeness of the consolidated database, cross-checking with the list of accidents and serious incidents from all single engine models.

The following has been pulled out from Eurocopter data:

- From the 1.029 accidents/serious incidents in Eurocopter database, 296 have EASA member state registrations.
- From the 296 EASA helicopters occurrences in Eurocopter database, 262 are in our consolidated database, obtaining 34 unidentified occurrences
- These 34 unidentified occurrences have been further clarified by Eurocopter
- And the following has been retrieved from Bell data:From the 96 accidents and incidents registered by Bell, 4 are missing in the consolidated database
- These 4 unidentified occurrences will be further clarified by Bell

## 4.4 Information gaps

Although quite complete, the final output after the merging process contains some information gaps. The most relevant and for which it will be necessary to reasonable try to find the missing information delivered the following percentages:

| Only Accidents and Serious Incidents | Whole Data Base | Finding |
|---|---|---|
| **1%** | **11%** | % of entries without a File Number. This is considered a minor problem, but would enhance the identification of duplicated events not yet identified. |
| **0%** | **0,04%** | % of occurrences with unidentified date |
| **1%** | **16%** | % of occurrences with unknown make, type or model |
| **0,6% (0,04 %)** | **25%** | % of helicopters with unknown year of manufacture <u>without</u> related official occurrence report (<u>with</u> related official occurrence report) |
| **0,8% (0,6 %)** | **36%** | % of occurrences with undefined type of operation <u>without</u> related official occurrence report (<u>with</u> related official occurrence report) |
| **0,6% (0,02 %)** | **20%** | % of occurrences with unspecified phase of flight <u>without</u> related official occurrence report (<u>with</u> related official occurrence report) |
| **-** | **10%** | % of type of occurrences not classified (unknown or not determined) |

Table 8: Information gaps

- In addition, none of the occurrences contains data regarding the terrain/obstacle suitability, neither the environment classification. To overcome this lack of information, we have analyzed, when available, the LatLong, data and placed in a map (see Figure 13). However it has been noticed the following:
    - around 90% of all the occurrences either in ECR or ADREP do not contain LatLong information
    - Around 40% of accident and serious accident in ECR or ADREP do not contain LatLong information
- When LatLong information is available, only degrees and minutes are provided which is not accurate enough (uncertainty of +- 2 Km in each direction).


Figure 13: Accident Map with LatLong information

## 4.5 Official Occurrence reports

In addition to the occurrence database, and in order to retrieve as much information as possible for each, all accident reports publicly available from the Air Accident Investigation Boards have been downloaded and crosschecked with the updated database: **535 reports** have been found.

The reports have been cross-checked with the consolidate occurrence database. From the **535** collected reports, **508** relate to accident or serious incident.

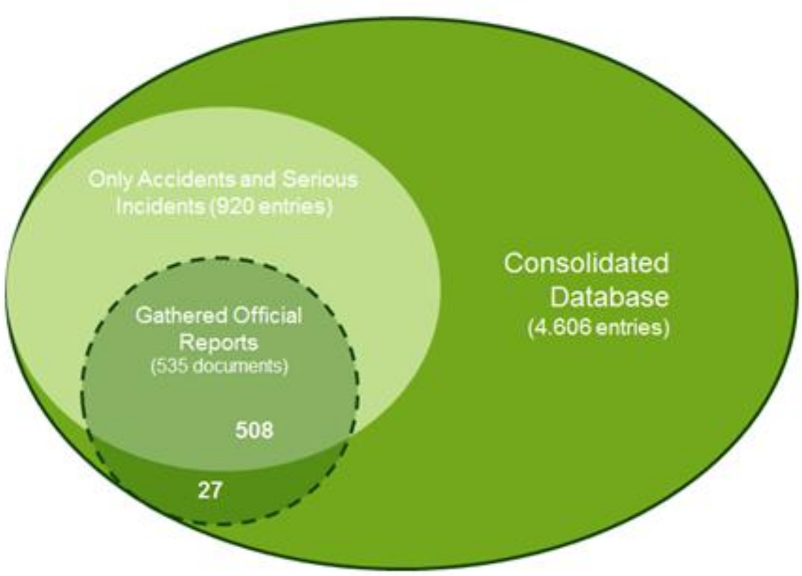



Figure 14: Occurrence database gaps

The countries for which it has not been possible to retrieve the official occurrence reports are:

- Liechtenstein
- Lithuania
- Luxembourg
- Malta

# 5 Usage Database

The third database to be obtained is the usage database that integrates all the information regarding the flight hours, cycles and other usage information considered relevant for the aim of the study.

The collection of usage data has proven more challenging and difficult than initially expected by the Consortium and could not be completed.

## 5.1 Raw data

The raw data to consolidate the usage database comes from two (2) different sources:

### 5.1.1 OEMs

From the OEMs identified in the previous report that were willing to collaborate with the study, only Eurocopter, Bell and Robinson have responded back to our queries. Turbomeca has also replied positively to collaborate with the study, but was not considered relevant for the aim of the study.

The OEMs contacted, in the same context of the query of occurrence data, have been Eurocopter and Bell, the only OEMs collecting usage information from their fleets. As with the incidents and accidents the OEMs agreed to deliver aggregated data upon defined query. The queries transmitted are the following:

1. For 31 EASA member states from 01/2003 to 12/2012:
   - Number of FH and FC accumulated over this period for each model family
2. For all other states from 01/2003 to 12/2012:
   - Number of FH and FC accumulated over this period for each model family
3. For 31 EASA member states and all other states from 01/2003 to 12/2012:
   - Number of FH and FC accumulated over this period for each model family

Eurocopter provided the usage data. This data consisted in the aggregated flight hours and cycles for each Eurocopter model over the studied period.

Bell provided the aggregated flight hours of all his models, as a percentage of the world total flight hours. It has been requested to Bell to further detail these figures because as delivered, data cannot be mined.

Whereas Eurocopter and Bell collect usage information from their fleets, Robinson does not maintain a record of ownership of the helicopters manufactured and therefore do not register usage data from its fleet.

In exchange, Robinson proposed to distribute a survey through its European dealer and service centre network to obtain this data. The Consortium designed a survey form to be filled by the operators. It queried the following information:

- Name of Operator:
- Owner:
- Country:
- Type of operations (Commercial/private):
- Contact Person
- Phone
- E-mail

It also requested to complete one of the tables below:

| Helicopter model | Registration | Date of registration (mm/yyyy) | Total Flight hours at 01/01/2003 | Total Flight hours at 31/12/2012 | Average Passengers transported (commercial or private) | Average yearly operations | Scope of main operations (commercial, training,private,...) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |

Table 9: Helicopter usage

| Fleet type | Number of units | Total Flight hours at 01/01/2003 (For the whole fleet) | Total Flight hours at 31/12/2012 (For the whole fleet) | Average yearly pax transported | Average yearly operations | Scope of main operations (commercial, training,private,...) |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |

Table 10: Fleet usage

### 5.1.2 Civil Aviation Authorities

The third source of information about the usage of helicopters is the ensemble of civil aviation authorities with the capabilities to deliver this information from each EASA ember state.

CAAs have been contacted using the e-mail contacts available in International Register of Civil Aircraft (IRCA) in first instance, obtaining response from a few CAAs. Then, after this first round of enquiries, the Consortium advised EASA about the lack of response from many CAAs.

EASA suggested to contact the members of the Regulatory Advisory Group (RAG), Flight Crew Licensing & Air Operations Thematic Advisory Group, and the Production and Maintenance Thematic Advisory Group. All the representatives from countries with needed information have been contacted, however some of the EASA member states do not have representation in these Advisory Groups (TAG).

The contacts are available in http://www.easa.europa.eu/rulemaking/consultative-bodies.php.

The following table states about the progress in the provision of data from the different sources:

| EASA Member State - Organisation | IRCA | RAG | Flight Crew Licensing & Air Operations TAG | Production and Maintenance TAG |
|---|---|---|---|---|
| **Austria**: Austrocontrol | | | | |
| **Belgium**: Service Public Federal Mobilite et Transports | | | | |
| **Bulgaria**: Civil Aviation Administration | | | | |
| **Cyprus**: Department of Civil Aviation (DCA) | | | | |
| **Czech Republic**: Civil Aviation Authority Ministry of Transport | | | | |
| **Denmark**: Danish Transport Authority | | | | |
| **Estonia**: Ministry of Economic Affairs and Communications | | | | |
| **Finland**: CAA Finland | | | | |
| **France**: Direction Generale de l'Aviation Civile | | | | |
| **Germany**: Luftfahrt-Bundesamt | | | | |
| **Greece**: Hellenic Civil Aviation Authority | | | | |
| **Hungary**: NKH Nemzeti Kozlekedesi Hatosag - National Transport Authority Hungary | | | | |
| **Iceland**: Icelandic Civil Aviation Administration | | | | |

| EASA Member State - Organisation | IRCA | RAG | Flight Crew Licensing & Air Operations TAG | Production and Maintenance TAG |
|---|---|---|---|---|
| **Ireland**: Irish Aviation Authority | | | | |
| **Italy**: Ente Nazionale per l'Aviazione Civile | | | | |
| **Latvia:** Civil Aviation Administration of Latvia. | | | | |
| **Lithuania:** Civil Aviation Administration | | | | |
| **Luxembourg**: Direction de l'Aviation Civile du Luxembourg | | | | |
| **Malta**: Transport Malta, Civil Aviation Directorate | | | | |
| **Norway**: Luftfartstilsynet - Civil Aviation Authority Norway | | | | |
| **Poland**: Civil Aviation Office | | | | |
| **Portugal**: Instituto Nacional de Aviacao Civil | | | | |
| **Romania**: Romanian civil aeronautical authority | | | | |
| **Slovak Republic**: Civil Aviation Authority | | | | |
| **Slovenia**: Civil Aviation Authority | | | | |
| **Spain**: AESA, Agencia Española de Seguridad Aérea (Spanish Aviation Safety and Security Agency) | | | | |
| **Sweden:** Transportstyrelsen | | | | |
| **Switzerland**: Federal Office of Civil Aviation (FOCA) | | | | |
| **The Netherlands**: Inspectie Verkeer en Waterstaat (IVW) | | | | |
| **United Kingdom**: Civil Aviation Authority | | | | |

Table 11: Status of the provision of data

- EASA Member State not represented in TAG
- Delivery failure of the enquiry
- Pending response (reminder sent on 21/03)
- Work in progress
- Provided (Partial or complete)

The query sent, introduced the study and requested the following information for each single engine helicopter:

- Registration mark
- Manufacturer
- Type
- Model
- Serial Number
- Year of manufacture
- Total Flight Hours (total accumulated flight time over the period 01/01/2003 – 31/12/2012)
- Total Flight Cycles
- Number of Engines
- Engine Manufacturer

The following replies were received:

Bulgaria

Provided full database including accumulated flight hours and cycles over the 10-years period.

Cyprus

Delivered all the information requested.

Czech Republic

Delivered all the registrations, types and operators information. No flight hours and cycles.

Denmark

Provided single-engine helicopter registry, including S/N and year of manufacture. Regarding the usage, provided aggregated data by model of helicopter.

Estonia

Provided single-engine helicopters registry, manufacturer, type, model, serial number, year of manufacturer, total flight hour, number of engines and engine manufacturer. No flight cycles.

Finland

Provided single-engine helicopters registry, manufacturer, type, model, serial number, year of manufacturer, total flight hour, total flight cycle, number of engines and engine manufacturer.

Greece

Provided single-engine helicopters registry, manufacturer, type, serial number, icao designator, number of engines, engine manufacturer, engine type and aircraft hours.

Hungary

Information provided by three operators. FlyCooop provide single-engine helicopters registry, manufacturer, type, model and total flight hours. Fly4Less provides total flight hours and cycles for their whole fleet. For HEMS single-engine, total flight hours and cycle are provided.

Iceland

Delivered the helicopter information, but did not include the operations information.

Ireland

Provided single-engine helicopters registry, and type.

Italy

Currently collecting the information, after several clarification messages.

Latvia

Provided full database, including accumulated usage in the 10 year period requested.

Lithuania

Provided single-engine helicopter registry, manufacturer, type, serial number, icao designator, number of engines, engine manufacturer, engine type and aircraft hours and aircraft cycles. Only one input.

Luxembourg

Delivered all the information requested, concerning the only single-engined helicopter registered in Luxembourg.

Norway

Provided detailed list of all single-engine helicopters registered in Norway, including serial number, year of manufacture and engine type .No usage data provided.

Poland

Delivered the current register file, containing single-engine helicopters registered in the country. The data concerning the flight hours and cycles is not maintained in their register.

Portugal

Agreed to compile all the requested data and deliver it when complete. Not received at the time of the delivery of this report.

Romania

Delivered aircraft registry. Flight hours would only be provided under NDA and payment of a high fee.

Slovakia

Provided single-engine helicopter registry, manufacturer, type, serial number, year of manufacture and type of engine.

Swedeen

Provided single-engine helicopter registry, manufacturer, type, serial number, year of manufacture and engine Manufacturer.

Switzerland

Provided single-engine helicopter registry, manufacturer, type, model, serial number, year of manufacture, flight hours (01/01/2003 – 31/12/2012), flight cycles, landings and engine manufacturer.

The Netherlands

Delivered the helicopter list, including registrations, years of operation, S/N and model. No flight hours and cycles delivered, stating that they do not keep track of those.

United Kingdom

Delivered a detailed spreadsheet, in CICTT IACIS format, containing registrations and flight hours in the 2003-2012 period, split by year. They informed that flight cycle data is not kept in extractable format.

## 5.2 Database consolidation

As most of the data has not been received at the time of the delivery of this report, the data consolidation has not yet been performed. Next deliveries will include usage data analysis.

*in consortium with*

**Alex Vidal**
avidal@alg-global.com
www.alg-global.com

**BARCELONA**
**Tanger 98, 3ª planta**
**08018 Barcelona (Spain)**
**Tel: (+34) 93 430 4016**
**Fax: (+34) 93 363 0623**
**alg@alg-global.com**