European Aviation Safety Agency

Study on single-engined helicopter operations over a hostile environment

Literature Survey Report

ALG TRANSPORTATION INFRASTRUCTURE & LOGISTICS
in consortium with
europraxis SGI AVIATION

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1 Introduction and Executive Summary

1.1 Introduction

In Europe there is an on-going discussion among the helicopter manufacturers, commercial operators and regulatory oversight bodies regarding the relevance of the number (single or multi) as well as the types of engines (piston or turbine) and their suitability for certain types of operations. The discussion focuses in particular those on single-engined helicopters that are used in Commercial Air Transport (CAT) [1] operations over a hostile environment.

EASA[2] has therefore decided to review the whole concept of single-engined helicopter operations, with an emphasis on whether single-engined helicopter operations over a hostile environment could be allowed, and if so to what extent. Any decision on this would need to be based on a full and objective safety risk assessment for commercial air transport operations. Also to be taken into account would be the impact from each type of operation, given the fact that helicopters are usually also used in aerial work and/or other non-commercial operations, such as private flights. This is the context in which the Study is to be conducted.

The aim of the Study, therefore, is to provide EASA with an operational factual picture on the suitability and safety of single engine helicopters for commercial air transport operations over a hostile environment; clarifying if and under which conditions this type of operations can be conducted.

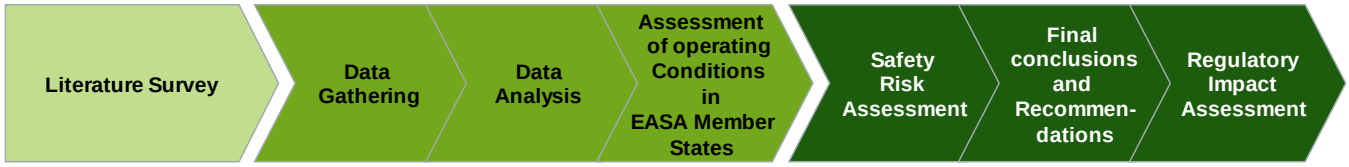
The purpose of the Study is fourfold:

1. collecting data on the use of single-engined helicopters in the EASA Member States for all types of operation for the last 10 years;
2. A study of the utilization of single engine helicopters in all types of operations in all types of environment in the EASA member states for the last 10 years;
3. an analysis of accidents and incidents of single engine helicopters in all types of operations and all types of environment in the EASA member States in the last 10 years;
4. A Safety Risk assessment on the utilization of single engine helicopters for Commercial Air Transport (CAT) operations over a hostile environment in the EASA member States.

The four above aspect of the Study could lead to a recommendation for changing the current regulation on the subject as such and, if it were deemed necessary, EASA would require in addition a regulatory impact assessment of the proposed rulemaking action.

Even though the main objective of the Study is to assess the concept of CAT single engine helicopter operations over hostile environment, it is understood that a wider scope needs to be considered in the analysis to encompass all types of operations (i.e. not only CAT). This recognizes the fact that quite often the helicopters used for CAT operations will also be used for other types of operations conducted by the same operator. The impact from each type of operation therefore needs to be taken into account when carrying-out the risk assessment for the CAT operations.

The study consists of the following tasks:



The present task consists of conducting a literature survey and appraisal on the relevant, currently available publications pertinent to the scope of this study. This includes 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. Indeed, the Literature Survey sets the basis for and identifies the databases from a multiplicity of sources necessary for the data gathering and analysis.

[1] Commercial air transport (CAT) operation' means an aircraft operation to transport passengers, cargo or mail for remuneration or other valuable consideration.
[2] European Aviation Safety Agency

The literature survey also focus on the already identified safety hazards and mitigations of relevant research/databases results found on this issue, additional potential risks which are not sufficiently investigated yet, and identify the information gaps which require further in-depth analyses.

This then is the “First Interim/progress report” of the Study and reflects the results for the above-defined task of conducting a comprehensive **Literature Survey**.

1.2 Executive Summary

This section of the report provides an overview of the work undertaken for the Literature Survey together with our initial finding and conclusions with regard to available reports and analyses and the potential data sources and their suitability for use in the on-going study.

Our approach to the Literature Survey has been first to identify the all the necessary type of information necessary to conduct this study and for each information type, to identify the most potentially reliable sources of information. The cross-matrix below serves to summarize the results of the survey. It shows the types of information against the various types of sources for this information. The coloured cells indicate the level of suitability of information found using a "traffic lights" system of red, green and amber to differentiate data of high, fair and low suitability

		Sources of Information									
		Authorities			Industry				Others		
		EASA	CAA	EHEST	Helicopter Operators	Manufacturers	Associations	Pilot Unions	Multi-client consulting. reports	Independent initiatives	Universities
Type of information	Operational Occurrences										
	Safety & Research Reports										
	Fleet and operator information										
	Usage data										
	Design Related Occurrences										
	Reliability Reports										

Legend:

	High Suitability: The information provided by the source is considered complete and reliable for the purpose of the study
	Medium Suitability: The information provided by the source is complete and reliable but only covering a specific area or period of the scope of the study - To be complemented with other sources.
	Low Suitability: Not completely reliable and not completely exhaustive
	No information available

In this report we consider each of these aspects in turn and summarize them in the following sections:

- This **Section 1** "Introduction and Executive Summary" is the Presentation of the Consortium and of the main outcomes of the Literature Survey report. It also highlights the information gaps by type of information surveyed and also by source of information. A further note on this aspect appears below and in the introduction of Section 4.
- **Section 2** "Background" recalls the regulatory background for this study and provides an overview of helicopter industry in general and in EASA member states in particular.
- **Section 3 "**Information Sources" describes the sources of information identified and details the different information that can be obtained from each source for the purpose of this study**.**
- **Section 4** "Databases" describes those databases available to produce a single high quality combined database to provide a comprehensive view of accident and incident history over the last 10 years and a matching database of operators and their corresponding commercial activities. It also includes an appraisal for each database.
- **Section 5** "Publications" addresses all those published reports and analyses found that are pertinent to the scope of this study and summarizes the already identified safety hazards and the mitigations in place or proposed.

In considering report Section 4 mentioned above, we have identified a large number of data sources, official and unofficial. In reviewing them we have concluded that no single source can provide the completeness and quality of data necessary to produce a meaningful analysis. We propose therefore to adopt a "multiple-source" approach to data collection both for safety occurrences and for identifying the operators and their fleets.

While reviewing the various data sources, for example for safety occurrences, we have noted that each of them contains unique occurrences as well as many common events. Inevitably, the common events provide significant data conflicts that will need to be resolved. With regard to the identification of events there is a large measure of agreement as to the date and location, the main problem being absent, and in some instances patently incorrect, data. We have identified a number of ways of adding absent fields and corroborating any conflicts, including current and historic aircraft registrations (the latter for aircraft written-off) such as IRCA and Rotorspot and helicopter type and model. We observe that the official sources are not always the most credible ones, and there is a need for a common-sense approach to missing and incorrect data rather than any strict hierarchy of credibility.

The two main official sources for safety occurrences, ADREP and ECCAIR contain differing occurrence populations – ADREP containing many more helicopter accidents and ECCAIR containing many more helicopter incidents. We have also noticed extensive missing and incorrect data in both systems, most of which it is possible to insert from a variety of other data sources. In addition we have observed that some of the less official accident sources contain significant numbers of additional events not officially recorded. In order to rectify this situation we propose to combine all the credible and available data into a single occurrence database.

Likewise with helicopter operators, and their fleets and utilisation we will need to combine the most reliable data sources to provide a truly comprehensive analysis of the developing status of helicopter operations over the past 10 years. We have not yet examined the potential sources in any detail but consider the Forecast International fleet and operator database is likely to provide the main data sources, supplemented by several other sources mentioned in section 4.2.

The fact that no information is available from Helicopter Operators nor Pilot Unions is not critical for the purpose of the study since the combination of all the other identified databases provides the necessary information coverage to conduct this study. On the other hand, during the contacts established with different OEMs willing to contribute to this study, OEMs expressed its desire to review the reports before official delivery, checking than none of the confidential information has been exposed with the aim to preserve the confidentiality of sensible data. The Consortium would appreciate to know the position of EASA on this request from OEMs

2 Background

2.1 Regulatory framework

The JAR OPS 3 Amendment 5 from 1st July 2007 prescribes the requirements applicable to the operation of any civil helicopter for the purpose of commercial air transportation by any operator until ultimately 28 October 2014, when the opt-out provisions of Commission Regulation (EU) n° 965/2012 (Air Operations) that entered into force from 28 October 2012 will expire.

Requirements of JAR OPS 3 have been transposed into Annex IV (Part CAT) Commercial Air Transport Operations, Subpart C Aircraft Performance and Operating Limitations, Section 2 Helicopters of EU Regulation n° 965/2012.

This regulation applies to EASA member states, which are European Union Member States and EEA/EFTA[3] States (Iceland, Liechtenstein, Norway and Switzerland).

2.1.1 Definitions

Before introducing the above-mentioned regulations, it is relevant to recall the definition of the following terms in the regulations:

- Performance Class
- Hostile Environment
- Congested area

Performance Class

A code of performance requirements has been developed for helicopter operations:

- **Operation in performance class 1**: means an operation that, in the event of failure of the critical engine, the helicopter is able to land within the rejected take-off distance available or safely continue the flight to an appropriate landing area, depending on when the failure occurs.
- **Operation in performance class 2**: means an operation that, in the event of failure of the critical engine, performance is available to enable the helicopter to safely continue the flight, except when the failure occurs early during the take-off manoeuvre or late in the landing manoeuvre, in which cases a forced landing may be required.
- **Operation in performance class 3:** means an operation that, in the event of an engine failure at any time during the flight, a forced landing may be required in a multi-engined helicopter and will be required in a single-engined helicopter

A single-engined helicopter is, therefore by definition, required to be operated in Performance Class 3

Hostile environment

Hostile environment means an environment in which:

a) a safe forced landing cannot be accomplished because the surface is inadequate;

b) the helicopter occupants cannot be adequately protected from the elements;

c) search and rescue response/capability is not provided consistent with anticipated exposure; or

d) there is an unacceptable risk of endangering persons or property on the ground;

e) in any case, the following areas are considered as hostile environment:

1. for overwater operations, the open sea areas north of 45N and south of 45S designated by the authority of the State concerned;
2. those parts of a congested area without adequate safe forced landing areas;

[3] EEA /EFTA – European Economic Area/European Free Trade Association

Congested area means in relation to a city, town or settlement, any area which is substantially used for residential, commercial or recreational purposes;

2.1.2 Regulatory requirements in EASA member states

The regulatory requirements states that performance Class 3 operations shall only be conducted in a non-hostile environment.

In case of a critical engine failure, performance class 3 operations over hostile environment will lead to a situation where either a safe forced landing cannot be assured - with a very high likelihood of injuries/fatalities – or, after a successful forced landing, survival of the occupants cannot be guaranteed – resulting in a very high likelihood of injuries/fatalities.

However, according to the provisions of article CAT.POL.H.420, helicopter operations over a non-congested hostile environment without a safe forced landing capability with turbine-powered helicopters may be conducted provided that:

a) Maximum Operational Passenger Seating Configuration (MOPSC) is six or less;

b) The operator has been granted an approval by the competent authority, following a safety risk assessment performed by the operator specifying the type of helicopter and type of operations;

c) If operations in another Member State, endorsement by the competent authority of the Member State where the operation will take place;

d) The operator shall only conduct these operations in the areas and under the conditions specified in the approval;

e) The operator shall not conduct these operations under a HEMS approval;

f) The operator substantiates that helicopter limitations, or other justifiable considerations, preclude the use of the appropriate performance criteria; and

g) Engine failure risk mitigation measures have been implemented:
   a. Attain and maintain the helicopter/engine modification standard defined by the manufacturer;
   b. Conduct the preventive maintenance actions recommended by the helicopter or engine manufacturer;
   c. include take-off and landing procedures in the operations manual, where they do not already exist in the AFM;
   d. Specify training for flight crew; and
   e. Provide a system for reporting to the manufacturer loss of power, engine shutdown or engine failure events;
   f. Implement a usage monitoring system (UMS).
   g. General Performance Class 3 limitations are fulfilled (operations are forbidden out of sight of the surface; or at night; or when the ceiling is less than 600 ft.; or when the visibility is less than 800 m),

The provisions of CAT.POL.H.420 are not implemented yet in EASA Member States. Indeed the requirements from Appendix 1 to JAR-OPS 3.005(e) still apply. But these requirements, which are aligned with those of CAT.POL.H.420 are differently transposed and implemented by Member States.

2.2 Helicopter industry

2.2.1 Helicopters Manufacturers

The helicopter industry has had a historical wide catalogue of players, most of them no longer existing, or having merged or changed names to establish new brands and strategies.

The most representative players nowadays are Eurocopter, Agusta Westland, Bell, McDonnell-Douglas, and Sikorsky, accounting for the turbine helicopters manufacturers, and Robinson as the major player in the single piston helicopter industry.

The following table has a brief description for all of the major and minor civil airframe manufacturers of all type of helicopters, and details changes on ownership over the time and indicates if at least one of their models is certified by EASA.

Manufacturer	Based in	Description	Owner	At least one (1) helicopter model with EASA type certificate
Aerospatiale	France: Toulouse	Historical French aerospace manufacturer, merging the state owned companies Sud Aviation, Nord Aviation, and SÉREB. The activity of the company went from the military and civilian aircraft and rotorcraft division, to rocket and satellite matters. Some of the models, prior to the merging into Eurocopter (EADS) are still in service.	Company merged into Eurocopter group.	Yes
Agusta Westland	Italy / United Kingdom.	Resulting from the merger of Agusta and Westland, this manufacturer has historically built some models collaborating with Bell. Currently it has some production in Russia, after an agreement with Russian Helicopters.	Since May 26th 2004, AgustaWestland has been completely owned by Finmeccanica (Italy).	Yes
Alpi Aviation	Italy	Recreational airplanes manufacturer, born from a group of amateurs. They are currently manufacturing a light helicopter emphasizing in its visual design, and latest technologies in its field		No
Avicopter	China	Helicopter division of the Chinese aircraft manufacturer AVIC.	Owned 69 per cent by AVIC (state) and 31 per cent by Tianjin municipal government.	No
Bell	USA: Fort Worth, Texas	Founded in 1935, it started to develop helicopters six years later, and became one of the better known helicopter manufacturers. Has a close relation with Agusta Westland and its developments in Europe.	Textron, from 1960 until now.	Yes
Boeing	USA: Chicago, Illinois	Mostly known by its airplane division, Boeing is the main manufacturer of the tandem rotor helicopters. It also developed the V-22 Osprey in conjunction with Bell.	Share holders.	No

Manufacturer	Based in	Description	Owner	At least one (1) helicopter model with EASA type certificate
Brantly International	USA: Vernon, Texas	Designer of the B-1 and B-2 models, its only model in production is manufactured in China.	Privately held company. In 2009 all activities were handed over to the Chinese company Qingdao Haili Helicopters Co. Ltd.	Yes
Enstrom Helicopter	USA: Menominee, Michigan	Producing three models either with piston or turbine engines, Enstrom has more than 50 years of history.	Privately owned company	Yes
Eurocopter	France: Marignane	Resulting from the merger of Daimler-Benz Aerospace, and the helicopter division of Aerospatiale, Eurocopter is the main European manufacturer.	EADS	Yes
Hélicoptères Guimbal S.A.	Les Milles, France, Europe	Founded by a former Eurocopter engineer, it produced a piston two-seater helicopter that is currently an EASA type certificate holder		Yes
Hiller Aircraft Corporation		Widely used as utility helicopters, the Hiller Aircraft Corporation has been developing models since 1942. However manufacturing seems to be interrupted. Plans to restart seem to have stalled back in 1995 when the Hiller family bought back the company from Rogerson-Hiller.		No
Hughes Helicopters	USA: Culver City, CA and Mesa, AZ	Started as the helicopter division from Hughes Aircraft, produced own and licenced models, before being acquired by McDonnell Douglas.	McDonnell-Douglas	No
Kaman Aerospace	USA: Connecticut	Founded in 1945, still active in the civil and military helicopter market.	Shareholders in the stock market.	Yes
Kamov	Russia: Moscow	Building helicopters since 1929, it developed several unconventional models, and merged with Mil in 2006.	Oboronprom, amongst others.	Yes (Restricted)
Kawasaki Aerospace	Japan	Manufacturer of several models under licence from Boeing, and Agusta Westland.	Kawasaki	No
Kazan Helicopters	Russian Federation: Kazan city	Producer of Mil models for more than 50 years.		No
Marenco Swisshelicopter	Switzerland	Helicopter division of the engineering company MARENCO		No
McDonnell Douglas	USA: St. Louis, Missouri	Helicopter division of the historical airplane company, it is a result of the acquisition of Hughes Helicopters. Well known by its NOTAR models, and widely used in the United States.	Patriarch Partners, LLC, an investment fund	Yes
Messerschmitt-Bölkow-Blohm	Germany	Well known manufacture, in a Europe-wide used helicopter, the BO 105. It is currently part of Eurocopter.	Merged into DASA, which merged in Eurocopter.	No

Manufacturer	Based in	Description	Owner	At least one (1) helicopter model with EASA type certificate
Mil	Russia: Moscow	Historical company, a quarter of all the helicopters worldwide are from its manufacture, or designs.	Shareholders with Oboronprom being the largest one by far.	No
Mitsubishi	Japan	It currently has a light utility model only sold in the Japanese market.	Mitsubishi	No
NHIndustries		Established by Agusta, Eurocopter and Stork Fokker Aerospace, was responsible for the development of the NH90 helicopter.	Agusta, Eurocopter and Stork Fokker Aerospace.	No
PZL Swidnik	Poland	Currently part of the Italian manufacturer AgustaWestland, has developed some models under soviet licence. Its medium helicopter is widely used in Europe.	AgustaWestland	Yes
Qingdao Haili Helicopters Co. Ltd	China	Holder of the license to manufacture the B-2B helicopter in China.		No
Quest Helicopters	Dubai	UAE's helicopter company, with little information about its current developments.	Quest Investments	No
Robinson Helicopter Company	USA: Torrance, California	Main piston helicopter OEM, producing three models used worldwide, known for its frequent use in instruction.	Frank Robinson	Yes
Rotorway International	USA: Chandler, Arizona	Third largest American helicopter company, currently developing north American and south African markets, has intention to develop its own engine manufacturing company.	Owned by senior management.	No
Russian Helicopters Joined Stock Company	Russia	Sole current Russian helicopter manufacturer, it shares the experience of historical companies as Kazan, MIL and Kamov, and has also agreements with Agusta Westland to build some of its models.	Partnership between Kazan, MIL, Kamov and others.	No
Schweizer	USA: Horseheads, New York	Mainly producing light, utility and training helicopters, this brand has had models that lasted for more than 50 years. It is currently owned and maintained by Sikorsky.	Sikorsky Aircraft Corporation	Yes
Sikorsky	USA: Stratford, Connecticut	Founded in 1923, initiated its activity in the rotorcraft industry in the 1940s. From then, Sikorsky has been one of the major players both in the civilian and military helicopter market.	United Technologies Corporation	Yes
Sud Aviation	France	Sud Aviation, founder of Aerospatiale, was a French state-owned aircraft manufacturer. Some of its designs are still in service, with maintenance provided by EADS group.	Eurocopter	Yes

Table 1 Helicopter manufacturers

2.2.2 Helicopters certified in EASA member states

As stated in the table above, a significant number of manufacturers have helicopter models currently holding an EASA type certificate [4]. These models, in the date of the study account for 102 European and 39 foreign, and are available in the following websites:

- European rotorcraft: http://www.easa.europa.eu/certification/docs/products/Rotorcraft_EUR.pdf
- Foreign rotorcraft: http://www.easa.europa.eu/certification/docs/products/Rotorcraft_non-EUR.pdf

It must be noted that the major part of the fleet in this states accounts for a few of this models, and brands, and though while analysing the data there must be an important consideration on which of the models certified, are actually flying or available in the territories.

It is also remarkable that the European helicopters with EASA type certificate are Agusta Westland, Eurocopter (and merged manufacturers), Guimbal, Mecaer (A licence for MD in Europe), and PZL-Swidnik.

The non-European manufacturers holding EASA type certificates for their helicopters models are Bell, Brantly, Enstrom, Erickson, MacDonnell-Douglas, Philippine Aerospace Development (a Bolkow licenced product), Robinson, Schweizer and Sikorsky.

According to the current type certificate holders, overviewing the fleets present in Europe, and in the basis of this study, the key manufacturers approached for a solid information channel have been:

- Eurocopter
- Bell
- Agusta Westland
- Sikorsky
- Robinson (key manufacturer of smaller mainly piston-powered aircraft

On the other hand, the engine manufacturers have to be studied separately. There are currently five manufacturers controlling the major part of the industry. These OEMs, some product of merging historical companies, are: Turbomeca, Rolls-Royce/Allison, Honeywell/Lycoming, Pratt & Whitney Canada, and General Electric.

2.2.3 Helicopters operated in EASA member states

According to our first rough estimations, EASA member states counts around 7,500 helicopters. Four countries concentrate almost 60% of the total fleet of helicopters in Europe

Country	% Helicopter fleet
France:	19 %
United Kingdom	16 %
Germany	12 %
Italy	11 %
TOTAL	59 %

Table 2 Distribution of Helicopter Fleet in Europe

The 7,500helicopters in EASA member states are divided in the approximate proportions:

- Single turbine 31% (most common type AS350 Ecureuil 1 followed by JetRanger series)
- Twin turbine 32% (most common type EC135)
- Single piston 37% (over two thirds of them Robinson 22/44)

[4] Including type certificate (including restricted type certificates) issued by an EASA member state prior to the transfer to EASA type-certification of aircraft and components activities

According the EHEST Final Report 2010 (Analysis of 2000-2005 European Helicopter Accidents), the fleet of helicopters in Europe is split in three different profiles of operators:

- Small operators (1 to 2 helicopters) → around 30% of whole helicopter fleet in Europe
- Medium operators (3 to 20 helicopters) → around 37% of whole helicopter fleet in Europe
- Large operators (more than 20 helicopters) → around 33% of whole helicopter fleet in Europe

The large operators have divisions for all types of activities (offshore, Search and Rescue, patrol…) and have the appropriate organisation to support their activities (training department, quality assurance,..). The small operators are generally specialised (sightseeing, crop spraying, flight training…). These small operators do not have the resources and means that a large operator may have.

A fourth type of operators is the public services operators with large fleet and only one type of service (Police, Transit, SAR…) (mainly included in 33% of whole helicopter fleet in Europe)

3 Information Sources

3.1 Authorities

3.1.1 EASA

The European Aviation Safety Agency (EASA) is an agency of the European Union established in 2002 by a regulation of the European parliament and the Council in order to ensure a high and uniform level of safety in civil aviation, by the implementation of common safety rules and measures. It became operational in September 2003.

The Agency promotes the highest common standards of safety and environmental protection in civil aviation in Europe and worldwide. The European Aviation Safety Agency (EASA) is the centrepiece of the European Union's strategy for aviation safety. The Agency develops common safety and environmental rules at a European level. Also, it monitors the implementation of standards through inspections in the Member States and provides technical expertise, training and research.

EASA has taken over the responsibilities of the former Joint Aviation Authorities (JAA) system which ceased on 30 June 2009. However, it is not a successor agency in legal terms since it functions directly under EU statute. The main difference between EASA and the JAA is that EASA is Regulatory Authority which uses NAAs to implement its Regulations whereas the JAA relied upon the participating NAAs to apply its harmonised codes without having any force of law at source.

The agency's responsibilities include:

- Expert advice to the EU for drafting new legislation;
- Implementing and monitoring safety rules, including inspections in the Member States;
- Type-certification of aircraft and components, as well as the approval of organisations involved in the design, manufacture and maintenance of aeronautical products;
- Authorization of third-country (non EU) operators;
- Safety analysis and research

The type formation available in EASA for the purpose of this study is detailed in the table below:

Type of Information		Support	Documented in
Operational Occurrences	☒	1. Accident/Incident Data Reporting (ADREP) 2. European Central Repository (ECR)	Section 4.1- Table 25, Table 26
Safety&Research Reports	☒	Various publications	Section 5.1
Fleet and operator information	☒	Operator and fleet database	Section 4.2 - Table 35 EASA Operator and Fleet Data
Usage data	☐	-	-
Design Related Occurrences	☒	Internal Occurrence Reporting System (IORS)	Section 0 - Table 43 Internal Occurrence Reporting System (IORS)
Reliability Reports	☐	-	-

Table 3 EASA Type of Information

3.1.2 Civil Aviation Authorities (CAA)

Each EASA member state possesses its Civil Aviation Authority which is given responsibility for determining and administering the regulatory regime which is in place to ensure that aircraft can be operated safely. In all there are 31 Civil Aviation Authorities with this responsibility.

As responsible for the delivery of aircraft registrations, each CAA maintains a database of aircraft national registers. Also, CAAs are responsible for collecting data related to the usage of aircraft reported by helicopter operators. Indeed it is required to operators to make available to the related CAA, the hours flown for each helicopter operated during the previous calendar year.

The information that may be obtained from the CAAs for the purpose of this study is detailed in the table below:

Type of Information		Support	Documented in
Operational Occurrences	☐	-	-
Safety&Research Reports	☒	Various publications	Section 5.3, Section 5.4
Fleet and operator information	☒	International Register of Civil Aviation (IRCA)	Section 4.2 - Table 37
Usage data	☒	International Register of Civil Aviation (IRCA)	Section 4.2 - Table 37
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 4 NCAA Type of Information

As far as research and safety reports are concerned, the most active are the northern states, as well as the United Kingdom, very active in helicopter transport to offshore locations, and though having large units that study the field.

It has been considered relevant to survey non-European authorities, such as the American and Australian, having an extended helicopter use, even if the whole operational concept for single-engined helicopters is defined otherwise. However the studies have methodologies and accident approaches that have been considered relevant, even if most of the data will not be comparable with the current study outputs

Sections 5.3 and 5.4 address the reports published by different Civil Aviation Authorities worldwide in relation of the scope of this study.

3.1.3 European Helicopter Safety Team (EHEST)

Launched on November 2006, the European Helicopter Safety Team (EHEST) brings together manufacturers, operators, research organisations, regulators, accident investigators and a few military operators from across Europe. EHEST is the helicopter branch of the ESSI, an aviation safety partnership between EASA, other regulators, and the industry. The three pillars of ESSI are EHEST, as well as the Commercial Aviation and the General Aviation safety teams.

It is also the European component of the International Helicopter Safety Team (IHST).

Committed to contribute to the goal of reducing the helicopter accident rate by 80 per cent by 2016 worldwide, with emphasis on improving European safety, the basic principle of EHEST is to improve aviation safety by complementing regulatory action by voluntarily encouraging and committing to cost-effective safety enhancements. Analysis of occurrence data, coordination with other safety initiatives and implementation of cost-effective action plans are carried out to achieve specific safety goals. In addition, the EHEST initiative implements actions of the European Aviation Safety Plan 2012-2015 (EASP).

The information obtained from EHEST for the purpose of this study is detailed in the table below:

Type of Information		Support	Documented in
Operational Occurrences	☒	European Helicopter Safety Analysis Team (EHSAT)	Section 4.1- Table 27
Safety&Research Reports	☒	Various publications	Section 5.2
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 5 EHEST Type of Information

3.2 Manufacturers

With the support of the European Helicopter Association (EHA), the Consortium established contacts with the following key airframe and engine manufacturers:

- Eurocopter
- Bell
- Turbomeca
- Sikorsky
- Robinson (key manufacturer of smaller mainly piston-powered aircraft)

Unfortunately, EHA could not provide contacts for the other key players of the Original Equipment Manufacturer (OEM) industry:

- Airframe: Augusta Westland, Boeing, McDonnell-Douglas Helicopters (ex Hughes),.
- Engine: Rolls-Royce/Allison, Honeywell/Lycoming, Pratt & Whitney Canada and General Electric.

The Consortium took the initiative to contact Augusta, but unfortunately no reply has been received yet.

At the time of this report only the following manufacturers showed willingness to contribute in this study

- Eurocopter
- Bell
- Turbomeca
- Robinson

Sikorsky is still considering our request of kind contribution to the study.

The Consortium intends to contact again OEMs once EASA releases the agreed mandate requesting the contribution of OEM through the provision relevant information to the purpose of this study.

According to our discussions with the above-mentioned manufacturers, it appears some differences between the databases of airframe manufacturers and power plant manufacturers.

- Airframe manufacturers keep track of every accident and serious incident. This information is either provided from authorities, reported to the manufacturer by the operators or by its extensive network of field engineers or simply collected by the manufacturer thanks to its active monitoring of fleet events
- Engine manufacturers records any reported accident or incident of their engine fleets. The added value with regard airframe manufacturer databases is that most probably it will contain more information related to incidents without catastrophic consequences. Indeed such engine incidents are not always reported. For example an engine failure ended in an autorotation without consequences, would not normally be reported either to the authorities or to the airframe builder. However, thanks to its network of repair stations, engine manufacturers are able to collect this information.

- In addition, engine manufacturers do not have extensive information about accidents and incidents without direct or indirect engine failure.

OEMS are willing to deliver aggregated data and statistics based on the queries that the Consortium will define. But the data stored in their databases would be redacted and therefore not be accessible for each single occurrence. OEMs will not provide access to their occurrence databases.

In addition to managing the above-mentioned databases, OEMs develops their own safety studies, parallel to and complementary with the ones from the national authorities.

3.2.1 Eurocopter

Eurocopter is a European manufacturer, resulting from the merge of various historical brands. It currently has the widest offering in single engine helicopters among all manufacturers, as well as the major fleet share of operators in Europe.

The Eurocopter group was created in 1992 with the merger between the helicopter divisions of Aerospatiale-matra (France) and DaimlerChrysler Aerospace (Germany).

The group is now a subsidiary owned 100% by EADS (European Aeronautic Defence and Space Company), one of the three largest aerospace groups in the world.

A meeting with Eurocopter was held at Eurocopter's facilities in order to expose the project, to identify the relevant information that could be shared and establish an information flow between the manufacturer and the consortium. The type formation that Eurocopter is aiming to share for the purpose of this study is detailed in the table below:

Type of Information		Support	Documented in
Operational Occurrences	☒	Eurocopter Operational Occurrence database	Section 4.1 - Table 28
Safety&Research Reports	☐	-	-
Fleet and operator information	☒	Eurocopter fleet database	Section 4.2 - Table 36
Usage data	☒	Eurocopter fleet database	Section 4.2 - Table 36
Design Related Occurrences	☒	To be obtained through IORS	Section 0 - Table 43
Reliability Reports	☒	Reliability Reports	Not yet available – Will be provided after signature of a Non-Disclosure Agreement by both parties

Table 6 EUROCOPTER Type of Information

3.2.2 Robinson

Robinson is an American helicopter company founded in 1973 by Frank Robinson to design and manufacture a light, inexpensive helicopter for general aviation markets. The Company is currently the world's leading manufacturer of civil helicopters, and has a network of more than 400 service centers.

Robinson manufactures three models of helicopter: two piston engine models, the R22, and R44, and a turbine engine variant the R66, all designed as a cheap and effective alternative to its competitors. Over the years Robinson has produced over 10.000 helicopters, from which almost a half have been R22, its most successful model.

Robinson does not maintain its own records of accidents or incidents. Instead Robinson relies on public databases such as NTSB accident reports and the FAA's SDR database. Also, Robinson does not maintain a record of ownership of the helicopters manufactured. As stated in the table below, the information provided by Robinson relates to Safety & Research Reports.

Type of Information		Support	Documented in
Operational Occurrences	☐		
Safety&Research Reports	☒	Study on R44 & R44 II engine power loss rates	Section 5.6
Fleet and operator information	☐		
Usage data	☐		
Design Related Occurrences	☐		
Reliability Reports	☐		

Table 7 Robinson Type of Information

3.2.3 Turbomeca

Turbomeca specialises in the design, production, sale and support of low- to medium-power gas turbines for helicopters. Including its joint programs with other manufacturers, Turbomeca is today the world's leading provider of helicopter engines, offering a full range of services close to customers, wherever they may operate.

The company also develops and markets turbo-jet engines for fixed-wing aircraft. Turbomeca also has one subsidiary: Microturbo, a specialist in turbo-reactors for missiles.

Turbomeca turbines power civil, parapublic and defence helicopters for all the leading helicopter manufacturers.

A conference call was organised with Turbomeca in order to expose the project, to identify the relevant information that could be shared and establish an information flow between the manufacturer and the consortium.

In the teleconference, Turbomeca pointed out that as part of its duties as a holder of the Engine Type Certificate, it is mandatory to report all design related occurrences to EASA.

The type formation that Turbomeca is aiming to share for the purpose of this study is detailed in the table below:

Type of Information		Support	Documented in
Operational Occurrences	☒	Turbomeca database	Section 4.1- Table 29
Safety&Research Reports	☐	-	-
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☒	To be obtained through IORS	Section 0 - Table 43
Reliability Reports	☒	Reliability Reports	Not yet available – Will be provided after signature of a Non-Disclosure Agreement by both parties

Table 8 TURBOMECA Type of Information

3.2.4 Bell

A major American helicopter company founded in 1935, has been a reference in the helicopter industry since the beginning. Bell was the first company to obtain certification for a commercial helicopter, and has delivered over 35.000 aircraft to customers.

In Europe, most of its models have been developed jointly with Agusta.

Communication with Bell has been established through e-mails. Bell expressed its willingness to contribute to this study and a Non-Disclosure Agreement has been signed between both parties. At the time of this report, only safety related reports have been made available. The table below details the information already available and the information that is expected to be provided by Bell.

Type of Information		Support	Documented in
Operational Occurrences	☒	To be determined	Not yet available
Safety&Research Reports	☒	Various publications	Section 5.5
Fleet and operator information	☐	-	-
Usage data	☒	To be determined	Not yet available
Design Related Occurrences	☒	To be determined	Not yet available
Reliability Reports	☒	Reliability Reports	Not yet available

Table 9 BELL Type of Information

3.3 Helicopter Operators and Fleets

Large operators (more than 20 helicopters single or multi engine) concentrate around 33% of whole helicopter fleet in Europe. The most relevant large operators operating single engine helicopters are sampled in the table below:

Country	Details
Portugal	Heliportugal LDA = HPL Cascais-Tires
	Aerodromo Municipal de Cascais, Hangar 3/7 S Domingos de Rana, Tires P-2785-632, Portugal Tel: +351 214447230 Fax: +351 214448067 Email: info@heliportugal.pt
	F: 1982 Emps: 78 Head: Pedro Silveira ICAO: HELIPORTUGAL Web: www.heliportugal.pt
Spain	**INAER Helicopteros = UV (Member of Grupo INAER) Alicante**
	Partida de la Almaina 92, Mutxamel, Alicante E-03110, Spain Tel: +34 965663835 Fax: +34 965665924 Email: info@inaer.com
	F: 1983 Emps: 250 Head: Luis San Valero IATA: 662 ICAO: HELISURESTE Web: www.inaer.es
Ireland	**Executive Helicopters Ireland (Executive Helicopters Maintenance) Galway**
	Hangar A, Galway Airport, Carnmore Co Galway, Ireland Tel: +353 91783300 Fax: +353 91755588 Email: info@executive-helicopters.com
	F: 1998 Emps: 10 Head: Chris Shiel Web: www.executive-helicopters.com Provides: Air Charter Services , Maintenance & Training
France	**Heli-Union = HLU Toussus-le-Noble**
	4 Avenue De la Porte-de-Sevres, Paris F-75015, France Tel: +33 153780818 Fax: +33 139258485 Email: marketing@heli-union.com
	F: n/a Emps: n/a Head: Jean-Christophe Schmitt Web: www.heli-union.com
Italy	**Heliwest**
	Localita Tagliata North 314, Frazione San Marzanotto, Asti I-14100, Italy Tel: +39 0141595985 Fax: +39 0141595995 Email: heliwest@heliwest.it
	F: n/a Emps: n/a Head: Luciano Villani Web: www.heliwest.it
Norway	**Airlift Norway = ALI (Subs. of Helicopter Transportation Group) Forde**
	Forde Lufthavn, Bygstad N-6977, Norway Tel: +47 57718100 Fax: +47 57718101 Email: firmapost@airlift.no
	F: 1986 Emps: 86 Head: Kjell Paulseth Web: www.airlift.no
Belgium	**Heli Service Belgium NV Halle-Heliport**
	Gaasbeeksesteenweg 140, Halle B-1500, Belgium Tel: +32 23612121 Fax: +32 23602770 Email: ops@hsb.be
	F: n/a Emps: n/a Head: Bernard Slegten Web: www.hsb.be
	Heli Holland BV = HHE Emmer-Helipad
	Postbus 16, Kanaal B ZZ 3, Emmen NL-7881NB, Netherlands Tel: +31 591351251 Fax: n/a Email: info@heliholland.nl
	F: 1976 Emps: 5 Head: Rene Haring Web: www.heliholland.nl
Switzerland	**Air Glaciers = AGV Sion**
	Aeroport Civil, Case Postale 27, Sion CH-1951, Switzerland Tel: +41 273291415 Fax: n/a Email: info@air-glaciers.ch F: 1965 Emps: 120 Head: Bruno Bagnoud ICAO: AIR GLACIERS Web: www.air-glaciers.ch
Austria	**Heli Austria GmbH St Johann Im Pongau-Heliport**
	5600 St Johann im Pongau, Salzburg A-5310, Austria Tel: +43 64624200 Fax: +43 6462420042 Email: fly@heli-tirol.at

Country	Details
	F: n/a Emps: n/a Head: Rolf Knaus Web: www.heli-austria.at
Czech Republic	**DSA AS Hradec Kralove**
	Bratri Stefanu 101, Hradec Kralove CZ-500 03, Czech Republic Tel: +420 495407407 Fax: +420 495407407 Email: office@dsa.cz
	F: n/a Emps: n/a Head: Tomas Suchanek Web: www.dsa.cz
Sweden	**Osterman Helicopter Gothenburg-Saeve**
	Save Flygplatsvag 38, Gothenburg S-42373, Sweden Tel: +46 31926000 Fax: n/a Email: info@ohab.se
	F: 1950 Emps: 20 Head: Chris Hagberg Web: www.ostermanaero.se

The Consortium is liaising with Grupo INAER, one of the major large operators for the provision of relevant information for this study. At the time of this report, INAER could not have made available any pertinent information.

3.4 Associations

A large number of associations exist for the helicopter sector, at industry and user/operational level. The most relevant for the purpose of this study are addressed in this section.

3.4.1 European Helicopter Association

The mission of the EHA is to speak as the voice for the European Rotorcraft industry at the European institutions and elsewhere, including to the general public; representing and promoting the best interests of all sectors as an economically important, safe and sustainable industry essential to the success of European and National economies.

Despite EHA is not a source of information itself for the purpose of this study, it has been supporting the Consortium to establish contacts with the following airframe and engine manufacturers:

- Eurocopter
- Bell
- Turbomeca
- Sikorsky
- Robinson (key manufacturer of smaller mainly piston-powered aircraft)

3.4.2 Oil and Gas Producers

The International Association of Oil & Gas Producers (OGP) encompasses the world's leading private and state-owned oil & gas companies, their national and regional associations, and major upstream contractors and suppliers.

In the OGP the members share its best practices to achieve improvements in health, safety, the environment, security, social responsibility, engineering and operations

The OGP itself publishes data, studies, guidelines and assessment about safety performance and operations.

The table below highlights the type of information that has been collected from OGP from internet (http://www.ogp.org.uk).

Type of Information		Support	Documented in
Operational Occurrences	☐	-	-
Safety&Research Reports	☒	Various publications	Section 5.6
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 10 OGP Type of Information

Through its Aviation Sub-Committee, OGP conducts research into rotary and fixed wing aircraft safety and produces industry guides for heliport design, helicopter operating standards and the auditing of chartered flight operations. The Consortium has been put in touch with the Chairman of the Aviation Sub-Committee to enable a dialogue to take place to explore possible contributions to this study.

3.4.3 Flight Safety Foundation (FSF)

The Flight Safety Foundation was formed in 1947 to pursue the continuous improvement of global aviation safety. The Foundation meets this objective through research, auditing, education, advocacy and publishing.

The Foundation's effectiveness in bridging cultural and political differences in the common cause of safety has earned worldwide respect.

Today, membership includes more than 1,200 organizations and individuals in 150 countries. The Foundation is based in Alexandria, Virginia, U.S., has a regional office in Melbourne, Australia, and is affiliated with associate organizations in Japan, Russia, Southeast Europe, Taiwan, China and West Africa.

The table below highlights the type of information that has been collected from FSF through internet (http://flightsafety.org) and AV-DATA.

AV-DATA is a single source for aviation regulatory and compliance data and provides immediate access to relevant information from the complex range of domestic and international aviation authorities and agencies.

AV-DATA contains critical information from the FAA and other US agencies and is the only aviation product that includes worldwide information from other authorities such as EASA, JAA, ICAO and UKCAA. AV-DATA includes quick access to Flight Safety Foundation (FSF) reports.

The table below highlights the type of information obtained from FSF.

Type of Information		Support	Documented in
Operational Occurrences	☒	Aviation Safety Net	Section 4.1- Table 31
Safety&Research Reports	☒	Various publications	Section 5.8
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 11 FSF Type of Information

In addition to these researches, the Consortium took the initiative to contact FSF to explore further contribution to this study, but at the time of this report, no answer was received yet.

3.4.4 International Helicopter Safety Team (IHST)

The IHST was created to lead a government and industry cooperative effort to address the unacceptably high long-term helicopter accident rates. The IHST chose to pursue the goal of reducing the worldwide civil and military helicopter accident rates by 80% in 10 years by adopting the methods that have been used by the Commercial Aviation Safety Team (CAST) to substantially reduce the worldwide fatal accident rate in the commercial air carrier community.

The process used by CAST was directly linked to real accident data, used a broad spectrum of industry experts to analyse it and included objective success measurements to ensure that the actions taken were having the desired effect.

Accordingly, the IHST chartered the Joint Helicopter Safety Analysis Team (JHSAT) to adapt the CAST process to analyse helicopter accident data and to offer recommendations for reducing the accident rate.

The IHST also chartered the Joint Helicopter Safety Implementation Team (JHSIT) to assess the JHSATs' recommendations and to develop detailed implementation plans for the safety enhancements deemed to have the greatest potential benefit. Industry helicopter safety experts representing operators, airframe and engine manufacturers, and regulators comprise both the JHSAT and the JHSIT.

The table below highlights the type of information that can be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☐	-	-
Safety&Research Reports	☒	Various publications	Section 5.9
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 12 IHST Type of Information

In addition to these researches, the Consortium took the initiative to contact IHST to explore further contribution to this study, but at the time of this report, no answer has been received yet

3.4.5 Other Associations

During the literature survey, some additional active helicopter associations were identified. Their websites were checked but not relevant information could be obtained. For some of the cases, these associations were also contacted but no reply has been received at the time of this report.

3.4.5.1 Helicopter Association of Canada (HAC)

The Helicopter Association of Canada, is a very active organisation within the helicopter world. Traditionally, Canada has been one of the reference countries in helicopter flights, and its operators along with its associations and authorities are considered worldwide. The HAC has the objective of ensuring the financial viability of the Canadian Civil Helicopter Industry, educating its members about issues important to the industry, promoting the enhancement of flight safety, developing the utilisation as a mean of transport, and exchanging best practices among members.

3.4.5.2 British Helicopter Association (BHA)

The BHA is the non-profit trade organisation that represents the UK's civil helicopter industry to government departments and international bodies. Its main aim is to promote the safe, efficient and environmentally responsible operation of rotorcraft throughout the UK. We have approached the BHA with a view to establishing a dialogue on the study issues and are currently awaiting receipt of a copy of their Yearbook

3.4.5.3 General Aviation Manufacturers Associations (GAMA)

International trade association representing over 80 leading manufacturers of general aviation airplanes, rotorcraft and its components.

Through its public information and education programs, GAMA promotes better understanding of general aviation and the important role it plays in economic growth and in serving the transportation needs of communities, companies and individuals worldwide.

3.4.5.4 Helicopter Association International (HAI)

For more than 60 years, HAI has provided support and services to its members and to the international helicopter community. Headquartered in Alexandria, Virginia, HAI members safely fly more than 5,000 helicopters some 2.3 million hours each year. Governed by a Board of Directors elected from the membership, with daily operations conducted by a dedicated professional staff.

3.5 European Cockpit Association

The European Cockpit Association (ECA) was created in 1991 and is the representative body of European pilots at European Union (EU) level. It represents over 38,000 European pilots from the National pilot Associations in 37 European states.

The European Cockpit Association represents the collective interests of its Member Associations at European level, striving for the highest levels of aviation safety and fostering social rights and quality employment for pilots in Europe.

The European Cockpit Association and in particular its Helicopter Working Group were considered a potential source of information. However no significant information has been provided yet.

3.6 Multi-client Consulting Reports

Among the extensive number of consultancy companies offering services related to helicopter safety, four firms have been identified as possible source of relevant information for the purpose of this study. Strictly in the context of the EASA study these organisations are consultancy and publishing companies specialising in the types of data required

3.6.1 ASCEND

Ascend is a global online information company, offering also a Valuations and Appraisals, and Consulting solutions across the entire aerospace industry. Their deliveries include detailed accident reports, analysis of safety trends, and recommending on air safety improvements.

It is currently owned by FlightGlobal (part of Reed Business Information), and claims to be the world's leader in multi-platform business information

Among its clients, it can be found the ICAO, FAA and UK CAA, as well as global insurers.

The table below highlights the type of information that can be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☒	World Aircraft Accident Summary (WAAS)	Section 4.1 - Table 30
Safety&Research Reports	☐	-	-
Fleet and operator information	☒	HELICAS Database	-
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 13 ASCEND Type of Information

3.6.2 AV-DATA

AV-DATA is a single source for aviation regulatory and compliance data and provides immediate access to relevant information from the complex range of domestic and international aviation authorities and agencies.

AV-DATA contains critical information from the FAA and other US agencies and is the only aviation product that includes worldwide information from other authorities such as EASA, JAA, ICAO and UKCAA. AV-DATA includes quick access to Flight Safety Foundation (FSF) reports.

The table below highlights the type of information that can be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☐	-	-
Safety&Research Reports	☒	FSF Publications	Section 5.8
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 14 AV-DATA Type of Information

3.6.3 FlightGlobal - JP Airlines Fleets International

FlightGlobal is an online news and information website related to the aviation and aerospace industries, providing different levels of service depending on the clients' needs. Its databases include information about airlines, routes, aircraft, and many sources of news. For the particular case of this study, FlightGlobal publishes a yearly book, with 46 editions at present, providing information about commercial operators, including its registered fleets, and main details.

The table below highlights the type of information that can be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☐	-	-
Safety&Research Reports	☐	-	-
Fleet and operator information	☒	JP Airline Fleets International	Section 4.2 - Table 38
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 15 AV-DATA Type of Information

3.6.4 Helivalue$

Helivalue$ has over 25 years of experience publicating The Official Helicopter Blue Book, giving the historical records of helicopter transactions, as well as a detailed specification sheet for a wide number of different models and brands.

The table below highlights the type of information that can be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☐	-	-
Safety&Research Reports	☐	-	-
Fleet and operator information	☒	The official helicopter Blue Book	Section 4.2 - Table 39
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 16 Helivalue$ Type of Information

3.6.5 Forecast International

Forecast International is a consultancy company, providing market intelligence, forecasting, and research services. Founded in 1973, the company evaluates data, and generates forecasts, offering accurate historic information as well as personalised reports. Its “Business Class” helicopter fleet report appears to be the most comprehensive and readiliy accessible means of identifying the main operators across the range of helicopters classes and models.

Type of Information		Support	Documented in
Operational Occurrences	☐	-	-
Safety&Research Reports	☐	-	-
Fleet and operator information	☒	Rotor Roster Business Class Helicopters	Section 4.2 - Table 40
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 17 Forecast International Type of Information

3.7 Independent Initiatives

A number of potential data sources both for accident data and for that relating to the worldwide helicopter fleet have been identified and analysed to determine its suitability for use in this study. This sections addresses these potential data sources:

3.7.1 Rotorspot

Developed mainly by an aeronautical engineer, and former spotter, Rotorspot is a website that gives access to a registration database built over the years. The database starting first with the Netherlands, then Belgium and Luxembourg, has been expanded to encompass the whole European territory and worldwide data.

The table below highlights the type of information that can be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☐	-	-
Safety&Research Reports	☐	-	-
Fleet and operator information	☒	Rotorspot database	Section 4.2 - Table 41
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 18 ROTORSPOT Type of Information

3.7.2 Helihub

HeliHub.com is wholly owned by Jeremy Parkin, and is independent of all helicopter manufacturers, suppliers, operators, sales companies, or media organisations. It has been created to provide helicopter information, trying to overcome the US and European industry focus, and offering information and news in a worldwide basis.

The table below highlights the type of information that can be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☒	Helihub database	Section 4.1 - Table 32
Safety&Research Reports	☐	-	-
Fleet and operator information	☒	Helihub database	Section 4.2 - Table 42
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 19 HELIHUB Type of Information

3.7.3 Griffin Helicopters

Griffin Helicopters is an online accident, news, and general information resource site, owned and developed by Gary Spender, with several pilots and experts collaborating in its content. The website is UK based, but has worldwide information in some fields, and some tools for the use of pilots.

The table below highlights the type of information that can be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☒	Griffin Database	Section 4.1 - Table 33
Safety&Research Reports	☐	-	-
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 20 GRIFFIN Type of Information

3.7.4 Helicopter Safety.org

Helicoptersafety.org is a website created by two pilots with an instructing background concerned about general aviation helicopter accidents in the UK. The organization was, at first, created to organize safety evenings to promote helicopter safety around the UK, and derived in a website providing as much information about helicopter safety in the UK as possible.

In the web there are some statistics from accident information extracted from a similar concept website, the Griffin Helicopter database.

The table below highlights the type of information that can be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☒	Griffin Database	Section 4.1 - Table 33
Safety&Research Reports	☒	Website based	Section 5.11
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 21 Helicopter Safety Type of Information

3.7.5 Helis

Maintained by a single person, the site belongs and is created by several pilots, experts, and helicopter amateurs. The website includes various historical informations, as well as an accident database, and some general information about the helicopter industry as shown in the table below:.

Type of Information		Support	Documented in
Operational Occurrences	☒	Helis database	Section 4.1 - Table 34
Safety&Research Reports	☐	-	-
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 22 HELIS Type of Information

3.8 Universities

3.8.1 Nationaal Lucht- en Ruimtevaartlaboratorium (NLR)

The NLR is the aerospace knowledge enterprise in the Netherlands. It carries out studies about safety, environment, efficiency in all the fields of aviation.

The table below highlights the type of information that can be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☐	-	-
Safety&Research Reports	☒	Various Publications	Section 5.10
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☐	-	-
Reliability Reports	☐	-	-

Table 23 Nationaal Lucht- en Ruimtevaartlaboratorium (NLR) Type of information

3.8.2 Cranfield

Cranfield University, located in the UK, is a leading aeronautical post-graduate school. The College of Aeronautics, part of the University's Faculty of Engineering, is a centre of excellence for education, training and research into aviation safety, including the areas of safety analysis, accident investigation and the effects of human factors in aviation generally.

We have approached the head of the air transport department with a view to determining exactly what information may be made available to assist with the study.

The table below highlights the type of information that is expected to be obtained:

Type of Information		Support	Documented in
Operational Occurrences	☐	-	-
Safety&Research Reports	☒	Not yet available	Not yet available
Fleet and operator information	☐	-	-
Usage data	☐	-	-
Design Related Occurrences	☒	Not yet available	Not yet available
Reliability Reports	☐	-	-

Table 24 Cranfield Type of information

4 Databases

The collection of comprehensive data from a variety of official and unofficial databases is a key element of the Study's analytical content. In our initial reviews we have concluded that there is a wide variety of data sources of differing quality, particularly those relating to accident and incident data and helicopters operators and their fleets and usage. It is our opinion that the most comprehensive and complete of these are not necessarily the official sources.

To date we have not examined helicopter operator and fleet databases in any detail, but we have spent some time reviewing four of the most significant occurrence databases.

These are: the official ADREP and ECCAIR "data repositories" and the unofficial Aviation Safety Net "Wikibase" and Helihub database.

There is little commonality among any of these: ADREP appears to contain the most comprehensive collection of worldwide accidents while ECCAIR contains fewer accidents but many more incidents focussed mainly on Europe. However, both suffer from a great deal of incomplete data relating mainly to the identification of aircraft (registrations, make and model). There is also a small but significant amount of errors (mis-identification of aircraft types and models). In our experience much of the incomplete and incorrect data can readily be inserted or replaced by cross-referencing with other data sources. However, and in view of the size of this task, we would not propose to undertake this task until each data sources was reduced to entries relevant to the Study, i.e to occurrences from 2003 to 2012 and occurring within EASA member states and/or the EASA-registered helicopters.

The Helihub database of some 2,500 worldwide occurrences dates mainly from 2009 and includes significant numbers of incidents as well as accidents. Overall the most complete accident database is that in the Aviation Safety Net "Wikibase", with relatively little absent information and the largest number of accidents included on a worldwide basis.

We have not yet examined the ASCEND WAAS but given its focus on larger turbine powered aircraft consider it will not add greatly to the numbers of occurrences but should provide a reliable source for missing data.

Regarding helicopter operators and fleets, as we mentioned we have not yet examined the potential sources in any detail but consider the Forecast International fleet and operator database is likely to provide the main data sources, supplemented by several other sources mentioned below.

The fact that no information is available from Helicopter Operators nor Pilot Unions is not critical for the purpose of the study since the combination of all the other identified databases provides the necessary information coverage to conduct this study.

4.1 Operational Occurrences

Accident/Incident Data Reporting (ADREP)	
Description	The Accident/Incident Data Reporting (ADREP) system is operated and maintained by ICAO. All aircraft accidents which involve aircraft of a maximum certificated take-off mass of over 2 250 kg are reported by the States to ICAO. ADREP also gathers information on aircraft incidents considered important for safety and accident prevention. The ADREP system receives stores and provides States with occurrence data that will assist them in validating safety. In this context, the term 'occurrence' includes both accidents and incidents. The ADREP system operates using a software platform developed by the European Union (EU) - the European Co-ordination Centre for Aviation Incident Reporting System (ECCAIRS).
Appraisal / Limitations	ADREP covers period 1970-2012 and contains global accidents and serious Incidents – mainly Commercial Air Transport but a lot of data on European Products. Not every accident is in the database – especially for General Aviation
Mitigation / Complementary	To be combined with the Accident/incident Investigation authorities
Suitability for the study	Medium

Table 25 Accident/Incident Data Reporting (ADREP)

European Central Repository	
Description	European occurrence database, compiling the information provided by of the national aviation authorities and accident investigators of the EASA Member States. The data is stored and accessed using the same Taxonomy based system as ADREP. The European Central Repository operates using the system the European Co-ordination Centre for Aviation Incident Reporting System (ECCAIRS).
Appraisal / Limitations	The data extracted from ECCAIR contains some 18,500 records covering an estimated 13,650 accidents and incidents with a strong focus on Europe. Over 1,200 records relate to fixed wing aircraft. There are also a significant number of military occurrences. A substantial amount of information is absent, notably aircraft registration, make and model. Operator identities are not available Data available mainly from 2005 onward. Only occurrences inside EASA states, or from EASA states operators. No regular incidents. Narratives and operator names available.
Mitigation / Complementary	Need to be completed with another databases such ADREP for the period 2001-2005
Suitability for the study	Medium

Table 26 European Central Repository

EHSAT, the European Helicopter Safety Analysis Team (in EHEST)	
Description	The European Helicopter Safety Analysis Team (EHSAT) is the analysis component of the European Helicopter Safety Team (EHEST). From its Terms: EHEST is a voluntary partnership bringing together manufacturers, operators, research organisations, regulators, pilots' associations, accident investigators and other aviation groups from across Europe aimed at improving helicopter safety It is also open to European military operators. The EHSAT brings the Analysis Tool, a database of helicopter accidents and serious incidents, in the European countries.
Appraisal / Limitations	It is a voluntary initiative for EHEST, not all EASA MS countries were involved in the work so not all countries are covered. The majority of the data is from 2000-2005, since the study was commenced in 2006 and has now moved from an analysis to an implementation phase. Some countries have continued to add further data since 2006, but this is limited.
Mitigation / Complementary	Complete with other accident databases.
Suitability for the study	Medium

Table 27 EHSAT, the European Helicopter Safety Analysis Team (in EHEST)

EUROCOPTER Operational Occurrence Database	
Description	EUROCOPTER keep track of every accident and serious incident. This information is either provided by authorities, reported to the manufacturer by the operators or by its extensive network of field engineers or simply collected by the manufacturer thanks to its active monitoring of fleet events. The data stored in its databases would be redacted and therefore not be accessible for each single occurrence. We will only have access to the requested statistics and aggregated data.
Appraisal / Limitations	Not yet accessed. Prior to provide any information, a non-disclosure agreement must be signed (NDA) between EUROCOPTER and the Consortium, protecting the manufacturer's confidential data. However it has been explained that: Data is in an internal format, different from ICAO ADREP Taxonomy. All the data accessed is limited to Eurocopter models, Engine incidents data may not be complete, as most are not reported to the airframe manufacturer The information needed is all available in the EUROCOPTER database.Willing to deliver requested statistics and aggregated data, not having access to occurrence database The necessary information will be extracted and treated (redacted) by EUROCOPTER before delivery for the study, providing access to the aggregate results but not to the raw data.
Mitigation / Complementary	Engine incidents to be completed with engine manufacturer information.
Suitability for the study	High

Table 28 Eurocopter Operational Occurrence Database

Turbomeca Operational Occurrence Database	
Description	TURBOMECA records any reported accident or incident involving its engines. But TURBOMECA does not have extensive information about accidents and incidents without direct or indirect engine failure. The data stored in their databases would be redacted and therefore not be accessible for each single occurrence. We will only have access to the requested statistics and aggregated data.
Appraisal / Limitations	Not yet accessed. Prior to provide any information being provided, a non-disclosure agreement must be signed (NDA) between TURBOMECA and the Consortium, protecting the manufacturer's confidential data Limited to Turbomeca engines. The added value with regard airframe manufacturer databases is that most probably it will contain more information related to incidents without catastrophic consequences. Indeed such engine incidents are not always reported. For example an engine failure ended in an autorotation without consequences, would not normally be reported, For example an engine failure ended in an autorotation without consequences, would not normally be reported either to the authorities or to the airframe builder. However, thanks to its network of repair stations, engine manufacturers are able to collect this information. Willing to deliver aggregated data, not having access to each single occurrence.
Mitigation / Complementary	To be completed with other manufacturers data, and compared with airframe manufacturers information
Suitability for the study	High

Table 29 Turbomeca

World Aircraft Accident Summary (WAAS)	
Description	World Aircraft Accident Summary (WAAS) includes detailed descriptions for 8,000 accidents involving larger fixed wing aircraft and helicopter.
Appraisal / Limitations	We have not yet accessed this data but understand after enquiry that it contains only turbine-engined occurrences - civil and military – mainly accidents plus some more significant incidents. There is worldwide coverage and the data is largely complete but somewhat limited in scope. ASCEND claims there are 8,000 accidents in total, but not sure over what period, but this figure includes fixed wing aircraft
Mitigation / Complementary	Limited to Turbine occurrences – mainly accidents
Suitability for the study	Medium – possible additional source of turbine-powered aircraft accident data

Table 30 World Aircraft Accident Summary Occurrence Data Base

Aviation Safety Net	
Description	Private independent initiative, supported by the Flight Safety Foundation, covering accidents and safety issues. Most of its information is based on official sources such as regulatory authorities and safety boards as well as more informal sources and press reports. It also contains statistics from its database, and industry news with interest from the safety point of view. The database is in wiki format, edited by its users but well-moderated, and contains 11538 worldwide occurrences involving helicopters from 1932 to the present. http://aviation-safety.net/index.php
Appraisal / Limitations	Provides an extensive list of occurrences going back many years. This includes worldwide civil and military accidents and incidents
Mitigation / Complementary	To be considered along with other occurrence databases.
Suitability for the study	High – useful to substantiate missing information from some of the more official sources

Table 31 Aviation Safety Net Occurrence Data Base

Helihub	
Description	Helihub compiles and presents information regarding the helicopter industry. It contains an accident database, as well as a classified news and reports extensive file. http://helihub.com/
Appraisal / Limitations	Many of the accidents not supported by accurate, official, information, often redirecting to newspaper articles. Not all registers are fully up to date and has very limited coverage prior to 2009. Contains an extensive list and data of some 2,500 occurrences. This includes civil and military accidents and incidents – some apparently not reported elsewhere.
Mitigation / Complementary	To be compared and complemented with other occurrence databases.
Suitability for the study	Medium – useful to substantiate missing information from some of the more official sources

Table 32 Helihub

Griffin Helicopters	
Description	Primary database of accidents based on findings. Other resources to be used in the helicopter operation area. http://www.griffin-helicopters.co.uk/
Appraisal / Limitations	Low level information, based on news and internet findings.
Mitigation / Complementary	To supplement other occurrence databases
Suitability for the study	Low

Table 33 Griffin Helicopters

Helis	
Description	Primary database of accidents based on findings. Historical records, and articles. http://www.helis.com
Appraisal / Limitations	Low level information, based on news and internet findings.
Mitigation / Complementary	To supplement other occurrence databases
Suitability for the study	Low

Table 34 Helis Helicopters

4.2 Operator, Fleet and Usage Data

EASA Operator and Fleet Database	
Description	EASA also manages a worldwide fleet database containing aircraft registration, make, model series, serial number, year built and engine details of some 10,800 single engine helicopter. We understand that multi-engines type data is also potentially available.
Appraisal / Limitations	Not all the fields are fully populated and there is no operator data
Mitigation / Complementary	To be considered along with other operator and fleet databases.
Suitability for the study	Medium – potentially useful to cross-reference with other sources.

Table 35 EASA Operator and Fleet Data

EUROCOPTER Fleet database	
Description	In addition to the occurrence database, EUROCOPTER also maintains a database with usage data of its fleet.
Appraisal / Limitations	Not yet accessed. Prior to provide any information being provided, a non-disclosure agreement (NDA) must be signed between EUROCOPTER and the Consortium, protecting the manufacturer's confidential data. However it was explained that EUROCOPTER is regularly informed of usage of the fleet by the operators. When this information is not provided, usage is calculated through extrapolated assumptions.
Mitigation / Complementary	To be considered along with other usage databases
Suitability for the study	High

Table 36 EUROCOPTER Operator and Fleet Data

International Register of Civil Aviation (IRCA)	
Description	The International Register of Civil Aircraft collects information on over 86 national aircraft registers including 27 EASA Member States plus the USA and Canada on a single database. The aim of IRCA is to provide with an international database comprising of harmonized and substantial information on national aircraft fleets, in order to ease data access and exchange worldwide. All the information in IRCA is official, since it is directly provided by National Civil Aviation Authorities, assuring the complete veracity of the data. The original register's data is also enhanced with the addition of generic technical information such as: Airworthiness information Aircraft technical information Engine and propeller information
Appraisal / Limitations	It has been estimated that IRCA includes some 24,000 helicopters of the main helicopter makes. However the data does not lend itself to detailed analysis. The Civil Aviation Authorities of Bulgaria, Hungary, Romania and Slovenia have not provided any data to IRCA. Also, some Civil Aviation Authorities do not provide all the expected information.
Mitigation / Complementary	The Consortium will endeavour to contact the NCAA for which data is missing. For this purpose, the Consortium expects to receive from EASA a mandate requesting the contribution of CAA through the provision of national register and helicopter usage databases.

Suitability for the study	Medium

Table 37 International Register Of Civil Aviation (IRCA)

JP Airline Fleets International	
Description	Yearly reference book providing information for most of the known commercial aircraft operators. Covering over 6.000 operators, and 50.000 aircraft, the major commercial helicopter operators are listed in its pages. We estimate provisionally that some 11,500 mainly turbine-powered helicopters used in a variety of roles are included It contains information about each registered member of the included fleets, as well as some specifications and configuration data as indicated below
Appraisal / Limitations	Previous years editions are also available. Crucially JP Fleets identifies the main civilian commercial operators and their fleets. However, with some exceptions it excludes privately-owned aircraft and those under 2.0 tonnes and 2.8 tonnes maximum weight, for single and twin-engined aircraft respectively. This automatically excludes significant numbers of smaller and predominantly piston-engined helicopters.
Mitigation / Complementary	To be complemented with IRCA and National Registers information and other unofficial sources such as Rotorspot and Forecast Internationals “Business Class” helicopter fleet report
Suitability for the study	Low
The data in JP Airline Fleets is presented as follows: **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 1: JP Airline Fleets information example As shown in previous figure, the data presented for each operator includes some general and contact information, as well as the description of each model operated, including registration, age, powering, or configuration.	

Table 38 JP Airline Fleets International

Helicopter Blue Book	
Description	The Official Helicopter Blue Book is a publication containing helicopter extensive specification sheets, as well as historical selling values. Its values vary every short period, adapting to the current market prices, while its specification sheets are precise and updated for almost every model
Appraisal / Limitations	No Russian or Polish helicopters
Mitigation / Complementary	Find data by other means (spec sheets, brochures)
Suitability for the study	Medium

Table 39 Helicopter Blue Book

Rotor Roster Business Class Helicopters	
Description	Database including 30,365 turbine and piston powered helicopters registered worldwide, with serial number and owner. Spreadsheet format.
Appraisal / Limitations	Not yet accessed but recommended by Robinson. Indeed Robinson does not maintain a record of ownership of the helicopters manufactured. The publicly available database "Rotor Roster", or

	civil registers are used when this information is needed.
Mitigation / Complementary	-
Suitability for the study	High

Table 40 Rotor Roster Business Class Helicopters

Rotorspot	
Description	Dutch database of current and historical worldwide rotorcraft registers. Most of this registers include production lists, and it is presented in a search-friendly interface The historical database currently contains 137.600 civil rotorcraft registrations, for 80.150 rotorcraft. http://www.rotorspot.nl/
Appraisal / Limitations	Rotorspot.com has more-or-less worldwide coverage of some 42,000 currently registered helicopters. However information is limited to registration, make and model and serial number.
Mitigation / Complementary	-
Suitability for the study	Medium

The database is a simple three column sheet, presenting each registration number, model and production number. This registers combined with information from the operators will provide a good picture of the fleets operating in each country.

The current registration data is presented 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 2: Rotorspot registration example

The history section additionally contains the previous and subsequent registration history of each aircraft plus the eventual fate of non-current aircraft

Table 41 Rotorspot

Helihub	
Description	Helihub compiles and presents information regarding the helicopter industry. It contains an updated register database with data limited to register number, type, and owner. http://helihub.com
Appraisal / Limitations	Not all registers are fully up to date.
Mitigation / Complementary	To be compared and complemented with other databases
Suitability for the study	Medium – mainly for accident and incident occurrences post 2008

Table 42 Helihub

4.3 Design Related Occurrences

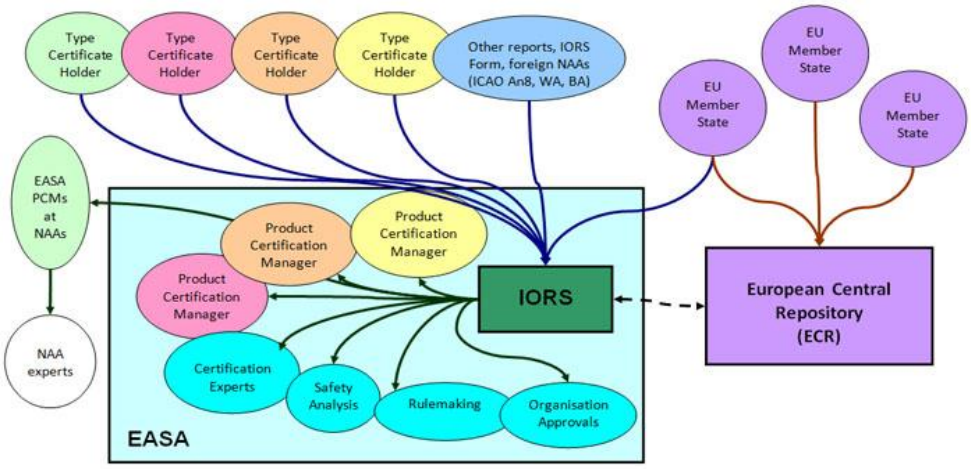
EASA Internal Occurrence Reporting System (IORS)	
Description	The Internal Occurrence Reporting System (IORS) is the system that the Agency uses to process and store in a central database using the ECCAIRS 5 format all safety related occurrences thus design related ones reported to EASA The Internal Occurrence Reporting System at a glance. Please note that the inter-organisation reporting flows are not depicted on the picture below:  IORS – ECR relationship: IORS may have access to the ECR by virtue of article 19 of Commission Regulation (EU) No 996/2010. In the future IORS may be required to integrate occurrences into the ECR
Appraisal / Limitations	Possibility to share the certain portion of data related to engines of single-engined helicopters to be explored. It is expected from this database to collect airworthiness related occurrences, in particular for those reported by engine OEMs causing an incident. However the operational data related to the type of operation, location etc. would not generally be available.
Mitigation / Complementary	Statistics with engine OEMs
Suitability for the study	To be confirmed after appraisal, in particular for data prior to the implementation of IORS

Table 43 Internal Occurrence Reporting System (IORS)

5 Publications

This section addresses all those published reports and analyses found that are pertinent to the scope of this study and summarizes the already identified safety hazards and the mitigations in place or proposed

The publications surveyed that explicitly reported the subject concerning this study are four:

- ***Measuring safety in single and twin-engine helicopters***, published in 1991 – See section 5.8
- ***Measuring Risk in Single and Twin-engine helicopters***, published in 1992 – See section 5.6
- ***Argumentaire monomoteur***, published in 2009 – See section 5.11
- ***Single engine helicopter operations: an OEM view on flight safety, mission performance, environmental and economic constraints***, EUROCOPTER, presented in 2010

The first two publications are a result from the same study, presenting minor redaction differences, but with the same core data.

It is remarkable that none of this studies are investigating only the single-engine area, but comparing the performances and data of both single and twin-engine helicopters. As a matter of fact, helicopter flight has high accident rates compared to other means of transport, and those studies are generally stating that most of these accidents are not due to the helicopter characteristics, but to the inherent danger of operating helicopters.

Even though, two of these reports are more than 20 years old, and during this time helicopter technology has been improving along with the growth of the helicopter popularity in passenger transport, so the information, data and conclusions must be reviewed and updated.

The EUROCOPTER study, even if it is more recent, is OEM-oriented, and has a clear orientation in emphasizing that single engine helicopters have results comparable to multi engine rotorcraft.

On the other hand, EASA publishes its Annual Safety review, where in the 2011 edition it identifies the system component failure of the power plant as the sixth highest contributing factor in helicopter accidents. However, it is not detailed the cause of the failure.

Other reports and studies, do not have a clear aim to single-engine safety and operations investigation, but where mentioned, still do not identify the single-engine specification as a safety issue prior to other accident causes such as human error.

5.1 EASA

As part of its duties to promote the highest common standards of safety and environmental protection in civil aviation in Europe and worldwide, the Agency has been issuing a certain number of publications since its establishment.

- **Annual safety review**, published on an annual basis since 2005 - These documents are published by EASA to inform the public of the general safety level in the field of civil aviation. It also offers an overview of aviation safety measures taken in the different EASA Directorates Reports are available at http://www.easa.europa.eu/communications/general-publications.php

  Provides trends and statistics only

- ***Risk Assessment for European Public Transport Operations using Single Engine Turbine Aircraft at Night and in Instrument Meteorological Conditions,*** published by QinetiQ with date of 15 October 2007 for EASA under contract nºEASA-2006-C46 – The objective of the report is to conduct a full and objective risk assessment for SE-IMC operations in the European Context before introducing SE-IMC operations

Additionally, since 2007, EASA organises the annual EASA Rotorcraft Symposium, defined as a regular forum for the worldwide rotorcraft community, where topics of common interest in the rotary wings world are presented and discussed, aiming at updating participants, and getting their feedback on industry and authority initiatives concerning operational, design, manufacturing and regulatory matters with the common scope of fostering safety.

These symposiums have a wide variety of participants, and the presentations of each annual event can be found in the following links:

- **EASA Rotorcraft Workshop:** http://www.easa.europa.eu/events/events.php?startdate=05-12-2007&page=EASA_Rotorcraft_Workshop
- **Second EASA Rotorcraft Symposium:** http://www.easa.europa.eu/events/events.php?startdate=04-12-2008&page=Second_EASA_Rotorcraft_Symposium
- **Third EASA Rotorcraft Symposium:** http://www.easa.europa.eu/events/events.php?startdate=02-12-2009&page=Third_EASA_Rotorcraft_Symposium
- **Fourth EASA Rotorcraft Symposium:** http://www.easa.europa.eu/events/events.php?startdate=08-12-2010&page=4th_EASA_Rotorcraft_Symposium
- **Fifth EASA Rotorcraft Symposium:** http://www.easa.europa.eu/events/events.php?startdate=07-12-2011&page=5th_Rotorcraft_Symposium
- **Sixth EASA Rotorcraft Symposium:** http://www.easa.europa.eu/events/events.php?startdate=05-12-2012&page=6th_Rotorcraft_Symposium

Most of the presentations are only supported by slides, without further explanations, probably given during the conferences and the round of questions, and giving only some figures. The following have been found relevant for the purpose of the study:

- **Single Engine Argument**, Union Française de l'Helicoptère, presented in 2008. Supports the use of single-engine helicopters.
- **Rotorcraft Safety in Europe: Analysis Results by the European Helicopter Safety Team (EHEST) and Paths for Improvement**, presented in 2008
- **Flight Data Monitoring of Small Helicopters**, presented in 2008
- **Helicopter Flight in Degraded Visual Conditions**, UK CAA, presented in 2008
- **Helicopter Performance a historical perspective**, presented in 2010
- **Single engine helicopter operations: an OEM view on flight safety, mission performance, environmental and economic constraints**, EUROCOPTER, presented in 2010
- **Review and Analysis of UK and European Part 27 Helicopter Incident and Accident Data**, presented in 2012

Other reports are available at:

http://www.easa.europa.eu/rulemaking/docs/research/Single%20Engine%20Operations%20in%20IMC%20and%20at%20Night%20Risk%20Assessment%20Issue%202.pdf

5.2 EHEST

EHEST, from the results of its safety studies, publishes the following reports:

- ***EHEST analysis of 2000-2005 European Helicopter Accidents***, published in 2010. Safety report with the aim of improving aviation safety by analysing occurrence data, and implementing a cost-effective action plan. http://easa.europa.eu/essi/ehest/wp-content/uploads/2010/10/EHEST-Brochure.pdf
- ***Helicopter airmanship, Methods to Improve Helicopter Pilots Safety,*** published in 2011. After the EHEST review of helicopter accidents 2000 to 2005 revealed 140 general aviation helicopter accidents in Europe identifying airmanship related issues. This guide of best practices is addressed to improve this statistics. http://easa.europa.eu/essi/ehest/wp-content/uploads/2011/12/HE2_leaflet_helicopter_airmanship_v1.pdf

5.3 Civil Aviation Authorities from EASA Member State

As far as research and safety reports are concerned, the most active are the northern states (refer to 5.10.1 for details), as well as the United Kingdom, very active in helicopter transport to offshore locations, and though having large units that study the field.

The UK CAA publishes a wide selection of reports, leaflets and regulations, being one of the most active countries concerning helicopter flight safety. The following have been considered:

- ***Helicopter Flight in Degraded Visual Conditions,*** published in 2007, http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=2887
- ***Intelligent Management of Helicopter Vibration Health Monitoring Data***, published in 2012, http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=5040
- ***Review of Helicopter Offshore Safety & Survival***, published in 1995, http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=138
- ***Helicopter Operations Over a Hostile Environment,*** published in 2012, http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=5304
- ***Helicopter Airmanship,*** published in 2011, http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=1171

5.4 NTSB & FAA

It has been considered relevant to survey non-European authorities, such as the American and Australian, having an extended helicopter use, even if the whole operational concept for single-engined helicopters is defined otherwise. However the studies have methodologies and accident approaches that have been considered relevant, even if most of the data will not be comparable with the current study outputs

From the NTSB reports and presentations, the following have been kept for the concerns of this study:

- ***Human factors in helicopter accidents***, presented in the Fifth International Helicopter Safety Symposium 2011. www.ntsb.gov/doclib/speeches/sumwalt/Sumwalt_110911.pdf
- ***ROBINSON HELICOPTER Co. R22 loss of main rotor control accidents***. Published in 1996. www.rotorshop.com/sir9603.pdf

The FAA has published many safety reports, but this particular and updated study has been chosen for its singularity:

- ***Safety Study of Wire Strike Devices Installed on Civil and Military Helicopters***, published in 2008. www.tc.faa.gov/its/worldpac/techrpt/ar0825.pdf

5.5 BELL

Bell has some online publications that fit the requirements of this study:

- **The history of helicopter safety, published in 2005,** www.bellhelicopter.com/MungoBlobs/815/470/HelicopterSafetyHistory.pdf
- **Safety article published in Heliprops,** www.bellhelicopter.com/MungoBlobs/107/29/Vol%2020%20number%203%20-En.pdf

In addition, Bell sent some other reports directly to the Consortium:

- ***Measuring Risk in Single and Twin-engine helicopters***, Roy G. Fox, published in 1992
- ***Civil Rotorcraft Risks***, Roy G. Fox, published in 2002
- A supplementary report to "The history of helicopter safety" updating the data up to 2010.

5.6 ROBINSON

Robinson provided a report concerning engine failure in the R44 model. The report analyses statistical data registered in Robinson's database:

- ***R44 and R44 II Engine Power Loss Rates – Engineering Report,*** published in 2007.

5.7 OGP

The OGP publishes many reports regarding transport to oil production facilities. The following have been selected, in the interest of the study:

- ***Aviation transport accident statistics***, published in March 2010. Provides information on aviation accident statistics for use in QRA. http://www.ogp.org.uk/pubs/434-11.pdf
- ***Safety performance of helicopter operations in the oil & gas industry***, published yearly from 2002 to 2009. Report based on submissions from operators worldwide, presenting the safety performance of helicopters involved in exploration & production. http://www.ogp.org.uk/publications/safety-committee/safety-performance-of-helicopter-operations/
- ***Aircraft management guidelines***, published in 2008, updated in 2011. Guidelines to provide a ready reference for the management of aviation. http://www.ogp.org.uk/pubs/390.pdf

5.8 Flight Safety Foundation

FSF has been publishing safety reports and studies related to helicopters. Among its most relevant publications within the scope of this study it is worth to mention.

- ***Measuring safety in single and twin-engine helicopters,*** Roy G. Fox, published in 1991 www.flightsafety.org/fsd/fsd_aug91.pdf
- ***For helicopter pilots, Managing stress is part of flying safely,*** Joel S. Harris, published in 1995, http://flightsafety.org/hs/hs_jan_feb95.pdf
- ***Most Fatal U.S. Commercial Helicopter Accidents Occur in Instrument Meteorological Conditions, FSF.FSD.01.03***, published in 2003.
- ***Use Of Night Vision Goggles Increases In Civilian Helicopter Operations, FSF.HS.11.04***, published in 2004
- ***Changes Expand U.S. Helicopter Operations Under Instrument Flight Rules, FSF.HS.11.95,*** published in 1995
- ***Typical Helicopter Accidents Profiled, HS.19.3,*** published in 1993
- ***Poll of Helicopter Operators Yields Data On Flight Operations and Fleets, HS.19.5,*** published in 1993
- ***Satellite-based Navigation Promises to Enhance Helicopter Utility in IFR Conditions, HS.20.06.1*** published in 1994

- ***Fatal Turbine-helicopter Accidents Provide Clues to Safer Operations, HS.21.02.1*** published in 1995
- ***Every Helicopter Pilot Must Be Prepared for Inadvertent Entry into Instrument Meteorological Conditions, HS.22.02.1*** published in 1996
- ***Engine-power Loss Was Most Frequent Category of U.S. Agricultural-helicopter Accidents, 1989-1995, HS.23.05.1*** published in 1997
- ***Helmets with Visors Protect Helicopter Crews, Reduce Injuries, HS.23.05.1,*** published in 1997
- ***Reports Show Pilot Error as the Major Cause of Helicopter Accidents in U.S. On-demand Operations, HS.24.06.1***, published in 1998
- ***Engine, Transmission Failures Lead Causes of Accidents in U.S. Helicopter Logging Operations, HS.25.5,*** published in 1999
- ***Data Show 50 U.S.-Registered Helicopters Involved In Wire-Strike Accidents From 1996 Through 2000, FSF.HS.07.02,*** published in 2002
- ***Unusual Attitudes: Helicopters and Instrument Flight, HS.19.1,*** published in 1993
- ***NTSB Investigates Loss-of-control Accidents Among Lightweight Helicopters, HS.23.06.1***, published in 1997
- ***Data Show Same U.S. Fatal-accident Rate for Single-turbine and Twin-turbine Helicopters, HS.25.01,*** published in 1999
- ***Records Show 27 U.S.-registered Helicopters Involved in Mid-air Collisions During 1990s, HS.26.4,*** published in 2000

5.9 IHST

The IHST has published various reports and compendiums mainly focused in the US market. However, for the potential use in this study by extrapolating the results, the following have been considered relevant:

- ***US JHSAT Compendium –Volume I, The U.S. JHSAT Baseline of Helicopter Accident Analysis ,*** (CY2000, CY2001, CY2006), published in August 2011.
  http://www.ihst.org/portals/54/US_JSHAT_Compendium_Report1.pdf

  US JHSAT Compendium –Volume II, The U.S. JHSAT Baseline of Helicopter Accident Analysis , (CY2000, CY2001, CY2006), published in July 2011.
  http://www.ihst.org/portals/54/US_JSHAT_Compendium_Report2.pdf

5.10 NLR

Most of the publications of the NLR are investigation reports, and technical studies. For the aim of the study, the following one has been considered appropriate to be taken in to account:

- ***European Helicopter Safety Team (EHEST): Mapping Safety Issues with Technological Solutions,*** Stevens, J.M.G.F.; Vreeken, J.; Masson, M.A., published in 2011.

  http://reports.nlr.nl:8080/xmlui/handle/10921/468

Other reports are found in:http://reports.nlr.nl:8080/xmlui/

5.11 Helicopter Safety.org

Website containing a comprehensive UK helicopter accident database, and the results of a study carried out in early 2008 to support the figures being discussed at the safety evenings.

The site also contains links to freely available safety material and information on venues and dates of helicopter safety evenings organised by some volunteers around the UK.

Classifies and studies the Griffin Helicopters database, using each individual report to build statistics. It also has a library of external reports in the subject.

http://www.helicoptersafety.org/

5.12 Others

Other entities not listed in the chapters above have published interesting documents in the terms of the study. The following are the ones considered most relevant:

5.12.1 SINTEF

SINTEF is the largest independent research organisation in Scandinavia, its most known and up to date studies are the Helicopter Safety Studies (HSS). This studies, although centred in the North Sea transportation, and then twin-engined focused, have been selected:

- ***Helicopter Safety Study 3***, published in 2010,

  www.norskoljeoggass.no/PageFiles/6353/100610sintefa15753helicoptersafetystudy3hss-3mainreport-100610071828-phpapp02.pdf?epslanguage=no

- ***HSS-2***, published in 1999,

  www.sintef.no/upload/Teknologi_og_samfunn/Sikkerhet%20og%20p%C3%A5litelighet/Rapporter/STF38%20A99423.pdf

5.12.2 Union française de l'helicoptère

In order to justify the permission or not to fly over hostile areas, the Union Française de l'Helicoptère has published a study in 2009 concerning this field:

- ***Argumentaire monomoteur***, published in 2009,

  http://www.helicomontagne.fr/PDF/Monomoteur.pdf

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