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EUROPEAN AIR TRAFFIC MANAGEMENT

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SAFETY

Airspace Infringement Risk Analysis

Part II

General Aviation Airspace

Infringement Survey

Analysis of pilot-reported causal factors

and prevention measures

EUROCONTROL

EUROPEAN ORGANISATION
FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL

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Part II

General Aviation Airspace Infringement Survey

Analysis of pilot-reported causal factors and prevention measures

EUROPEAN AIR TRAFFIC MANAGEMENT PROGRAMME

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Abstract
The purpose of the General Aviation Airspace Infringement Survey 2007 was to develop a detailed understanding of the causes of airspace infringement risks and help identify the most efficient risk mitigation measures. The survey was carried out among the general aviation pilot community in Europe in the period July to September 2007. No single clear factor could be identified as a major cause of airspace infringements. However, pilots' navigation and communications skills appear to play essential role. Nevertheless, improved AIS, ATC and flight information services for VFR flights, coupled with improved air ground communications are considered essential risk reduction focus areas by the pilot community. The analysis of survey results allowed the establishment of a number of safety improvement recommendations which could be considered by the organisations concerned when establishing their risk mitigation strategies and local action plans in line with the general recommendations agreed within the scope of the airspace infringement initiative.

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Airspace complexity	Airspace infringement	Causal factors	FIS
General aviation	Risk mitigation	Survey	VFR flight

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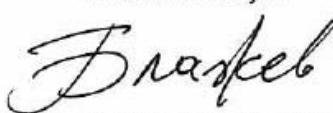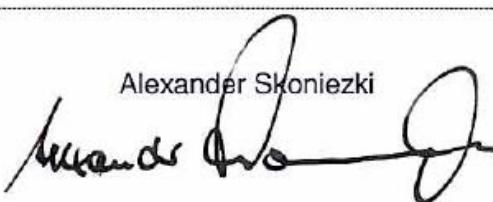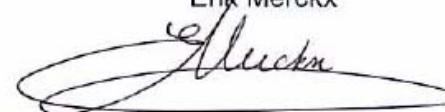
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CONTENTS

EXECUTIVE SUMMARY

Airspace infringement, known also as "unauthorised penetration of airspace", has been recognised as a "key risk area" by ATM safety professionals in Europe. Although airspace infringements are not new, their rate of occurrence and the associated threat to aircraft operations call for dedicated efforts to develop effective prevention strategies and risk reduction solutions. In 2006 EUROCONTROL launched the Airspace Infringement Safety Improvement Initiative with the main goal of developing a European–wide risk reduction action plan and supporting all risk stakeholders - regulators, service providers, aviation establishments, the military and industry in implementing the agreed actions.

A number of projects, including the General Aviation Airspace Infringement Survey 2007, were undertaken to develop a detailed understanding of the causes of airspace infringement risks and identify the most efficient risk mitigation measures.

The survey was carried out among the general aviation pilot community in Europe in the period July to September 2007. Both quantitative and qualitative methods for data collection and analysis were used to achieve the study objectives. Seven focus groups meetings with GA pilots groups from seven different European countries, and telephone interviews with pilots from another country were conducted to collect qualitative data. A dedicated online questionnaire ensured the collection of quantitative data through the participation of pilots from 24 European countries.

The vast amount of data collected allowed the establishment of deeper and systemic explanations for the reasons behind, mechanisms of and contributors to airspace infringements in European airspace, but also the collection and consolidation of pilots' ideas about potential improvements to the safety of flights and the associated rationale.

No single clear factor could be identified as the major cause of airspace infringements. However, pilots' navigation and communications skills appear to play the most important role. Although the volume of initial pilot training raises some concerns about the level of acquired navigation and communication skills, it is the gradual diminishing of the skills of pilots with few flight hours which requires serious consideration and measures.

Another major finding of the survey is the general perception in the pilot community of a rather unfavourable attitude towards VFR flights, as opposed to the priority and services given to IFR traffic and commercial flights. Such an attitude could be a major contributor to inadequate controller-pilot communication, which has been identified as a major point of concern of VFR pilots.

Current aeronautical information service products and the dissemination/provision methods applied appear not to be adequately meeting VFR flight needs. Pilots believe that improved availability and accessibility of aeronautical and meteorological data would support better pre-flight preparation.

Unfavourable weather phenomena are considered major contributors to the airspace infringement risk. Improved pre-flight preparation and in-flight service to VFR flights could reduce their impact on the airspace infringement risk and safety of VFR flights in general.

The safety improvement potential of advanced equipment/avionics is fully recognised by the pilot community. However, the cost, and to a lesser extent certain performance parameters of certified advanced equipment, appear to be the obstacles preventing GA from taking full advantage of available modern technology. It is perceived that a more pragmatic and

proportionate approach to light aircraft instrument equipment and certification issues would not only ensure satisfactory compliance with general safety requirements, but allow further safety improvement in various risk areas, such as airspace infringement.

Improved ATC and flight information services for VFR flights, coupled with improved air ground communications are considered essential risk reduction focus areas by the pilot community.

Pilots provided subjective estimates of the probability of occurrence of various precursory situations, and the subsequent probability of the situations' developing into airspace infringements allowed the establishment of perceived frequencies of occurrence of the airspace infringement hazard relevant to the said precursory situations. These perceived probabilities, estimated in the range 10e(-4) to 10e(-2) per flight, should be further developed, refined and validated in subsequent studies to aid the quantitative airspace infringement risk analysis.

The analysis of survey results allowed the consolidation of the suggested mitigation and prevention means and measures into a number of safety improvement recommendations which might inform the next phase of the Airspace Infringement Initiative and could be used by the organisations concerned in their risk management activities.

1. INTRODUCTION

1.1 Background

Airspace infringement, known also as "unauthorised penetration of airspace", has been recognised as a "key risk area" by safety professionals in the European air navigation service providers and the EUROCONTROL Safety Regulation Commission. Although airspace infringements are not new, their rate of occurrence and the associated threat to aircraft operations call for dedicated efforts to develop effective prevention strategies and risk reduction solutions.

Taking into account previous successful experience in addressing key risk areas (e.g. runway incursion, level bust, air-ground communications), in 2006 the EUROCONTROL Safety Team launched the Airspace Infringement Safety Improvement Initiative. The main goal of this ongoing initiative is to develop a European–wide action plan to reduce the risk caused by airspace infringements and support all risk stakeholders - regulators, service providers, aviation establishments, the military and industry in implementing the agreed actions.

A number of projects have been planned and carried out in order to develop a detailed understanding of the reasons leading to airspace infringements, thus providing the basis for establishment of the action plan. A significant number of safety occurrence reports have been collected with the help of European service providers and these have been analysed. Not surprisingly, a large number of these reports did not provide the required level of detail to allow identification of the underlying reasons for and contributory factors to airspace infringement.

In order to overcome this problem and acquire the required confidence in the airspace infringement data analysis results, EUROCONTROL launched a dedicated survey, namely the Airspace Infringement Survey 2007, aimed at eliciting general aviation pilots' experience and knowledge of the problem. Pilots' opinions and suggestions are considered paramount in establishing correct and efficient risk reductions measures.

The survey has been carried out with the support of Compass Innovative Solutions Ltd., a private consultancy company based in Sofia, Bulgaria.

1.2 Survey objectives and scope

The objective of the present survey is to deliver the support required for the establishment of efficient safety improvement recommendations and to gain additional confidence in the results of the analysis of airspace infringement occurrence data by:

- extracting deeper and systemic explanations for the reasons behind, mechanisms of and contributors to airspace infringements;

- eliciting pilots' ideas about potential improvements to the safety of flights and the rationale for such improvements;

- validating the airspace infringement causal factor model developed in the

context of the initiative (EUROCONTROL, 2007).

The survey has been limited to general aviation[1] (GA) in Europe. According to the results from the occurrence data analysis, about 80% of airspace infringements involve GA VFR flights.

The survey was conducted in the period July to September 2007.

1.3 Organisation of the report

The report is in five sections.

Section 2 briefly describes the methodological approach to the survey and the data collection methods (qualitative and quantitative) used to elicit the required information. It also makes reference to the taxonomy used in this project.

Section 3 presents the results from pilot interviews and data collected through the on-line questionnaire.

Section 4 is dedicated to the analysis of the survey results. Both statistical and qualitative analysis methods have been used to process the collected information.

Section 5 contains the conclusions regarding the causes of airspace infringement and the recommendations for a potential mitigation strategy and measures that could be established on the basis of the analysis results.

Annexes 1 to 7 provide more detailed information about the survey methodology, the content of the questionnaire and the problems mentioned by the GA pilots during the interview meetings and through the web-based questionnaire.

Lists of references and acronyms are also provided at the end of the report.

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[1] The ICAO definition of GA applies.

2.   SURVEY METHODOLOGY

2.1   General considerations

Two important considerations were taken into account when deciding on the methodology to be used in the survey:

- the need to conduct empirical research among the GA pilot community in order to improve understanding of the causes of airspace infringements, obtain supporting evidence and enhance the output of the airspace infringement occurrence report analysis;

- the need for further elaboration of the airspace infringement causal model [EUROCONTROL, 2007], i.e. to support the establishment of precise relationships between the scenario elements and the explanatory factors, and the potential risk mitigation solutions.

Thus defined, the need to carry out more extensive empirical research among the GA pilot community presupposes the application of both quantitative and qualitative methods.

2.2   Data collection methods

2.2.1   Qualitative method

The aim of the qualitative method used in the survey was to achieve the following objectives:

- to extract deeper and systemic explanations for the reasons behind, mechanisms of and contributors to airspace infringements *(50% of importance)*;

- to elicit pilots' ideas about potential improvements to the safety of flights and the rationale for such improvements *(40% of importance)*;

- to validate as far as possible the results of the airspace infringement data analysis project *(10% of importance)*.

The method of **focus group interview** was considered the most appropriate for collecting qualitative data. Focus groups are structured small group interviews. They are "focused" in two ways. Firstly, the persons being interviewed are similar in some way (e.g. GA pilots). Secondly, the purpose of the interview is to gather information about a particular topic guided by a set of focused questions. Participants hear and interact with each other and the moderator, which yields different information from that obtained if people were interviewed individually. The purpose of focus groups is to develop a broad and deep understanding rather than a quantitative summary. The hallmark of focus groups is the explicit use of the group interaction to generate data and insights that would be unlikely to emerge without the interaction found in a group. The technique inherently allows observation of group dynamics, discussion, and first-hand insights into the respondents' behaviour, attitudes, language, etc. It is not necessary for the group to reach any kind of consensus, nor is it necessary for people

to disagree. The objective is to get high-quality data in a social context where people can consider their own views in the context of the views of others, and where new ideas and perspectives can be introduced. Focus groups may consist of 6 to 12 people who share some characteristics relevant to the evaluation.

The focus group method does not require a representative and statistically adequate sample. To guarantee validity of the results, the pool of potential participants should contain representatives of all relevant subgroups from the target population. This ensures the registration of as many opinions as possible on the problems investigated.

Seven focus groups meetings were conducted in seven (7) different European countries (Bulgaria, France, Germany, the Netherlands, Norway, Portugal and the UK) in order to achieve acceptable validity of the results of the present project. The pool of interviewed GA pilots was established with the assistance of the national AOPAs, French Federation of ultra-light aircraft (FFPLUM) and air navigation service providers.

Because the project timeline coincided with the summer holiday period, it was not possible to hold the planned focus group meetings with French and Swiss GA pilots before the end of September 2007. Instead, the telephone interview method was used to collect Swiss pilots' experience of the problem and suggestions for improvements. Data were collected with the crucial support of AOPA Switzerland. The focus group meeting with French GA pilots was held at the end of November 2007. The collected information has been reflected in the main body of the report.

The number of group interviews is considered sufficient to meet the study objectives for the following main reasons:

- the GA pilots receive fairly standardised training, have to meet JAR-FCL licensing requirements and all follow the ICAO "Rules of the Air" (on the understanding that individual States may file certain differences);

- the scope of the interview is limited to a very narrow expert area - airspace infringement. Extending the number of focus groups/countries would have brought very limited added value to the project, and at high cost.

A number of considerations, such as the level of GA development, regional specificities, the planned completion time, the budget available and the difficulty of establishing contacts with appropriate GA establishments in the various countries were taken into account when determining the number of groups and countries.

To ensure a structured and efficient process of qualitative data collection, a standardised interview scenario (provided at Annex 2) as well as methodological instructions to the field interviewers (provided at Annex 1, Appendix A) were developed.

The findings of the group interviews with GA pilots have been summarised in dedicated reports provided at Annex 4. However, due to time related constraints the Toulouse meeting report could not be attached at annex.

2.2.2 Quantitative method

By applying the quantitative approach, we sought to achieve the following objectives:

- to validate as far as possible the results of the airspace infringement data

analysis project. A feasible way of achieving this is to compare and where necessary supplement occurrence data analysis results with the GA pilots' perception of the relative frequency and importance of the various scenarios and their contributory factors *(40% of importance)*;

- to elicit pilots' ideas about potential solutions to the airspace infringement problem *(30% of importance)*;

- to extract deeper and systemic explanations for the reasons behind, mechanisms of and contributors to airspace infringements *(30% of importance)*.

Quantitative data was collected by means of a sociological survey. The survey method allows the measurement of the incidence of various views, opinions and personal experience of GA pilots. It reveals the relative importance of the theoretical airspace infringement causal model components.

The surveys produce descriptive or analytical information about a given target population. In this particular project the target population consists of hundreds of thousands of GA pilots from all European countries. Crucial for every sociological survey is the choice of the pool of respondents. Since it is virtually impossible to examine the whole population, a sample is drawn. The sample is meant to reflect the key characteristics of the target population.

Sampling methods are classified as either *probability* or *non-probability*. In the case of probability samples, each member of the population has a known non-zero probability of being selected. In non-probability sampling, members are selected from the population in some non-random manner. The advantage of probability sampling is that the sampling error can be calculated. In non-probability sampling, the degree to which the sample differs from the population remains unknown.

In this project a truly representative (random) sample could not be drawn for the following reasons:

1. It is not possible to identify everyone in the target population (GA pilots in Europe) from their personal data;

2. It is not possible to contact randomly selected pilots owing to the confidential nature of the personal details in the existing databases;

3. Budget and time limitations are also important obstacles in drawing a representative sample.

There are, however, important common features of the target population, which allow a small but representative sample to be drawn. Such features are:

- The relative homogeneity of the population: common interests (with regard to flying); interpersonal and inter-organisational communication and exchange of opinions about their flying experience; fairly standardised training and licensing requirements and "rules of the air", etc.;

- The problem investigated by this project is very important to the community, requires a minimum level of expertise and has been discussed recently on various occasions at national and international level.

Taking into account the above factors, the pilots can be expected to share common opinions, evaluations and attitudes.

We can therefore claim with a sufficient degree of confidence that a convenient sample is appropriate and will not jeopardise the validity of the collected data.

The quantitative data was collected by means of a dedicated survey questionnaire. The questions were constructed using the main airspace infringement scenarios and the set causal factors established by the previously developed airspace infringement causal model. The questionnaire was designed to collect pilots' ideas about underlying reasons for and contributory factors to airspace infringement, as well as contextual information about their flying experience, aircraft flown, nationality, experience of airspace infringement incidents', etc. Closed, semi-open, open-ended questions and rating scales were used for the purpose. The responses to the semi-open and open-ended questions were coded as responses to closed question in the data analysis phase. The estimated confidence interval for this sample size at a 95% confidence level is 5.6% for a 50% estimate. This estimate is based on a minimum of 400 collected questionnaires.

The questionnaire was administered via a dedicated web site, e-mail and phone. To reach the GA pilot community, the survey team received the support of the general aviation establishments in various European countries. In addition, a number of individual invitations to participate in the survey were sent to GA pilots.

The survey questionnaire is provided at Annex 3.

2.3   Confidentiality policy

Strict confidentiality principles and rules were applied throughout the survey. Personal details of participants in the survey are not subject to disclosure. Individual answers will be kept confidential and have been used solely to aid the airspace infringement risk analysis. All experts and consultants involved in the project were obliged to sign a declaration of confidentiality before starting work on this project.

2.4   Data taxonomy

Where possible, the taxonomy developed by the EUROCONTROL airspace infringement causal factor modelling study has been used. However, the need to correctly reflect pilots' views calls for the use of further terms and the associated explanations. Nevertheless, the survey team believes that all terms used are self-explanatory, descriptive and should be easily understood by the aviation experts concerned.

The following definition of the term *airspace infringement* has been applied:

"a flight into a notified airspace that has not been subject to approval by the designated controlling authority of that airspace in accordance with international and national regulations."

Notified airspace includes controlled airspace[2] as well as restricted airspace. The

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[2] Controlled airspace includes ICAO airspace Classes A to E. However, VFR traffic cannot infringe Class E airspace, because under ICAO rules neither an ATC clearance nor a radio communication is required to enter or operate within it, unless filed national differences call for one or the other (or both). IFR traffic can infringe Class E airspace when not in receipt of a clearance to enter it.

generic term "restricted airspace" denotes prohibited areas, danger areas, restricted areas and temporary reserved (segregated) airspace.

2.5 IT support

A dedicated web site was developed for on-line data collection using available best practice and advanced software solutions. The web site was published on URL http://www.cis.bg/.

The logical architecture of the system is based on the multi-tier model – the functions of the system are distributed between several logical levels where each level performs a different logical function. The main idea of the multi-tier model is that different layers communicate with one another on the basis of strictly defined interfaces. Each layer is therefore absolutely autonomous. The implemented logic ensures improved flexibility and faster system development.

Five logical levels were defined:

Client software layer	Web browser
Client interface layer	ASP.NET (IIS 6.0)
Business logic layer	Business components
	Microsoft .NET Framework 2.0
Data access layer	stored procedure (SQL Server)
Database layer	MS SQL Server 2005
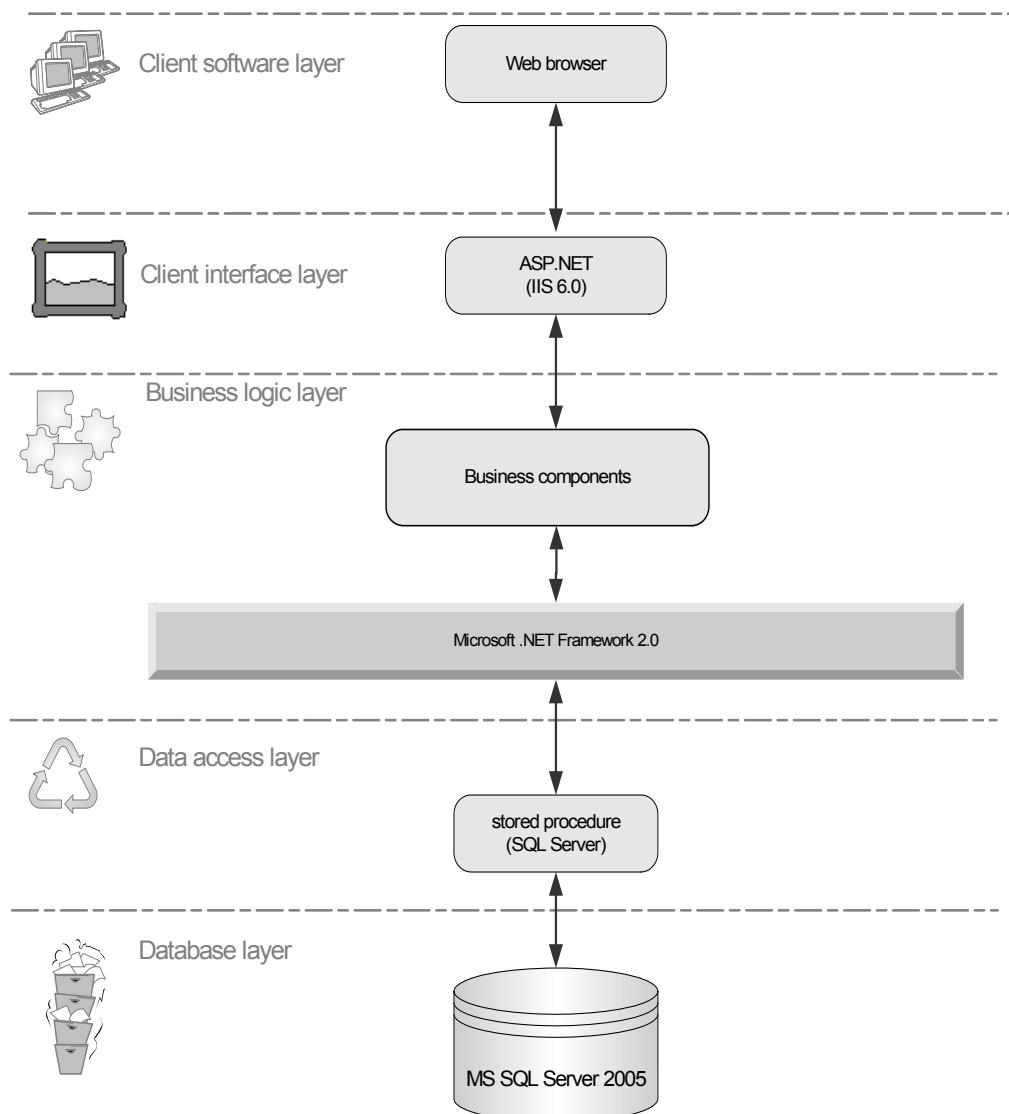
During the survey, the IT team performed daily database back-ups to ensure the required reliability and a smooth data collection process. All servers were maintained 24/7 to ensure a proper working process.

To prevent server failure or technical problems, each user received an automatically generated e-mail with a URL linked directly to his/her last saved question. This prevented any loss of information during the questionnaire answering process and allowed users to complete the survey in several steps.

The website was developed using the following environment:

- MS Server 2003;
- IIS 6.0;
- MS SQL Server 2005;
- ASP.NET 2.0 (VB);
- JavaScript / DHTML;
- Cross-browser capabilities.

3. SURVEY FINDINGS

3.1 Focus groups results

Seven focus groups (interviews) were conducted in various European countries, namely Bulgaria, France, Germany, the Netherlands, Norway, Portugal and the UK. The overall number of pilots who took part in the sessions was 71. The meeting locations were chosen so that the environment was familiar to the pilots. The duration of the interview meetings was 3 to 4 hours. The atmosphere was relaxed, friendly and honest. The two brainstorming sessions (on causal factors and potential means of prevention) were at the core of the interview meetings managed by the meeting moderators. In addition to the focus groups, telephone interviews were used to elicit Swiss pilots' opinions.

The complete interview reports are provided at Annex 4[3].

3.1.1 Composition of the focus group

3.1.1.1 General

The number of pilots who took part in the focus groups (between 7 and 19) provided a good balance between the need to collect sufficient representative data and the requirements for ensuring efficiency. The composition of the groups was designed to achieve an optimum mix of pilot experience and qualifications in order to ensure as wide a representation of the various types of GA operations as possible, from gliders to jet aircraft.

3.1.1.2 Pilot qualifications

Pilot profiles ranged from those who were very experienced, possessing a CPL, to beginners. The majority of the GA types of operations were covered through the participation of pilots holding the following licences and ratings (in various combinations):

- glider pilot licence;

- student pilot licence;

- private pilot licence (PPL);

- commercial pilot licence (CPL);

- air transport pilot licence (ATPL);

- instrument rating (IR);

- flight instructor licence;

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[3] Except the report from the meeting in Toulouse

- examiner licence;

- type and class ratings, e.g. single-pilot/multi-pilot type ratings; single-engine or multi-engine piston aeroplanes, motor gliders, etc.

Pilots reported a wide range of types of aircraft flown, from ultra-lights and non-motorised gliders to large jet aircraft such as the A340. Many pilots reported having experience on a variety of aircraft types.

3.1.1.3   *Pilot experience*

In line with the study objectives and survey methodology adopted, a truly representative sample has been achieved in terms of pilot flying experience. The following indicators were used to capture pilot experience:

- Total number of flight hours: The reported range was between 40 for a student pilot and 21,000 for an experienced ATPL/CPL licence-holder.

- Number of years as a licensed pilot: The reported range was between a few months (< 1 year) and 54 years.

- Number of flight hours logged in the last 12 months: The reported range was between 3 for a pilot doing recreational flying and 750 for an instructor at a flying school or training centre.

- Number of flight hours per month: The reported range was between 0 (leisure pilots) and 120 (flight instructors).

- Airspace-related experience: Pilot experience varies from local flights (own country), through regional (neighbouring countries) and European, to global (other continents, for example North America or Asia).

- Type of flights: The sample included pilots performing recreational flights, aerobatics, glider flights, flight training, taxi flights, aerial work, and even commercial flights.

3.1.2   Airspace infringement causal factors

This section provides a summary of the pilots' individual responses to the following basic question:

What are the 3 main reasons why a GA aircraft enters controlled or restricted airspace without a clearance?

The pilots interviewed were asked to provide their individual responses on post-it paper cards. The responses were collected, and posted in a way that ensured visibility for each participant, e.g. on a wall or a white board.

Group discussion was then initiated by the facilitator using the post-it as an input. During the discussion, the pilots provided their arguments and additional explanations of the factors considered by them to be most important. The factors have been grouped in several categories using the taxonomy developed in previous airspace infringement studies.

Only causal factors considered of high importance by three or more focus groups have been listed below. Causal factor categories are listed in alphabetical order.

The full list of the most common causal factors reported by pilots is provided at Annex 5.

3.1.2.1 Aeronautical information

3.1.2.1.1   NOTAMs difficult to read and/or understand

This problem was mentioned at all meetings and in the telephone interviews. Pilots admitted that the abundance of abbreviations and the large number of NOTAMs irrelevant to VFR flights often make them skip this essential flight preparation activity, thus ignoring information applicable to their intended route. The shared opinion was that it is difficult and time-consuming to filter out the relevant information and often even impossible owing to the lack of graphical presentation. The description of active danger and restricted airspace provided in numerical form (Lat/Long-s) makes it practically impossible for the majority of GA pilots to understand the actual dimensions and location of such areas.

This factor was given highest importance.

3.1.2.1.2   Lack of standardised VFR maps/charts and guides for GA

Participants shared their concern that the difference in map/chart design and layout is an important contributor to poor flight preparation, but can also distract the pilot in flight or prevent him/her from recognising the object on the map/chart. In addition to the different colours and symbols used, scale is sometimes also considered unpractical. The problem of cluttered maps/charts was also referred to.

The maps and charts used in some countries are either old (obsolete) or are military documents. Pilots often find it difficult to obtain current updated maps/charts.

3.1.2.1.3   Lack of an integrated aeronautical information (AI) briefing facility

There is no single source (portal) of aeronautical information capable of providing the required data for any given flight. The pilot needs to spend a lot of time searching various websites and sources, and this is often not done. Pilots requested a single, common, on-line portal, free of charge, for aeronautical information for GA VFR flights.

3.1.2.1.4   Use of out-of-date charts

The survey team was informed that many pilots decide to cancel their AI subscriptions because of financial considerations and the large amount of information (pages) to be replaced at each update cycle, most of which does not concern VFR flights.

Some pilots expressed the opinion that AI updates are not effectively promoted on the internet sites providing this service. The fact that many pilots

are not in the habit of checking periodically for AI updates may also contribute.

3.1.2.2 Airspace and navigation

3.1.2.2.1 Complex airspace design

The complexity of airspace is a major problem which can cause a loss of or recurring gaps in situational awareness, and even loss of orientation. Complex airspace can contribute to misidentification of ground features. A strong consensus of opinion emerged among pilots that the considerable number of restricted zones and areas (including temporary segregated areas) and their dynamic management (activation/deactivation) cannot easily be followed by GA. It may also result in pilots' deciding to take shortcuts.

Non-alignment of airspace boundaries with prominent ground features (visual references) is also a factor that needs consideration.

3.1.2.2.2 VFR routes (choke points) close to controlled/restricted airspace

According to pilots, there is often no buffer zone between busy VFR routes and controlled airspace, which increases the likelihood of unwanted infringements. The presence of many hotspots, which the pilots can decide to avoid, is another major contributor.

3.1.2.2.3 Problems with GPS

Several problems of a different nature have been cited by the pilots:

- The GPS system sometimes provides less information about the airspace than an ordinary map/chart would provide to a pilot who has been trained to use paper maps/charts. This is the case when the GPS does not provide a graphical display of the airspace but only shows the route which the aircraft should follow. The pilots are not confident and unsure of their position, since they are not familiar with the airspace that lies between the first and the last point of their route.

- Failure of the GPS power supply (batteries) or antennas.

- Young pilots rely on the information provided by the GPS rather than on their visual navigational skills.

- Inaccurate GPS database. Updating the GPS system could be costly.

3.1.2.3 Air traffic control and flight information services

3.1.2.3.1 Unfavourable attitude towards VFR flights

Pilots unanimously agreed that there is a lack of proper communication between controllers and GA pilots. The general perception is that GA flights are not welcome in controlled airspace and that commercial flights are always given higher priority. The opinion was expressed that in some situations the VFR flights are handled with lower priority even by FIC officers.

It is worth noting that the quality of FIS provided by military personnel is often

considered better than those provided by civil ATS providers.

3.1.2.3.2   Inadequate scope of FIS

The general consensus among GA pilots is that the scope of the flight information services provided is insufficient (e.g. traffic information, "flight following" not ensured). Lack of standardisation is considered a major contributor. The amount of information provided to the pilots varies depending on the FIS officers' skills, workload and training. This may cause a false sense of security in pilots (being provided with a separation service). More efficient use of available radar information and extension of radar services were recommended. Pilots referred numerous times to US flight information services as an example of good practice.

3.1.2.3.3   Inadequate ATC clearance

In the pilots' opinion, the root cause is to be found in the lack of dedicated training or the insufficient training received by controllers and/or FIS officers in dealing with GA flights. It is perceived that ATS staff are often unfamiliar with the performance characteristics of light aircraft.

The passing of complex instructions (several clearances in one transmission) and the speed at which controllers speak play an important role.

3.1.2.4   The environment

3.1.2.4.1   Bad weather

All pilots considered the weather problem to be important, in particular in terms of the rise in the stress level in the cockpit. However, specific weather parameters and phenomena, such as wind, visibility, cloud-base, thunderstorm, icing, etc. were not considered to deserve explicit consideration.

3.1.2.5   Human factors

3.1.2.5.1   High pilot workload (overload)

Navigating, communicating, and coping with bad weather might suddenly raise the level of "pressure" in the cockpit. The general opinion was that inexperienced pilots are more likely to be exposed to a high workload (stress) situation. A major contributor is reported to be inadequate pre-flight preparation.

3.1.2.5.2   Use of a foreign language

The English language knowledge of pilots and FIS staff in many countries is considered poor. Furthermore, in some countries staff providing flight information services are perceived to be reluctant to respond to pilots' calls in English.

On the other hand, some pilots insisted on the use of the pilots' mother tongue as a premise for flight safety (reduced likelihood of misunderstanding ATC

instructions).

3.1.2.5.3   Honest mistake

3.1.2.6   Pilot skills (airmanship)

3.1.2.6.1   Insufficient flight planning/preparation

It was reported that not every GA pilot does the necessary flight preparation by thoroughly checking the route, the weather and the airspace structures along the route. As a result, unexpected changes may not be taken into account. Poor flight planning (preparation) can result from either inexperience or neglect. Concerns have been raised that good practice in terms of flight preparation is being gradually abandoned and beginner pilots do not develop the habit of doing proper pre-flight preparation.

This factor was accorded very high importance by almost all focus groups.

3.1.2.6.2   Inadequate (insufficient) communication skills and discipline

General aviation pilots reported that they received insufficient training in air-ground communication. Combined with lack of experience, anxiety and in-flight stress, this can easily lead to airspace infringements. Some pilots receive better training simply by having the chance to depart and arrive through controlled airspace during their initial training. Pilots who have limited communication skills are reluctant to call ATC. Some pilots do not consider it worth contacting the FIC in view of the low quality of service provided.

Further opinions associate the problem of inadequate training of young pilots with the age and inexperience of the instructors. It is hard and expensive for a flying club to find and recruit highly skilled instructors. The pilots acknowledged the fact that the rich experience of the instructors presupposes a high level of safety on board.

Another problem appears to be the inadequate safety culture of certain instructors. It was reported that instructors at some flight schools do not efficiently transfer their knowledge to the students if they find it impractical. They do not teach the students how to contact FIC and use the service. The initial training is focused on teaching the basic flying skills (e.g. how to land the aircraft safely).

Pilot "ignorance" is also a factor which needs to be considered.

3.1.2.6.3   Inadequate (insufficient) navigation skills

This factor can be correlated with pilot inexperience, i.e. less experienced pilots cannot effectively use the available tools in the pre-flight briefing phase. Moreover, inexperienced pilots usually have a very high workload, focusing mainly on flying the aircraft and not having time to pay attention to correct navigation. This problem is most relevant to "leisure" pilots flying only few hours in a year.

Insufficient training on the use of GPS could lead to incorrect trajectory estimation.

An important contributory factor which appears to be of serious concern is the lack of refresher training for pilots with few flight hours.

3.1.3 Causal factor prioritisation

The objective of this session was to rank the factors that can lead to airspace infringements according to their perceived impact. To carry out the causal factor prioritisation task, focus groups were split into sub-groups. Cards presenting the consolidated list of causal factors identified by the airspace infringement causal factor modelling study were distributed to each sub-group. The full list of causal factors used can be found at Annex 2, Appendix 2.

The groups were asked to study the cards and rate the factors according to importance (relative contribution to the causes of airspace infringements) by choosing the top 10 (the ones most likely to lead to infringements). They were encouraged to suggest factors which the model failed to consider.

Twelve lists of ranked factors were obtained in this way. The mean rank score was calculated for each factor in these lists. Since the groups had to rank only 10 factors out of the full set, the factors which were not ranked within this range by any of the groups have been excluded from further processing. The prioritised lists causal factors from each sub-group and from the telephone interview can be consulted in the meeting reports provided at Annex 4.

Table 1 below presents the ranked causal factors considered of highest importance by pilots.

Rank	Causal factor	Mean score
1	Inadequate training and navigation skills	5.1
2	Honest mistake	6.3
3	High workload (overload)	6.4
4	NOTAMs difficult to understand	7.0
5	Airspace structure difficult to identify in flight	7.3
6	Use of out-of-date chart	7.6
7	Complex or unclear airspace use procedures	7.7
8	Bad weather	7.8
9	Unfavourable attitude towards VFR flights	8.4
10	Inadequate knowledge of airspace and procedures for its use	8.5
11	VFR routes close to restricted/controlled airspace	8.8

12	Inadequate R/T skills and discipline	9.1
13	False expectations about the level of ATC service	9.3
14	Inadequate ATC clearance	9.4
15	Distraction	9.5
16	Routine	9.8
17	Inadequate flight planning	9.8
18	Busy ATC frequency	9.8
19	Insufficient experience	10
20	Unclear (saturated) maps or charts	10.3
21	Lack of dedicated VFR maps	10.3
22	Lack of dedicated VFR routes	10.4
23	(Military) airspace status not known	10.4
24	GPS problem	10.5
25	(Navigation) equipment failure	10.6
26	Inefficient aircraft control	10.7
27	GA routes/sites situated close to controlled airspace	10.8
28	Training flight	10.8

Table 1 - Causal factor ranking

3.1.4 Preventive approaches and measures

This section provides a summary of the pilots' responses to the following basic question:

What could be the best 3 measures to prevent airspace infringements?

The pilots were asked to write down their individual responses on a sheet of paper sheet and in turn provide brief arguments and explanations for their choice.

The list of potential risk reduction measures was then elaborated in the ensuing group discussion. To facilitate the analysis, the suggested risk mitigation measures have been grouped in several categories using the same approach as for the casual factors. Categories are listed in alphabetical order.

Only measures proposed at three or more focus groups are described below. The full

list of pilots' suggested risk reduction measures is provided at Annex 6.

3.1.4.1 Aeronautical information

3.1.4.1.1   Standardisation and simplification of maps and charts in Europe

The need for standardised maps and charts for visual navigation was unanimously recognised. It should include a review and agreement on the most appropriate set of scales (e.g. use of 1:250 000 for local flights).

3.1.4.1.2   Improve NOTAM readability

Graphical presentation of NOTAMs where applicable (e.g. area/zone depiction) is considered essential. Simplification of NOTAMs concerning GA VFR flights is needed.

3.1.4.1.3   Implement integrated aeronautical information briefing facility

The availability of a pan-European facility for the timely provision of up-to-date aeronautical and MET information to GA flights is strongly recommended. The "one-stop shop" should be designed in a user-friendly manner and provide for easy and prompt access to any related information that the pilot might need for his/her flight preparation. Access to the facility should be free of charge for individual pilots. A further recommendation was to additionally provide an in-flight aeronautical information service.

3.1.4.2 Airspace and navigation

3.1.4.2.1   Review airspace design and reduce complexity

The airspace design criteria and priorities should be reviewed and updated, taking due account of different airspace users' needs.

Simplification and harmonisation of airspace classification among European States was identified as a major step towards a reduction of the airspace infringement risk.

3.1.4.2.2   Better use of airspace

Pilots recommended improved application of the FUA concept with regard to the management of restricted areas, zones and TSAs.

Also, optimising the volume of controlled airspace would prevent pilots' losing respect for the airspace use procedures and "cutting corners" (of controlled or restricted airspace) without asking clearance from ATC. Allocation of sufficient airspace for aircraft that cannot be equipped with communication means and/or transponders should be considered.

3.1.4.2.3   Use of modern technology

Pilots expressed their strong support for the use of state-of-the-art technology in air navigation. However, this does not remove the basic need to train pilots

in visual navigation techniques beforehand.

Several new technologies and advanced equipment have been recommended:

- digital radio will provide a simple and universal means of reliable and prompt communication between controllers and pilots;

- integrative software will enable information to be downloaded and uplinked in flight;

- advanced GPS functions: moving map, airspace infringement warning and further applications which can alert the pilot to deviations from the "safe flight path", for example flight alarm (FLARM);

- Mode S – Mode S transponders - will help improve FIS and mitigate certain risks. However, such equipment is considered very costly and many pilots are not convinced that Elementary Mode S will bring substantial benefits for GA.

3.1.4.3   ATS/FIS

3.1.4.3.1   Improve FIS: extend scope and harmonise FIS provision across Europe

The improvement of FIS should follow the market logic of supply matching demand. Since GA is asked to pay charges and taxes it should be offered high-quality FIS. Various services have been referred to as examples of good practice:

- provision of warnings to pilots of any unfavourable factors and weather phenomena;

- extension and enhancement of LARS (Low Airspace Radar Service);

- "Flight following" (US good practice recommended);

- airspace infringement and traffic warnings;

- raising the FIS level to ensure proactive prevention of potential conflicts.

3.1.4.3.2   Improve communication between controllers and pilots

An improved understanding of GA needs, a friendlier attitude, and a more accurate response to GA pilots' calls are required. Authorities and service providers should pay due regard to ultra-light aircraft, gliders and other types of GA.

Regular meetings (workshops) between ATC/FIS controllers and GA pilots were proposed as a means of improving the understanding of each side's problems and concerns. Pilot associations and flying clubs could play a role in improving the interface with ATC.

3.1.4.3.3   Harmonised training of controllers in handling VFR flights

Controller (FIS officer) knowledge of light aircraft and their performance

characteristics should be improved to allow correct understanding of and communication with GA pilots. Dedicated programmes aimed at improved GA pilot and ATC/FIC staff training and experience exchange (e.g. 'flight following' training for controllers) were proposed as steps in the right direction.

3.1.4.4 Pilot skills (airmanship)

3.1.4.4.1 Periodic refresher training and checks for pilots

Refresher training is considered of particular importance for recreational pilots, but it is relevant to GA pilots in general. Proficiency checks should be extended beyond simple aircraft handling to include navigation skills.

3.1.4.4.2 Improve navigation and R/T skills training

Teaching chart-reading skills and use of the basic (primary) navigation aids were the most frequently cited areas for improvement. Pilot training syllabuses should include new technology aids, like GPS. A special GPS system training course for post-graduate student pilots might be a possible approach.

Pilots' R/T communication skills should be improved by additional R/T training. A GA-tailored R/T guide was considered useful in this respect.

Harmonisation of training curricula and inclusion of cross-border flights are suggestions which deserve particular attention.

3.1.4.5 Safety culture
Raising the safety-awareness of GA pilots was considered to be an essential safety improvement factor in all focus group discussions. Various suggestions were made by pilots to help achieve this, such as seminars, workshops, knowledge-exchange programs (open-door days), support for GA organisation safety improvement efforts, dedicated safety initiatives, etc.

3.1.4.6 Regulation
The majority of suggested improvements are related to the pilots' training and licensing process. There was a clear emphasis on ensuring the ongoing competence of private pilots. A number of suggestions were made in this respect:

- introduce mandatory refresher training;

- implement an examination approach in licence-validation checks;

- close supervision of pilot training and flight instructor licensing processes;

- mandatory English-language R/T classes during initial training.

Some pilots felt there was a need for improved regulation on the carriage of transponders and use of airspace.

3.2   Questionnaire results

3.2.1   Data sample

A total of 886 responses to the questionnaire were collected in the period July to September 2007. Of these, 473 contained answers to all 66 questions. In view of the huge amount of information received and in line with the adopted methodology, only the complete questionnaire responses were subject to further analysis.

The analysed sample can be considered truly representative in geographical terms, as it contains responses from pilots from 24 European states: Albania, Austria, Belgium, Bulgaria, Croatia, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Slovakia, Sweden, Switzerland, and the United Kingdom.

Twenty-one (21) different languages are spoken by the pilots whose responses have been included in the analysed data sample.

3.2.2   Respondents' profiles

3.2.2.1 Pilot qualifications

A large majority of pilots participating in the survey are PPL-holders (77.1%) and 19.2% of the total have an IFR rating (see Figure 1 below). It is worth noting the pilots' view shared during focus group discussions that access to an IFR rating should be made easier for PPL-holders. This might help reduce the likelihood of airspace infringements.

Student pilots and CPL-holder groups are also represented, but to a lesser extent. The 3.6% "Other" category includes ATPL-holders, glider pilots and others who, depending on the local regulations in force, are not covered by the licensing regime under JAR-FCL Part 1 (Aeroplane).

Distribution by qualification
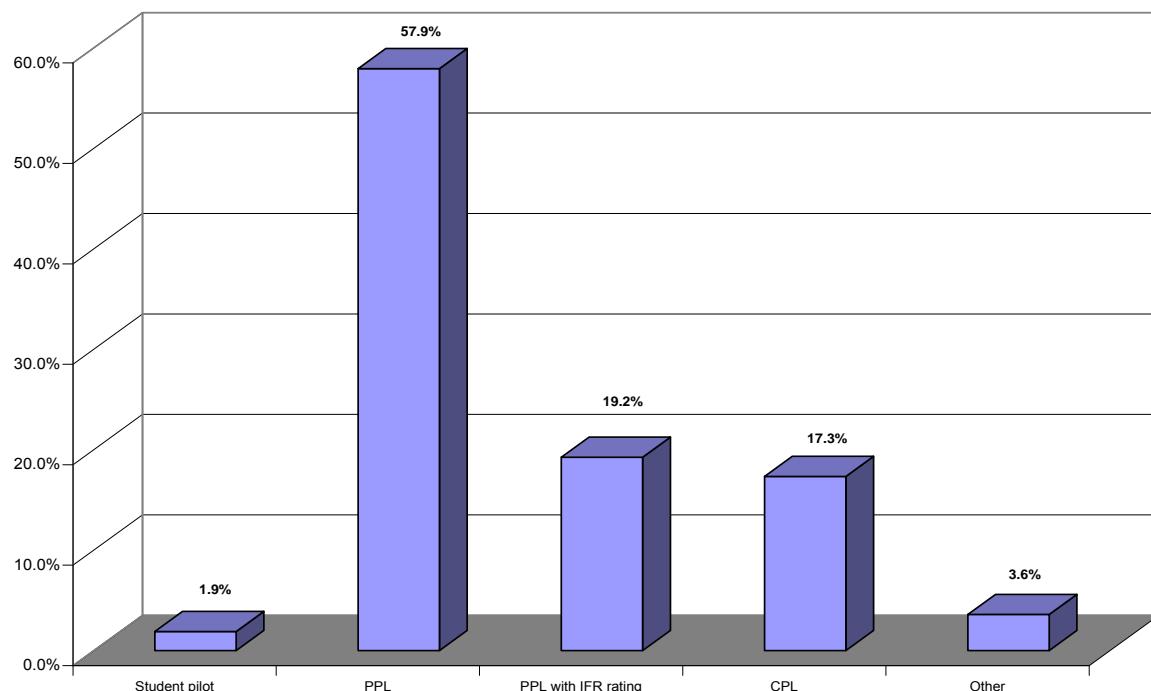
Figure 1

3.2.2.2 Pilot experience

Distribution by total flight hours
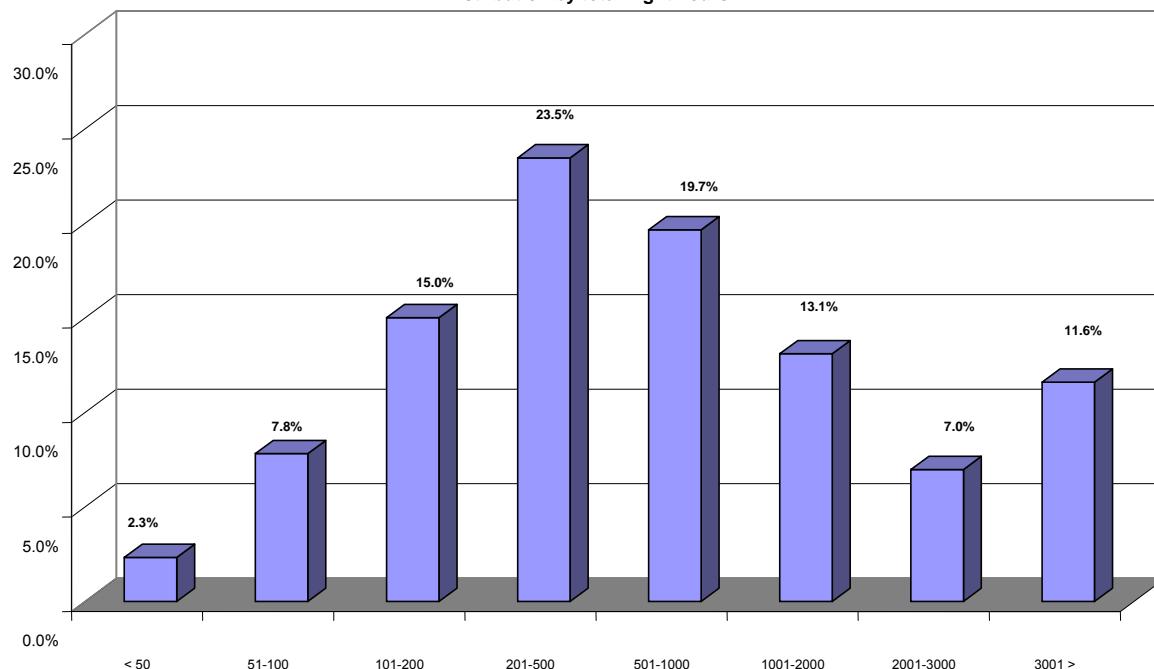
Figure 2

The analysed sample achieves a good balance, ranging from pilots with very little experience to pilots who have logged more than 9,000 flight hours. The group of pilots with flying experience of up to 500 hours represents 48.6% of the sample (see Figure 2).

Distribution by flight hours for previous year
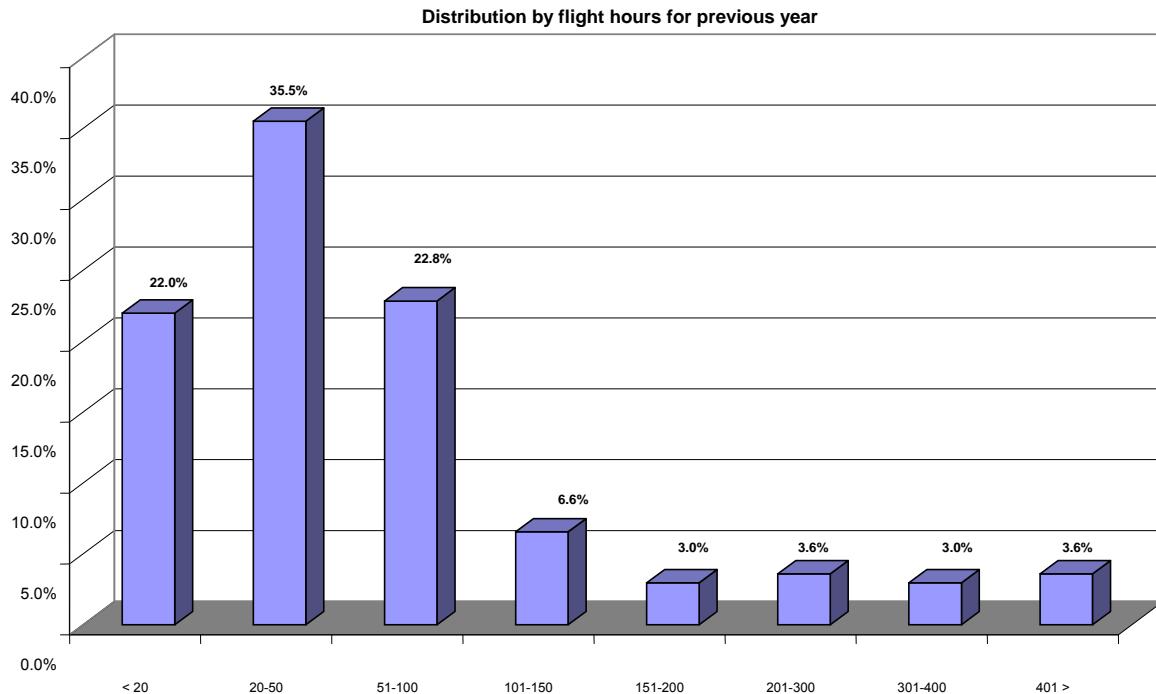
Figure 3

Further information about the average number of hours flown in a year is provided in Figure 3. It is worth noting that the majority of pilots (57.5%) fly fewer than 50 hours in a year.

3.2.2.3 Aircraft types/classes flown

Pilots were asked to input the ICAO aircraft type designators. Aircraft were grouped into (ICAO) classes for the purpose of the analysis and presentation of the results (see Figure 4).

Single-engine piston aircraft clearly predominate (76.7%). Nearly 3% of respondents are helicopter pilots.

The "N/A" category, amounting to 7%, includes mainly aircraft types which do not match ICAO aircraft type designators. There is high probability that the aircraft designator was not typed-in correctly in a considerable number of cases.

Distribution by aircraft

Aircraft	Percentage
Ultralight	4.9%
Twin-engine turboprop landplane	0.6%
Twin-engine turboprop helicopter	1.3%
Twin-piston-engine landplane	5.3%
Twin-engine jet landplane	1.5%
Single-engine turboprop landplane	0.8%
Single-engine turboprop helicopter	0.2%
Single-piston-engine landplane	76.7%
Single-piston-engine helicopter	1.3%
N/A	7.0%
Four-engine jet landplane	0.4%

Figure 4

3.2.3 Airspace infringement causal factors and mitigation

The on-line survey gave GA pilots an excellent opportunity to share their experience and opinions about the airspace infringement risk and the safety of GA flights in general. It offered a large number of closed, semi-open and open questions, which had to be answered in text. The high number of questions (66 in total) contributed to a tendency towards a gradual reduction in the volume of information provided in response to the semi-open and open questions. Many respondents provided most of their comments and suggestions about the airspace infringement problem in the answers to the first couple of questions.

The presentation of the results is consistent with the causal factor model used for the development of the survey questionnaire.

3.2.3.1 Airspace and navigation related issues

3.2.3.1.1 *Loss of awareness of exact aircraft position*

In the subjective opinions of the majority of pilots (60.4%), the likelihood of losing awareness of the exact aircraft position with regard to the airspace structures is greater than 10^{-1} per flight (see Figure 5). However, care should be taken when interpreting the above distribution. Since many pilots fly a limited number of hours in a year, the answers "once in a year" or "rarely" may be of the same order as "once in 10 flights".

PILOT IS UNSURE OF AIRSPACE (he/she is flying in) OR OF AIRCRAFT POSITION OR IS LOST
How often could this happen to a GA pilot?
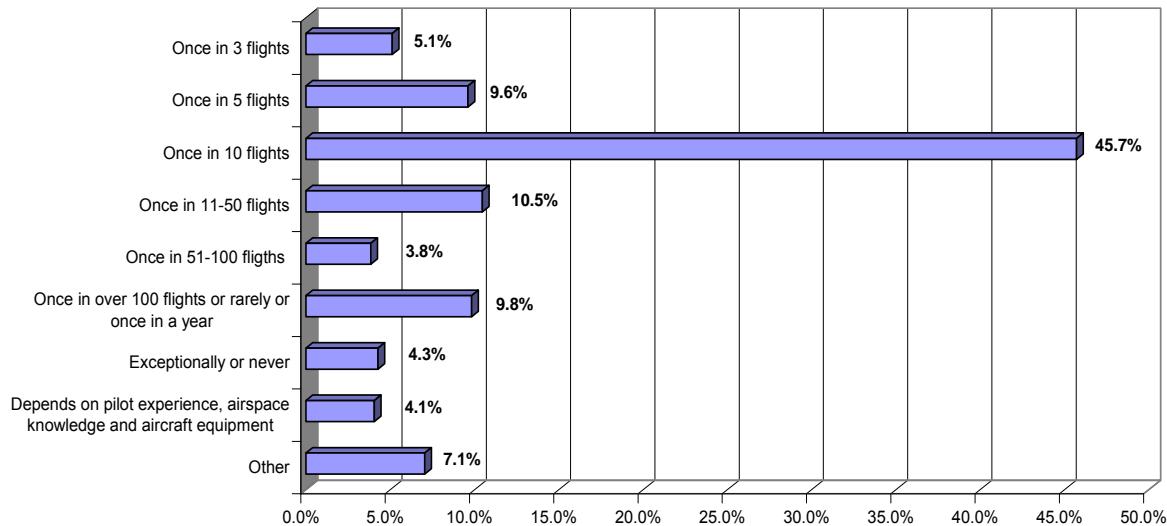
Figure 5

PILOT IS UNSURE OF AIRSPACE (he/she is flying in) OR OF AIRCRAFT POSITION OR IS LOST
Have you been in such a situation in the last 12 months?
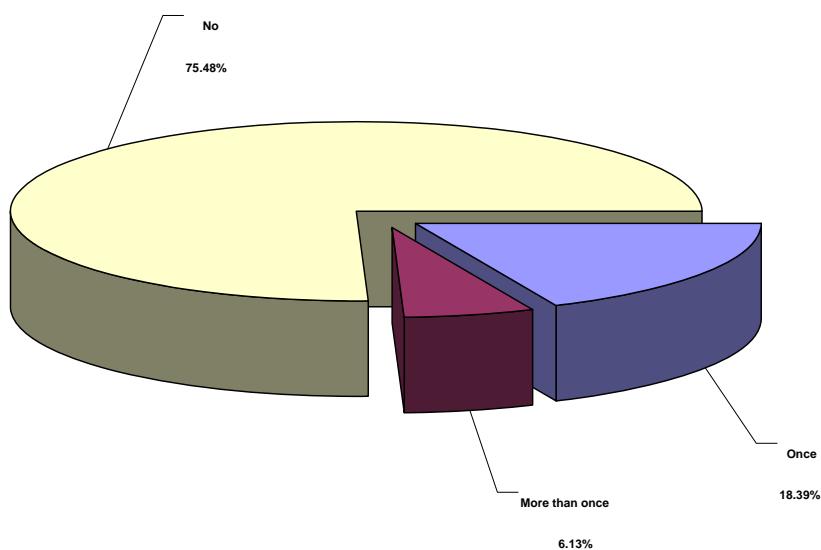
Figure 6

About 25% of the pilots had been unsure of their position at least once in the course of the previous 12 months (see Figure 6 above).

PILOT IS UNSURE OF AIRSPACE (he/she is flying in) OR OF AIRCRAFT POSITION OR IS LOST
How often might this lead to an airspace infringement?
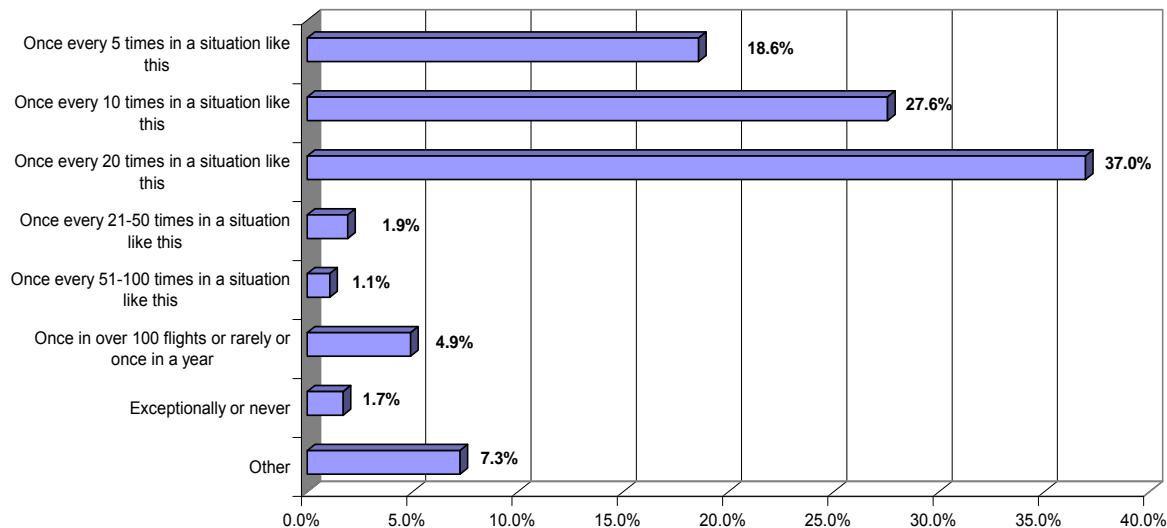
Figure 7

According to two-thirds of pilots, the likelihood of an airspace infringement occurring appears to be between 10^{-1} and 2×10^{-1} per situation of reduced or lost situational awareness (see Figure 7). The group "Other" reflects conditional and "difficult to estimate" type of answers.

PILOT IS UNSURE OF AIRSPACE (he/she is flying in) OR OF AIRCRAFT POSITION OR IS LOST
What could be the explanation? (more than one choice possible)
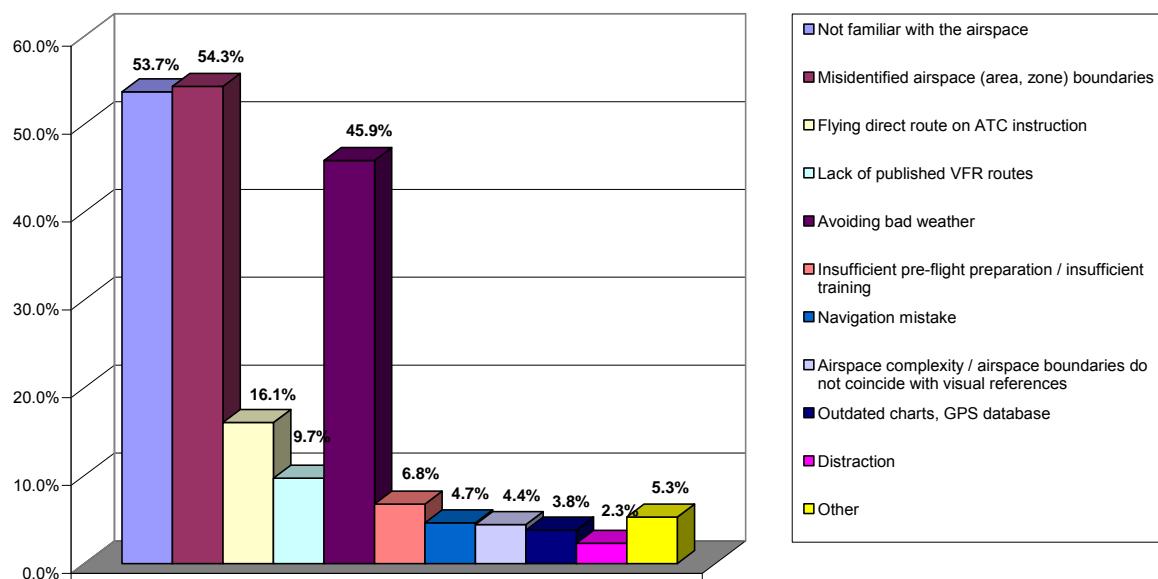
Figure 8

Two factors were identified as major contributors to a loss of position awareness – pilots' unfamiliarity with the airspace and failure to recognise the airspace structure boundaries (see Figure 8). Insufficient knowledge of airspace often results from inadequate flight preparation, whereas misidentification of airspace can also occur owing to complexity of design, use of low-quality or out-of-date maps, misinterpretation or lack of landmarks (area/zone boundaries not associated with prominent landmarks). Bad weather was ticked as the third most important factor, but it can also be considered a contributor to the first two factors.

A "silver-bullet" solution to the "lost awareness" problem could not be identified. Suggested preventive measures cover almost all ATM components: airspace design, navigation, air-ground communication, ATS, AIS, FIS and human factors.

Particular emphasis was placed on the need to improve flight planning and preparation and pilots' navigation skills. This can be achieved by improved training (focused on navigation) and dedicated refresher courses.

PILOT IS UNSURE OF AIRSPACE (he/she is flying in) OR OF AIRCRAFT POSITION OR IS LOST
What can be done to avoid such situations?
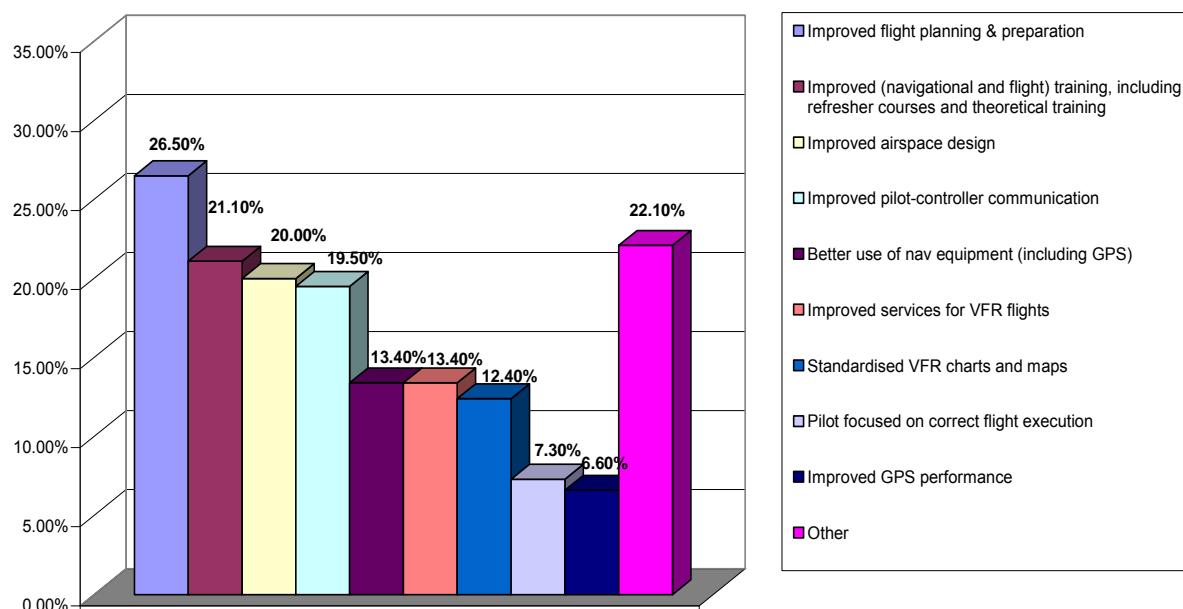
Figure 9

3.2.3.1.2   *Navigation equipment failure*

A particular aspect of navigation failure examined by the survey was navigation equipment failure and its impact on the airspace infringement risk. Nearly half the pilots reported having experienced such failure (see Figure 10).

NAVIGATION EQUIPMENT FAILURE
Have you ever suffered navigation equipment failure?

No
47.78%

Yes
52.22%
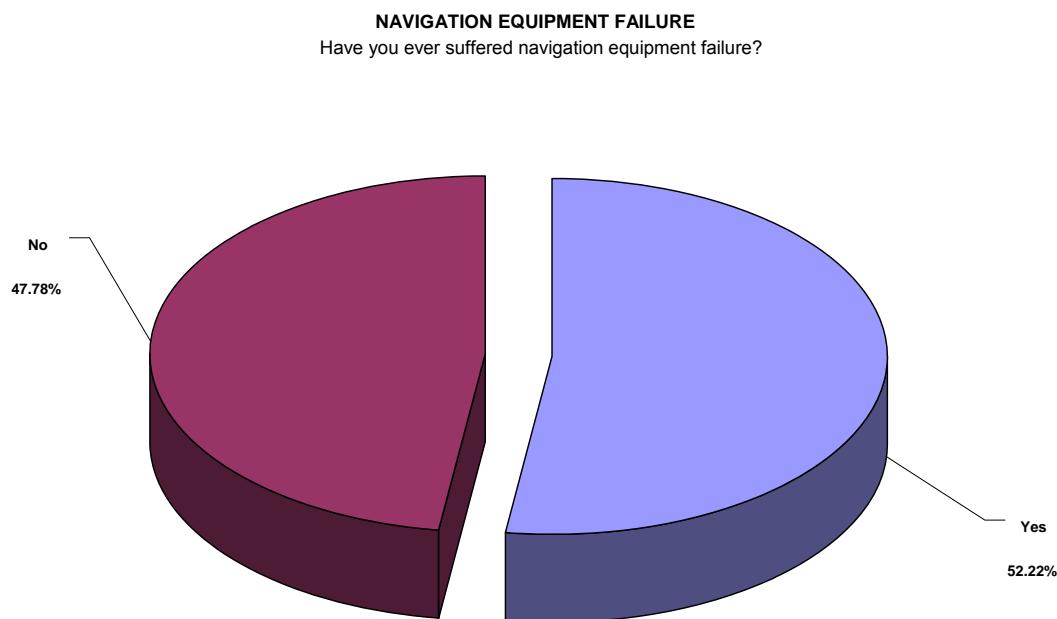
Figure 10

NAVIGATION EQUIPMENT FAILURE
What is the most common navigation equipment failure?
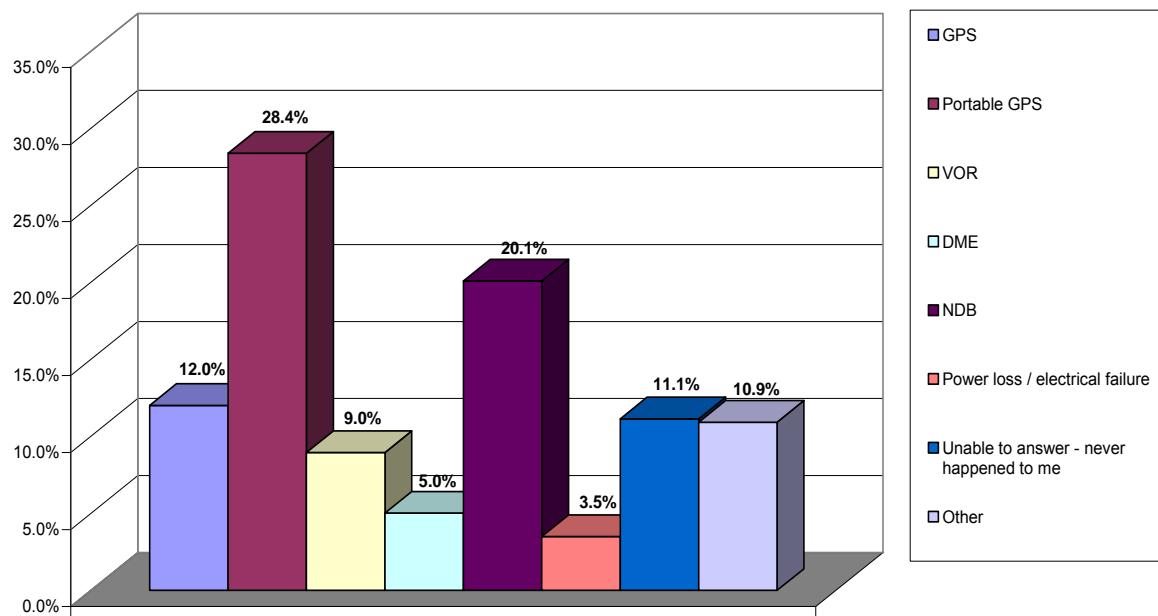
Figure 11

Figure 11 is a clear substantiation of the pilots' concerns voiced at the interview meetings about problems encountered when using various GPS sets. It appears that portable GPS sets used by pilots are the least reliable.

The majority of answers in the "Other" category refer to compass failure, many others to failure on the part of the pilot to read a map/chart or the instruments correctly.

NAVIGATION EQUIPMENT FAILURE
What can be done to avoid such situations?
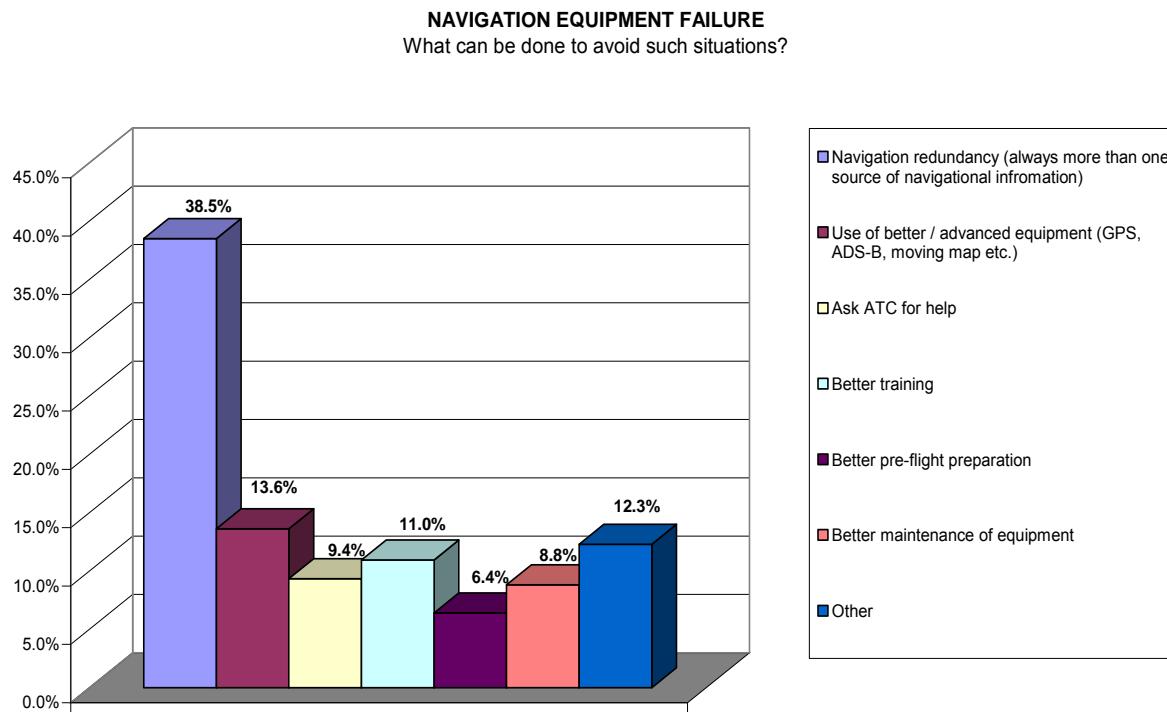
Figure 12

Navigation redundancy and use of better/advanced navigation equipment were cited as the most common solutions to the problem. Most of the suggestions refer to the use of back-up methods of navigation and not to a second navigation equipment set, for example use of GPS navigation backed-up by dead reckoning. By "better training", pilots were referring to improved map-reading skills and correct use of GPS.

It is important to note that less than 10% of the pilots regarded ATC as a means of mitigation. A possible explanation is the unfavourable attitude of ATS staff (as perceived by pilots) and reported communication problems.

Most of the answers in the "Other" category were "don't know" or recommendations for use of visual navigation and paper maps/charts, as well as alignment of airspace boundaries with visually observable landmarks.

Navigation equipment failure does not appear to be a very rare event according to Figure 13 – nearly 27 % of pilots had suffered it in the previous 12 months.

NAVIGATION EQUIPMENT FAILURE
Have you suffered navigation equipment failure in the last 12 months?

No
72.73%

More than once
7.40%

Once
19.87%
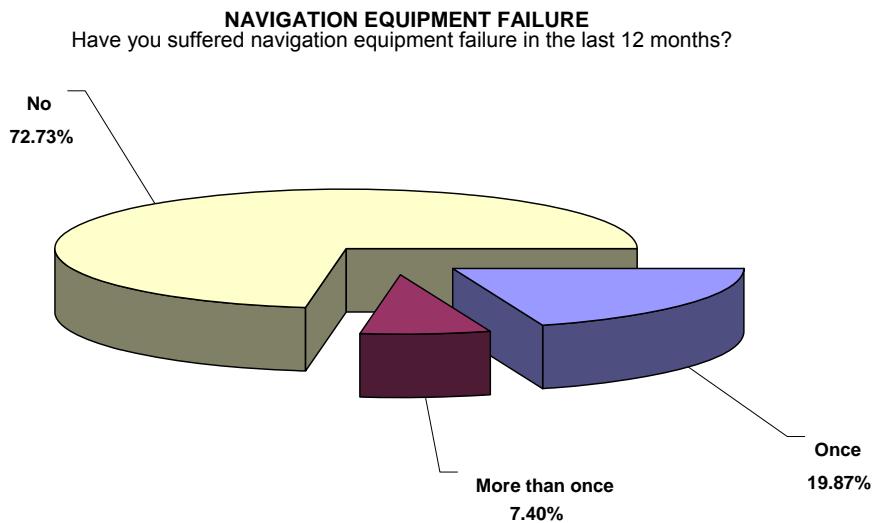
Figure 13

The subjective opinion of pilots about the likelihood of navigation equipment failure causing airspace infringement fits well within the distribution established for the generic case - lost awareness of the exact aircraft position or loss of orientation (discussed above).

3.2.3.2 Air-ground-communication-related issues

3.2.3.2.1   Failure to establish radio contact

PILOT FLIES WITHOUT RADIO CONTACT WITH ATC DESPITE THE FACT IT IS NEEDED OR REQUIRED
How often could this happen to a GA pilot?

Category	Percentage
Once in 3 flights	3.9%
Once in 5 flights	5.4%
Once in 10 flights	31.1%
Once in 11-50 flights	13.9%
Once in 51-100 flights	6.5%
Once in over 100 flights or rarely or once in a year	18.9%
Exceptionally or never	5.7%
Unable to answer - never happened to me	5.0%
Other	9.6%
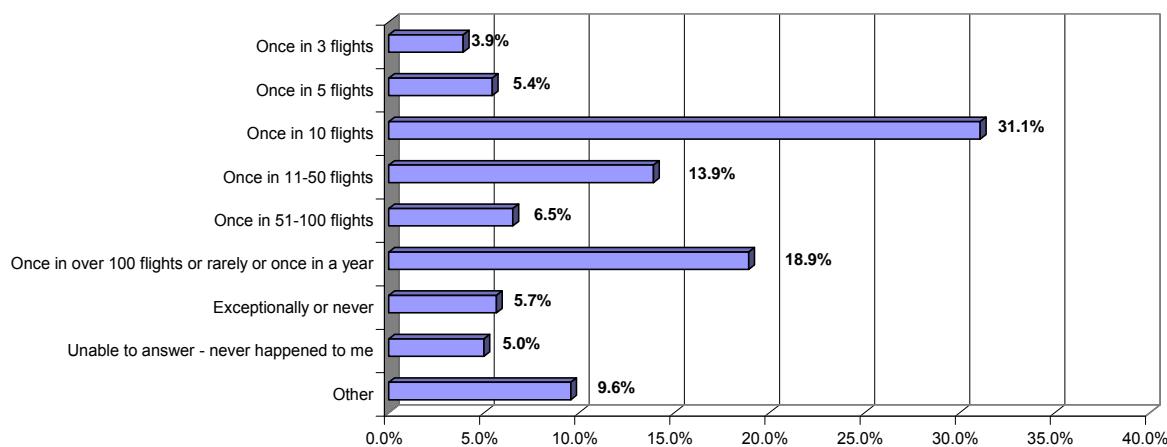
Figure 14

The analysis of pilots' subjective judgements regarding the likelihood of such a situation occurring indicates that the majority of pilots consider it to be in the range of 10^{-2} to 10^{-1} per flight.

However, a substantial proportion of pilots (29.6%) consider the likelihood lower than 10^{-2} per flight (see Figure 14).

PILOT FLIES WITHOUT RADIO CONTACT WITH ATC DESPITE THE FACT THAT IT IS NEEDED OR REQUIRED
Have you been in such a situation in the last 12 months?

- No 80.13%
- Once 13.11%
- More than once 6.77%
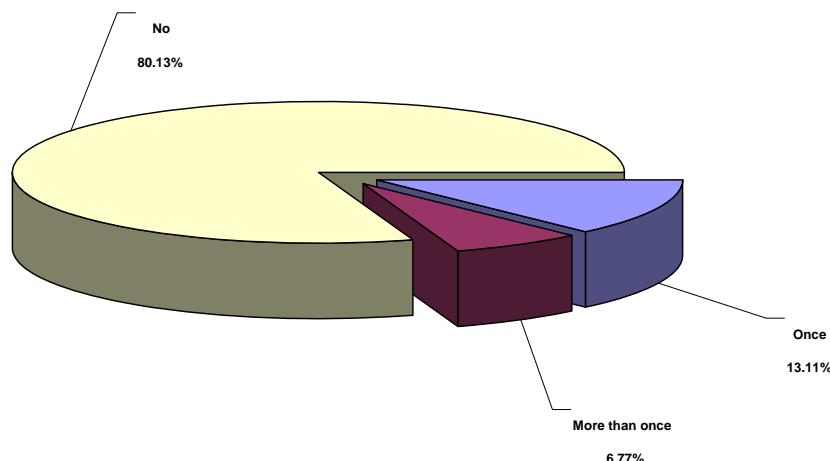
Figure 15

Nearly 20% of the pilots report having failed to establish communication with ATC in situations that required it at least once in the last 12 months.

PILOT FLIES WITHOUT RADIO CONTACT WITH ATC DESPITE THE FACT IT IS NEEDED OR REQUIRED
What could be the explanation? (more than one choice possible)

Legend:
- Radio failure
- Busy frequency
- No R/T coverage
- Frequency not known
- Wrong frequency selected
- Stayed on FIS frequency (should have changed to ATC)
- Unfavourable controller attitude
- Pilot unaware of airspace status / loss of orientation
- Poor R/T knowledge on part of pilot
- Ignorance of procedures on part of pilot
- Incorrect setting of radio
- False expectations of ATS/FIS service
- Other

Values: 26.8%, 31.3%, 17.8%, 19.2%, 36.8%, 21.1%, 18.4%, 8.0%, 4.7%, 2.5%, 1.9%, 2.7%, 7.8%

Figure 16

Figure 16 is an attempt to provide the most common explanation of this type of failure. The most common factors appear to be wrong frequency selection, density of radio exchanges and radio equipment failure. The fourth-ranking factor - not switching from FIC to ATC frequency - should be taken into account in the design of FIS procedures. Reluctance to call ATC because of the controllers' unfavourable attitude, use of outdated maps/charts and honest mistake have been included in the "Other" category among other low scoring factors.

PILOT FLIES WITHOUT RADIO CONTACT WITH ATC DESPITE THE FACT THAT IT IS NEEDED OR REQUIRED
What can be done to avoid such situations?
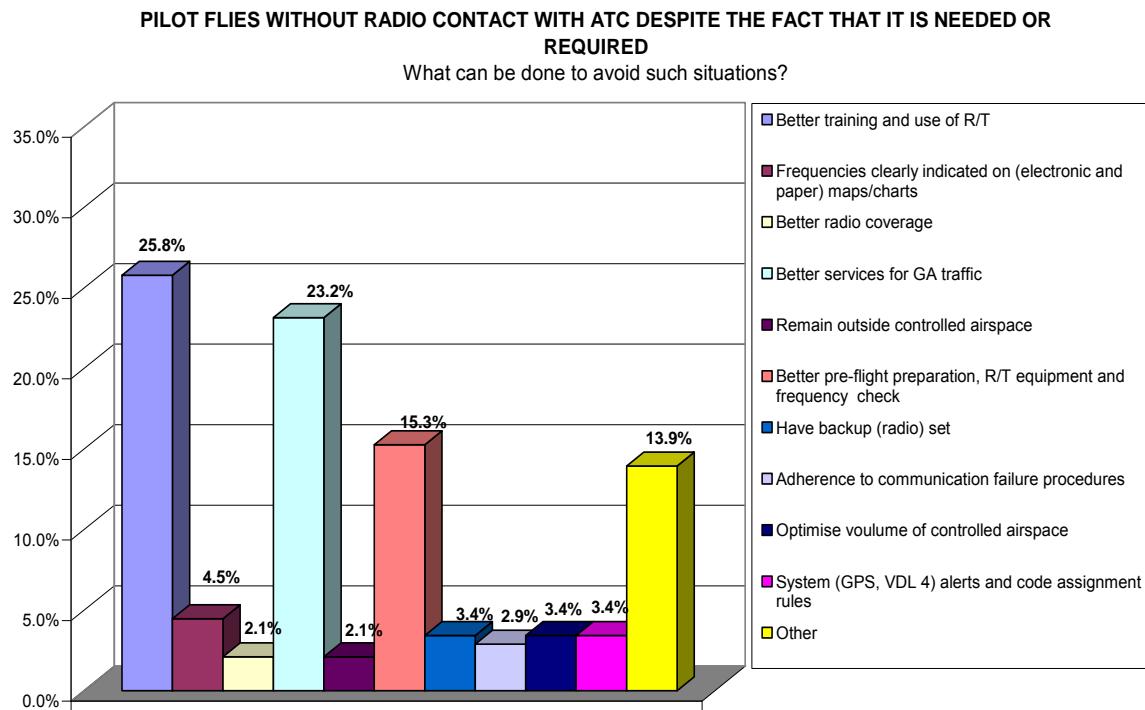
Figure 17

Three of the proposed preventive measures clearly stand out (see Figure 17), namely improved communication skills training for pilots, improved services for GA VFR traffic, and improved flight preparation, including radio equipment checks.

According to pilots, "improved services for GA VFR traffic" would include a change of attitude towards VFR traffic on the part of ATC, focused controller training on VFR services, FIS provided in the English language, dedicated FIC positions, improved ATS staffing, reduced ATCO workload, and provision of LARS.

The "Other" category includes a variety of suggestions ranging from use of data link to "do nothing", including a mandatory radio communication requirement for all VFR flights disregard of the airspace classification applied.

PILOT FLIES WITHOUT RADIO CONTACT WITH ATC DESPITE THE FACT IT IS NEEDED OR REQUIRED
How often might this lead to an airspace infringement?

Category	Percentage
Once every 5 times in a situation like this	24.6%
Once every 10 times in a situation like this	19.6%
Once every 20 times in a situation like this	27.2%
Once every 21-50 times in a situation like this	2.8%
Once every 51-100 times in a situation like this	1.7%
Once in over 100 flights or rarely or once in a year	7.2%
Exceptionally or never	2.8%
Always, nearly every time	2.6%
Unable to answer - never happened to me	4.1%
Other	7.4%

Figure 18

More than 70% of the pilots consider the likelihood of committing an airspace infringement to be higher than 5×10^{-2} per case of failure to establish the required radio contact with ATC. It is important to note that a quarter of all pilots estimate this probability at 2×10^{-1} per situation.

3.2.3.2.2 *Misunderstanding ATC clearance or flight information*

PILOT MISUNDERSTANDS AN ATC CLEARANCE OR FLIGHT INFORMATION
How often could this happen to a GA pilot?

Category	Percentage
Once in 3 flights	8.0%
Once in 5 flights	17.5%
Once in 10 flights	45.4%
Once in 11-50 flights	8.4%
Once in 51-100 fligths	3.0%
Once in over 100 flights or rarely or once in a year	7.6%
Exceptionally or never	1.9%
Unable to answer - never happened to me	1.5%
Other	6.7%
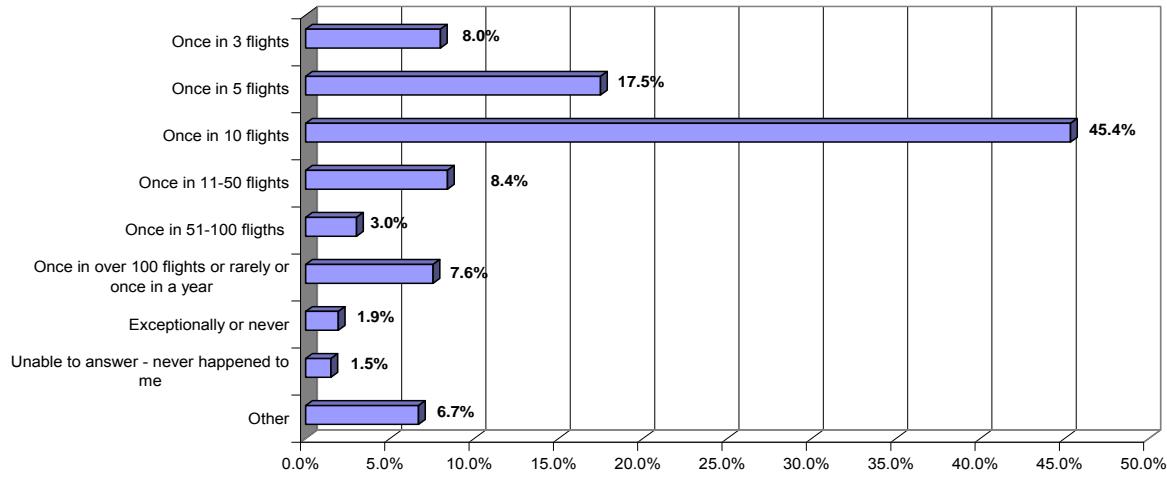
Figure 19

In the opinion of the majority of pilots (70.9%), the likelihood of misunderstanding the ATC clearance or flight information transmitted is greater than 10^{-1} per flight. This number appears quite high and could be considered as further evidence of the need to improve VFR pilots' communication skills. The significance of the problem is confirmed by the fact that 1/3 of the pilots reported being in such situation at least once in the course of the previous 12 months (see Figure 20 below).

PILOT MISUNDERSTANDS AN ATC CLEARANCE OR FLIGHT INFORMATION
Have you been in such a situation in the last 12 months?

No
66.17%

Once
18.39%

More than once
15.43%
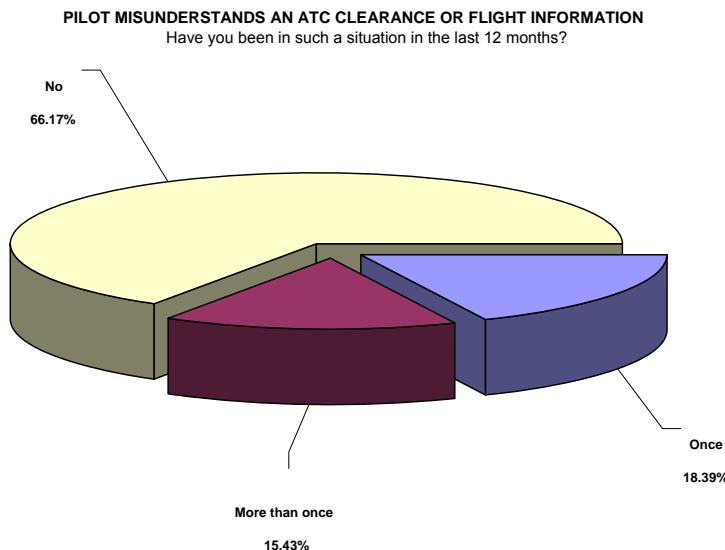
Figure 20

PILOT MISUNDERSTANDS AN ATC CLEARANCE OR FLIGHT INFORMATION
How often might this lead to an airspace infringement?

Once every 5 times in a situation like this	24.5%
Once every 10 times in a situation like this	24.0%
Once every 20 times in a situation like this	33.8%
Once every 21-50 times in a situation like this	1.7%
Once every 51-100 times in a situation like this	0.9%
Once in over 100 flights or rarely or once in a year	6.8%
Exceptionally or never	1.1%
Unable to answer - never happened to me	2.8%
Other	4.4%
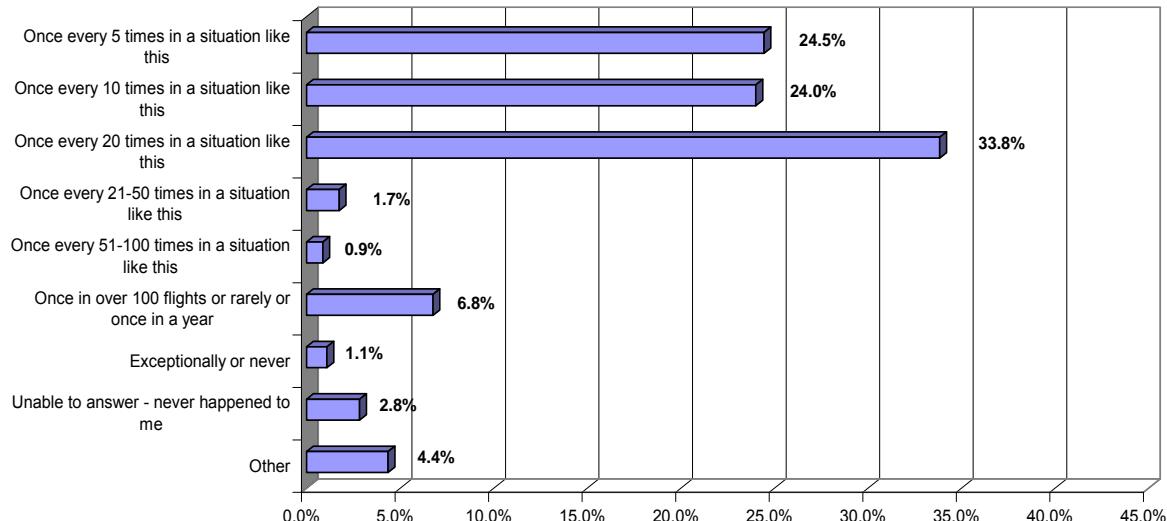
Figure 21

A large majority of pilots (more than 82%) consider the likelihood of committing an airspace infringement higher than 5×10^{-2} per case of misunderstanding the ATC clearance. It is important to note that half the pilots estimate this probability to be higher than 2×10^{-1} per situation (Figure 21).

PILOT MISUNDERSTANDS AN ATC CLEARANCE OR FLIGHT INFORMATION
What could be the explanation? (more than one choice possible)
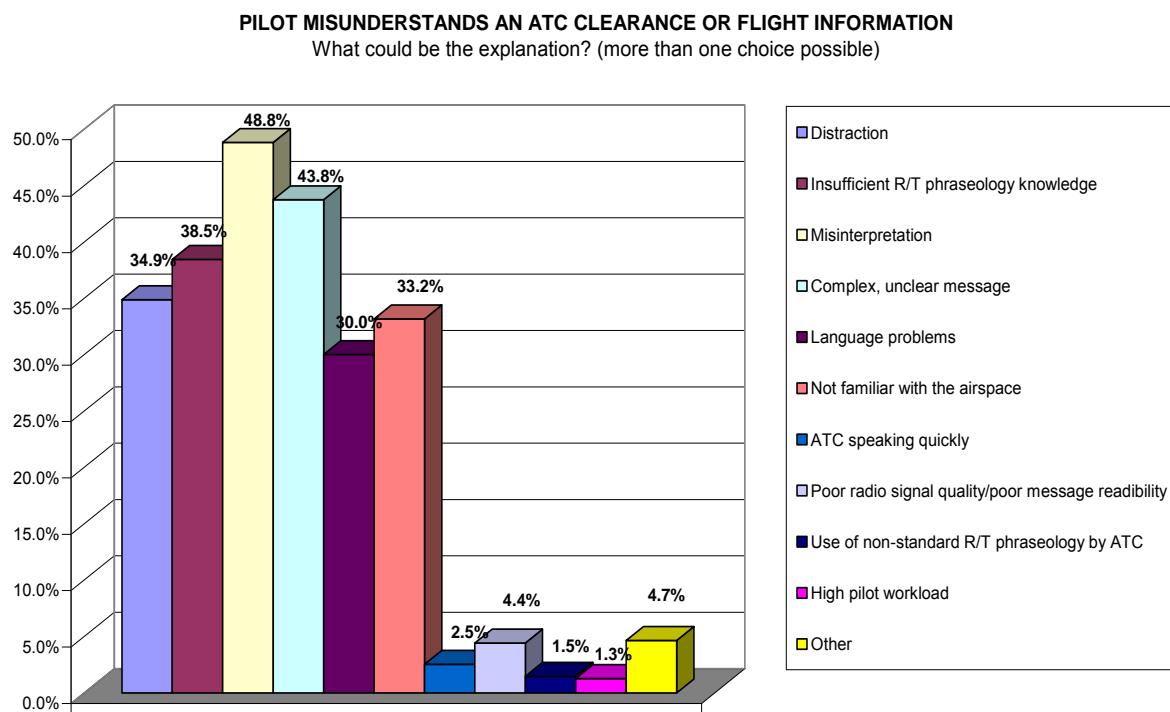
Figure 22

There are several factors of similar weighting that can cause clearance misunderstandings (see Figure 22). The use of a foreign language appears to be a problem that deserves special attention, as does that of insufficient pilot R/T skills.

The ATC contribution, in the form of unclear (often as a result of speaking quickly) and complex messages was ranked second. Human-factor-related problems - distraction and misinterpretation - make the identification of effective mitigation measures a complex task.

Figure 23 presents a summary of the measures which in the pilots' opinion can help reduce the occurrence of dangerous situations caused by misunderstanding of ATC clearances or the information transmitted. The emphasis is clearly placed on improving controllers' and pilots' R/T communication skills and discipline. Pilots should be taught and trained to request confirmation/repetition of information in the event of any doubt about the correct reading. Readback and hearback procedures should be followed strictly. The inclusion of R/T exchange in flight proficiency checks was also proposed.

Simplified R/T phraseology and better meeting of VFR flight needs by the ATS service are considered to be further alternatives worth exploring. Slower, more concise transmissions by ATC staff, if necessary broken into small segments, and advance warnings to pilots about instructions to be passed are suggestions for improvement that deserve due consideration.

Controllers should take into account cockpit workload and recognise the lower level of training and experience of PPL pilots compared with CPL-holders when issuing clearances and demanding strict and prompt execution of instructions.

PILOT MISUNDERSTANDS AN ATC CLEARANCE OR FLIGHT INFORMATION
What can be done to avoid such situations?
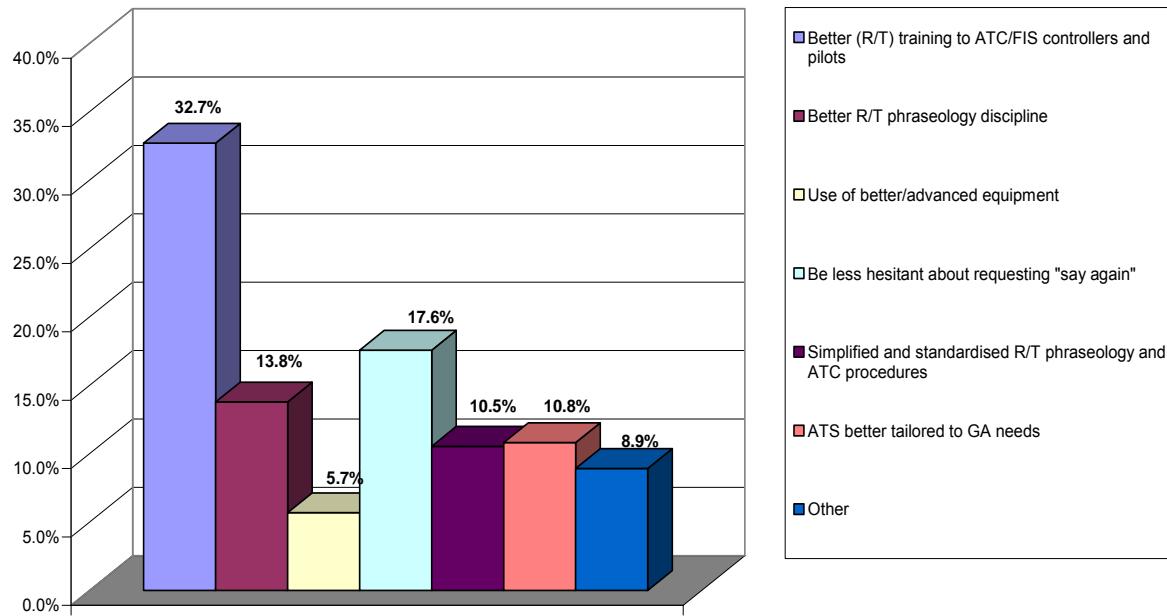
Figure 23

3.2.3.2.3   Pilot takes clearance issued to another aircraft

PILOT TAKES AND FOLLOWS A CLEARANCE MEANT FOR ANOTHER AIRCRAFT
How often could this happen to a GA pilot?
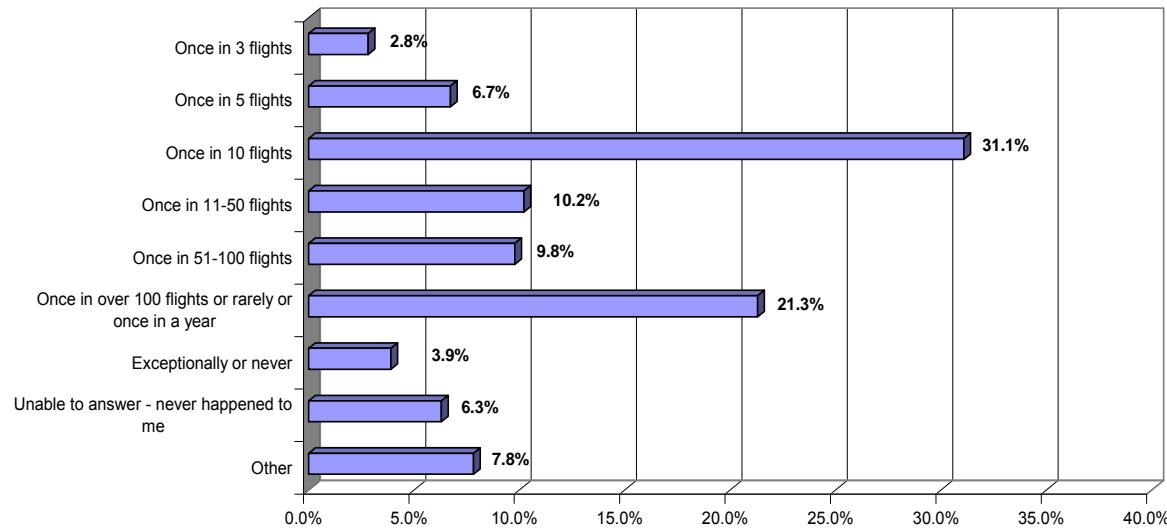
Figure 24

Unlike the previous more generic situation of miscommunication, pilots' subjective

estimates of the likelihood of taking an ATC clearance meant for another aircraft are diverse (see Figure 24). About a quarter consider it to be lower than 10^{-2} per flight. Another 20% of pilots put it in the range 10^{-1} to 10^{-2} per flight. And about 40% believe the likelihood to be higher than 10^{-1} per flight. However, the distribution based on reported actual experience and presented below (Figure 25) indicates a relatively low rate of occurrence of such situations. The suggested lower likelihood of occurrence thus appears to be closer to the operational reality.

PILOT TAKES AND FOLLOWS A CLEARANCE MEANT FOR ANOTHER AIRCRAFT
Have you been in such a situation in the last 12 months?
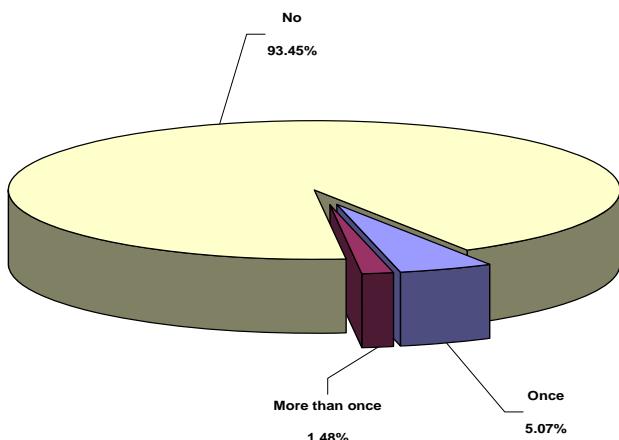
Figure 25

The distribution of pilots' subjective estimates of the likelihood of committing an airspace infringement by implementing a clearance meant for another flight is highly consistent with the distribution derived for the more generic case of "misunderstanding an ATC clearance" presented above. Nearly 70% of pilots consider the likelihood to be higher than 5×10^{-2} per situation.

PILOT TAKES AND FOLLOWS A CLEARANCE MEANT FOR ANOTHER AIRCRAFT
What could be the explanation? (more than one choice possible)
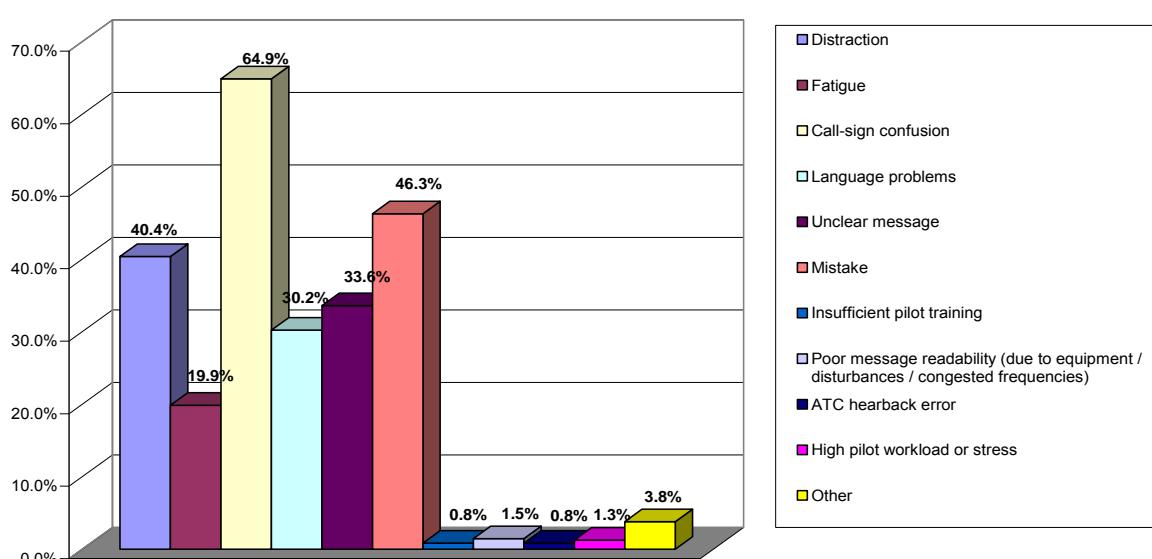
Figure 26

The list of most often cited causal factors is clearly dominated by those belonging to the human factors category: distraction, fatigue, honest mistake and use of a foreign language. A lower-level analysis has to be carried out in order to establish which contributory factors will enable correct mitigation and prevention measures to be identified. Some of the most common explanations which can be derived from the pilots' responses are inexperience, language problems and loss of concentration.

A well-known risk factor, namely "call-sign confusion" has earned the "highest score" (see Figure 26). This problem is well known and has been widely analysed and discussed within the scope of the Air Ground Communications Safety Initiative. Solutions have been developed and should be reviewed for applicability to GA operations.

As in the previous case (misunderstanding an ATC clearance or flight information), pilots suggest reducing the risk by implementing measures aimed at improving pilot and controller R/T communications skills and discipline. Such measures should include (but not be limited to) recurrent training, more active practicing of R/T exchange, and improvement of language skills. Pilots should be trained to write down clearances. Again, particular emphasis is placed on the need to follow the readback/hearback procedures correctly. Controllers speaking more slowly and simpler ATC clearances should not be dropped from the potential list of solutions (see Figure 27).

The "Other" Category contains a lot of useful practical measures deserving appropriate consideration: controllers to repeat message if unusual; use of simple VFR routes and procedures close to airports; mandatory communication above 500 feet AGL; other pilots on frequency to advise if they notice a wrongly taken clearance.

PILOT TAKES AND FOLLOWS A CLEARANCE MEANT FOR ANOTHER AIRCRAFT
What can be done to avoid such situations?

Legend:
- Better R/T training for pilots and controllers
- Readback/hearback clearances with callsign (readback to be confirmed by ATC)
- Use of unambigous callsigns (full callsign, callsign coupled with aircraft type)
- Use clear and standard R/T phraseology / speak more slowly
- Ask controller to confirm clearance if in doubt
- ATC should issue simpler clearances and procedures
- Reduce sector R/T load/use datalink
- More alertness on part of pilots
- Other

Values: 15.1%, 29.9%, 9.3%, 8.6%, 8.3%, 2.8%, 4.3%, 7.7%, 13.9%

Figure 27

3.2.3.3 Aircraft control issue

**PILOT IS UNABLE TO FOLLOW THE INTENDED FLIGHT PATH OWING TO AIRCRAFT CONTROL
PROBLEM**
(vertical or lateral plane)
How often could this happen to a GA pilot?
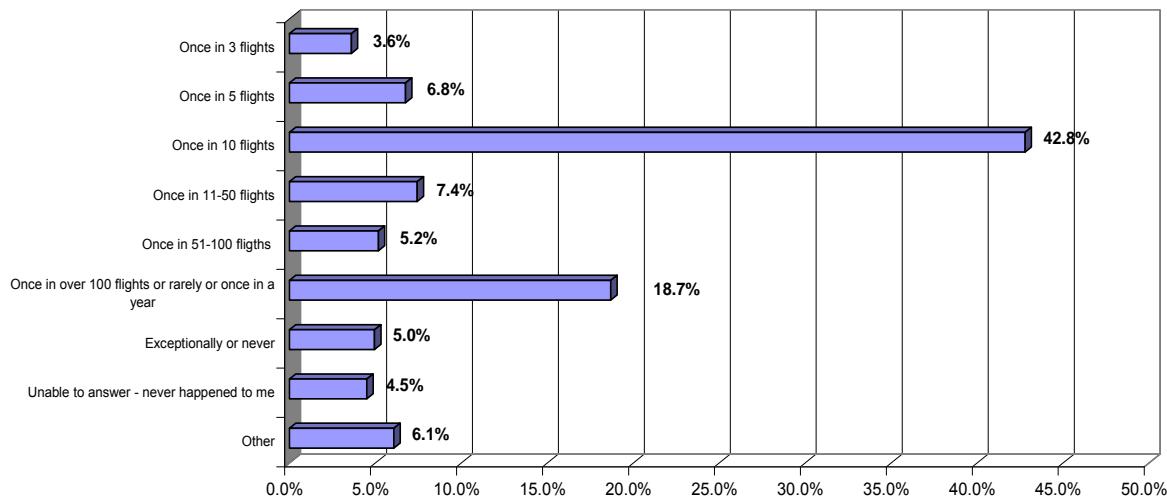
Figure 28

More than half the pilots (53.2%) estimate the likelihood of being unable to follow the intended flight path because of aircraft control problems greater than 10^{-1} per flight. A significant number of pilots (more than a third), however, consider it to be an order lower – closer to 10^{-2} per flight (Figure 28).

The subjective estimates are backed up by the relatively high proportion of pilots (26.8%) who report having been exposed to such a situation in the previous 12 months (Figure 29).

PILOT IS UNABLE TO FOLLOW THE INTENDED FLIGHT PATH OWING TO AIRCRAFT CONTROL PROBLEM
(vertical or lateral plane)
Have you been in such a situation in the last 12 months?
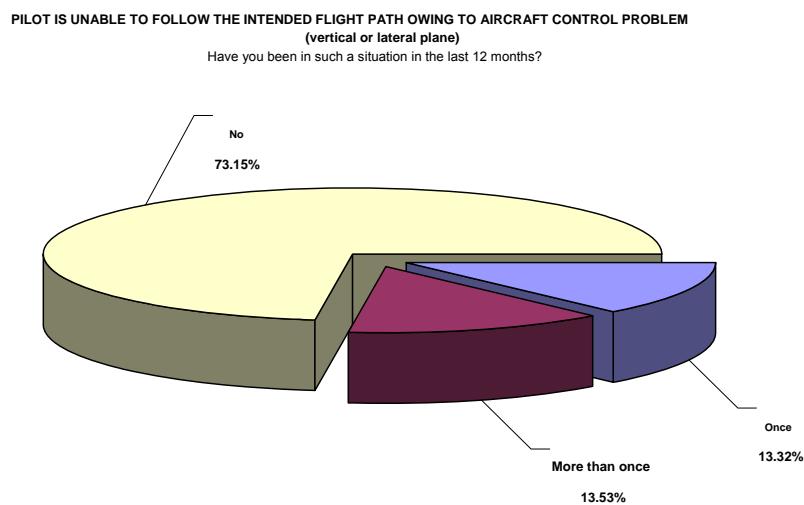
Figure 29

The distribution presented in the next graph shows that more than two-thirds of the pilots (71.7%) consider the likelihood of committing an airspace infringement to be greater than 5×10^{-2} in situations where they are unable to follow the intended flight path owing to aircraft control problems (Figure 30). About 10% of pilots believe it is to be an order higher (2×10^{-1}), and a similar number (9.2%) an order lower - lesser than 10^{-2} per situation.

PILOT IS UNABLE TO FOLLOW THE INTENDED FLIGHT PATH OWING TO AIRCRAFT CONTROL PROBLEM
(vertical or lateral plane)
How often might this lead to an airspace infringement?
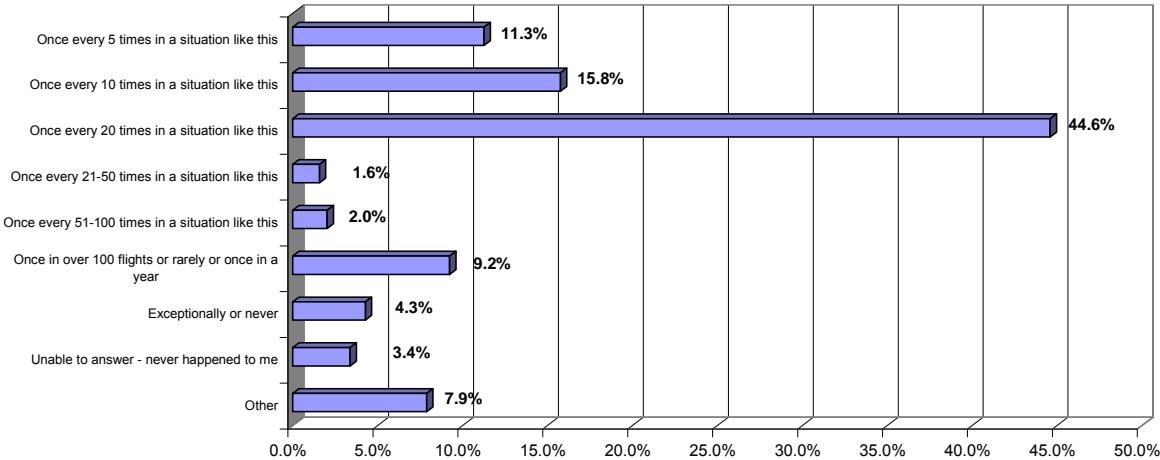
**Figure 30**

PILOT IS UNABLE TO FOLLOW THE INTENDED FLIGHT PATH OWING TO AIRCRAFT CONTROL PROBLEM (vertical or lateral plane)
What could be the explanation? (more than one choice possible)
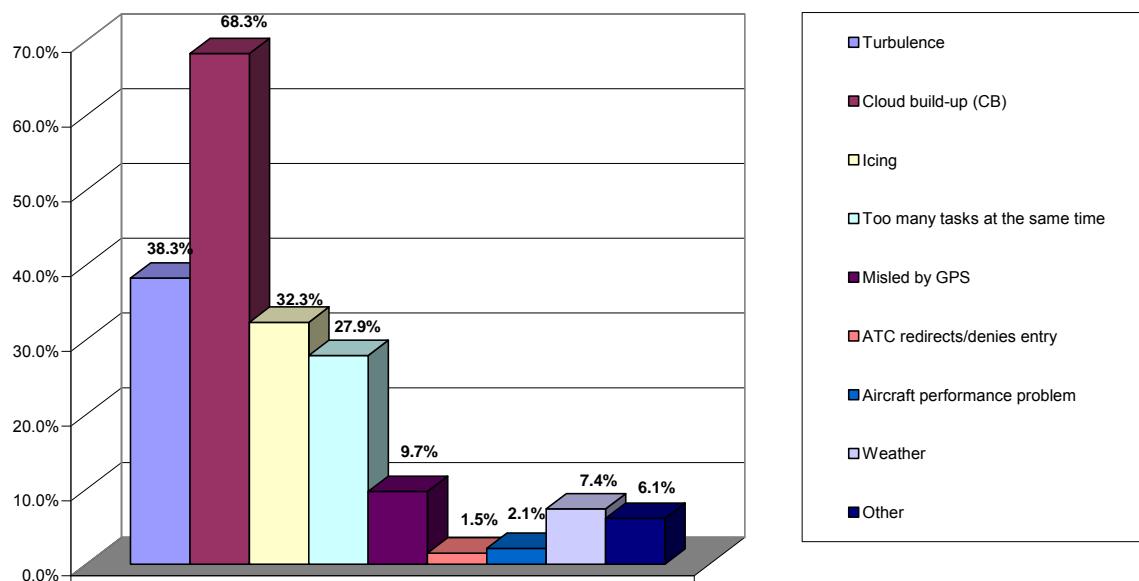

Figure 31

The vast majority of the explanations of the reasons for ineffective flight path control are associated with weather phenomena – turbulence, cloud build-up, icing, strong crosswind, poor visibility, unexpected weather change, manoeuvring to remain in VMC (see Figure 31). Pilot workload is also considered to be an important contributor, in particular in bad weather conditions. The GPS contribution (misleading the pilot) appears to be relatively low at about 10%

PILOT IS UNABLE TO FOLLOW THE INTENDED FLIGHT PATH OWING TO AIRCRAFT CONTROL PROBLEM (vertical or lateral plane)
What can be done to avoid such situations?

- Better training for pilots and controllers
- Better pre-flight preparation (weather)
- Advise ATC/obtain new clearance
- Nothinig much/nothing at all
- ATS better tailored to GA needs
- Remain outside controlled airspace
- Use of better/advanced equipment
- Redesign airspace
- Other

Figure 32

Simple solutions to the problem have been suggested (see Figure 32), such as that the pilot should request and obtain a revised clearance from ATC and improve his/her flight preparation by checking the actual weather and forecast for an extended flight corridor to cater for deviations where necessary. Also, better pilot and controller training should aim at improving controller knowledge of light aircraft performance and pilot qualifications via an affordable IFR rating for GA pilots. However, improving training and pre-flight preparation appears to be a challenging objective.

3.2.3.4 ATS/FIS-related issues

3.2.3.4.1 ATC clearance/flight information cannot be obtained

About 62% of the pilots estimate the likelihood of being unable to obtain the required flight information or ATC clearance to be greater than 10^{-1} per flight. Nearly 20% of the pilots' opinions can be grouped around a probability figure which is an order lower – close to 10^{-2} per flight (see Figure 33).

It can be assumed with some confidence that the likelihood is greater than 10^{-2} per flight, given the relatively high percentage of pilots (33.4%) who report being unable to obtain the required clearance or flight information at least once in the previous 12 months (see Figure 34).

PILOT CANNOT OBTAIN THE REQUIRED FLIGHT INFORMATION OR ATC CLEARANCE
How often could this happen to a GA pilot?
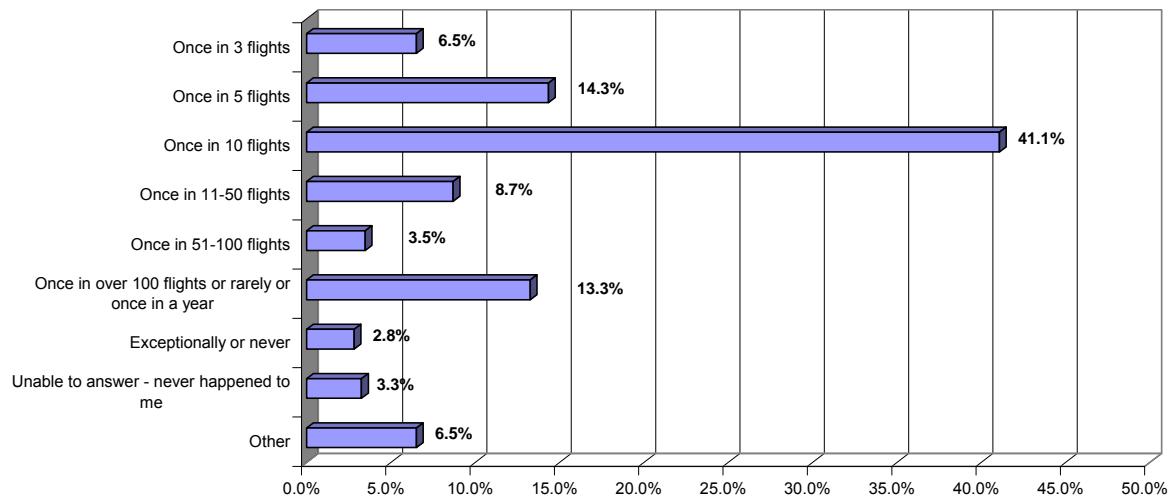
Figure 33

PILOT CANNOT OBTAIN THE REQUIRED FLIGHT INFORMATION OR ATC CLEARANCE
Have you been in such a situation in the last 12 months?
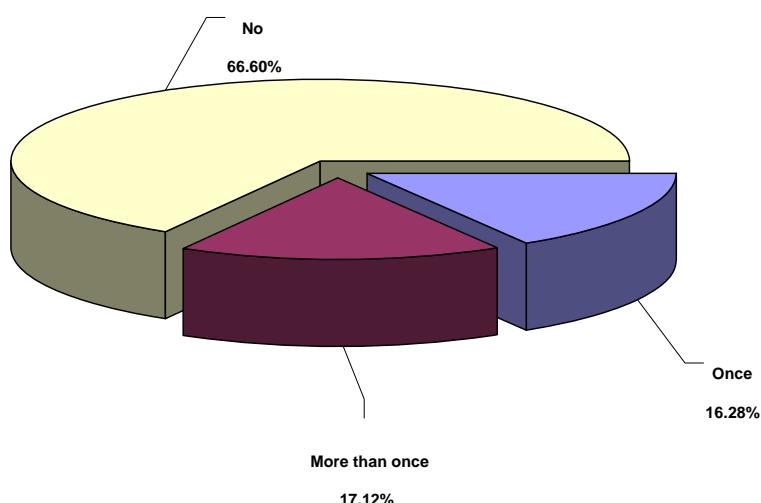
Figure 34

PILOT CANNOT OBTAIN THE REQUIRED FLIGHT INFORMATION OR ATC CLEARANCE
How often might this lead to an airspace infringement?
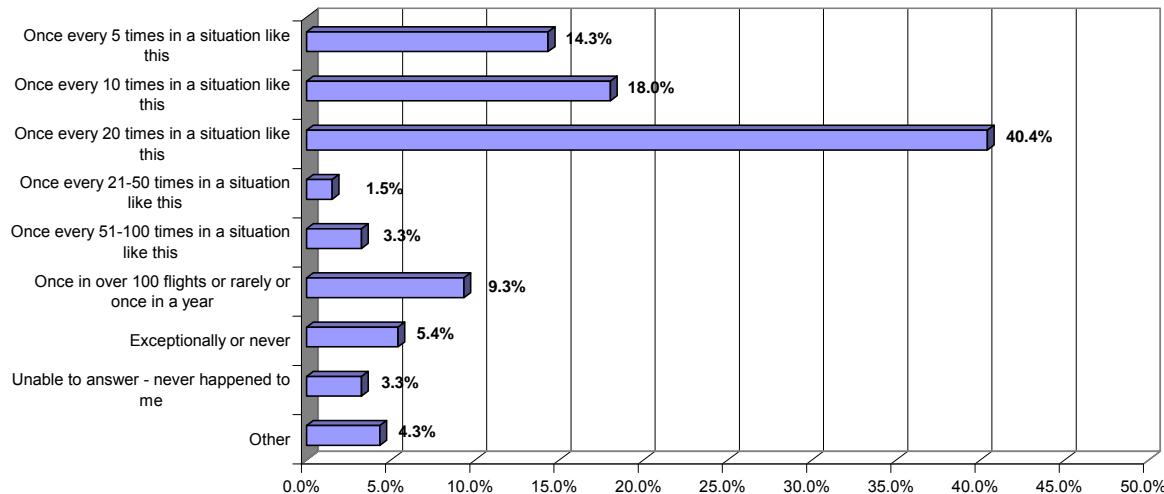
Figure 35

The majority of pilots (72.7%) consider the likelihood of committing an airspace infringement to be greater than 5×10^{-2} if they are unable to obtain the required ATC clearance or flight information. Nearly a third of pilots believe the likelihood to be even greater than 10^{-1} per case of this kind (Figure 35).

PILOT CANNOT OBTAIN THE REQUIRED FLIGHT INFORMATION OR ATC CLEARANCE
What could be the explanation? (more than one choice possible)
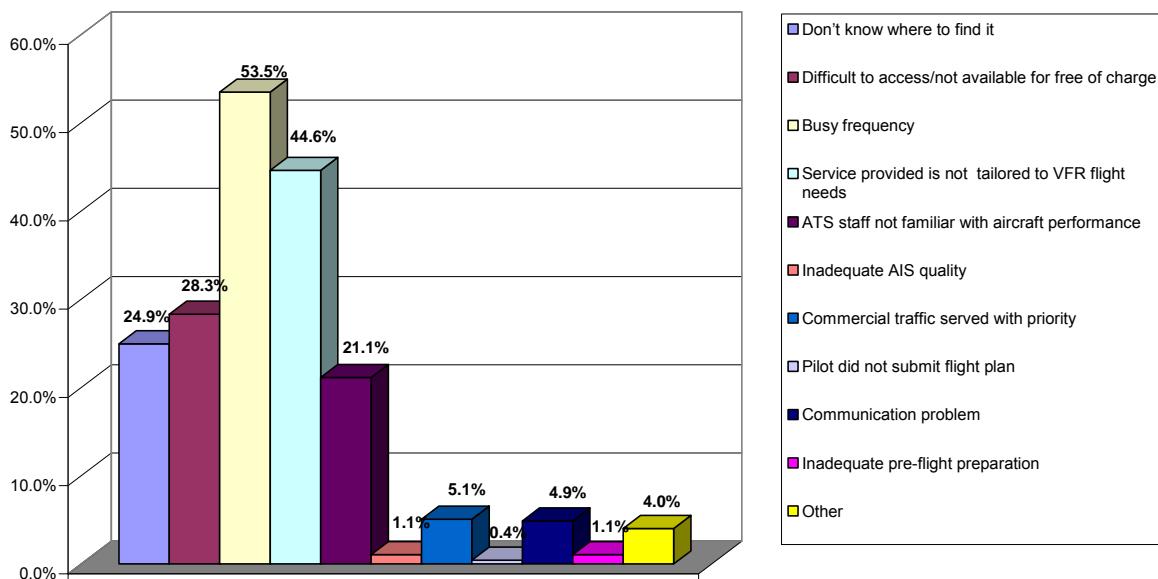
Figure 36

"Busy ATC frequency" appears to be the most common reason for a pilot being unable to obtain the required ATC clearance. Pilots perceive the service provided by ATS staff as

being often inconsistent with GA-specific needs and consider controllers to be rather unfamiliar with GA aircraft performance characteristics. Availability and accessibility of aeronautical and meteorological information and timely delivery of such information by ATS/FIS staff are also cited as a major causal factor (see Figure 36). High ATC workload and under-resourced FIS have been pointed to as major contributors. Poor radio coverage, radio failure, inadequate (wrong) settings and low-level flight (out of radio coverage) are the communication problems which occur most often.

According to pilots, pertinent risk reduction measures should target improving the ATC service for GA VFR flights (including enhanced tools for ATC, reduced controller workload, and more frequencies for ATS/FIS in busy areas) and the accessibility of aeronautical information (including free in-flight access, use of graphical information, improved and harmonised briefing facilities, a single phone number for AI in Europe, and a single portal for AI). Decreasing controller workload and thus facilitating the air-ground communication exchange is considered to be as important as measures aimed at improving pilots' pre-flight preparation (Figure 37). Practical suggestions such as printing radar frequencies on VFR charts and predefined VFR entry/crossing procedures and corridors in CAS were made under the "Other" category.

PILOT CANNOT OBTAIN THE REQUIRED FLIGHT INFORMATION OR ATC CLEARANCE
What can be done to avoid such situations?
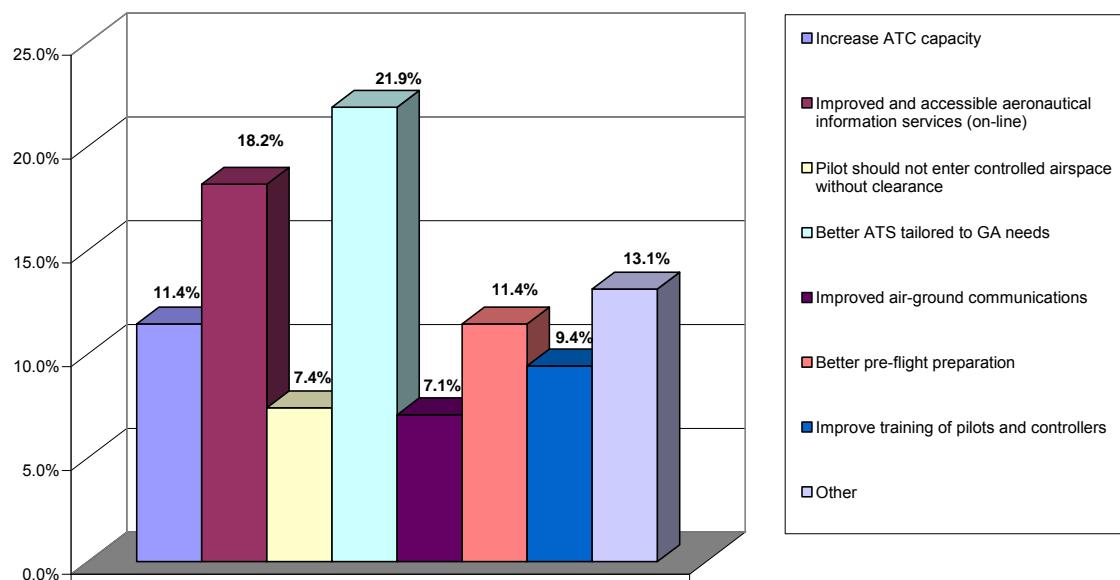
Figure 37

### 3.2.3.4.2   *Non-compliance with ATC clearance limits*

More than half the pilots (56.5%) consider the likelihood of being unable to comply with ATC clearance limits to be greater than 10^{-1} per flight. Another 20% consider it to be lower than 10^{-2} per flight or marginal (see Figure 38).

About 20% of pilots reported having been unable to comply with the conditions of the issued ATC clearance during the previous 12 months (see Figure 39).

No reasoned statement about the likelihood of occurrence of situations of this type could be made owing to the rather diverse opinions of the pilots.

PILOT IS UNABLE TO COMPLY WITH THE CONDITIONS (LIMITS) OF AN ATC CLEARANCE
How often could this happen to a GA pilot?
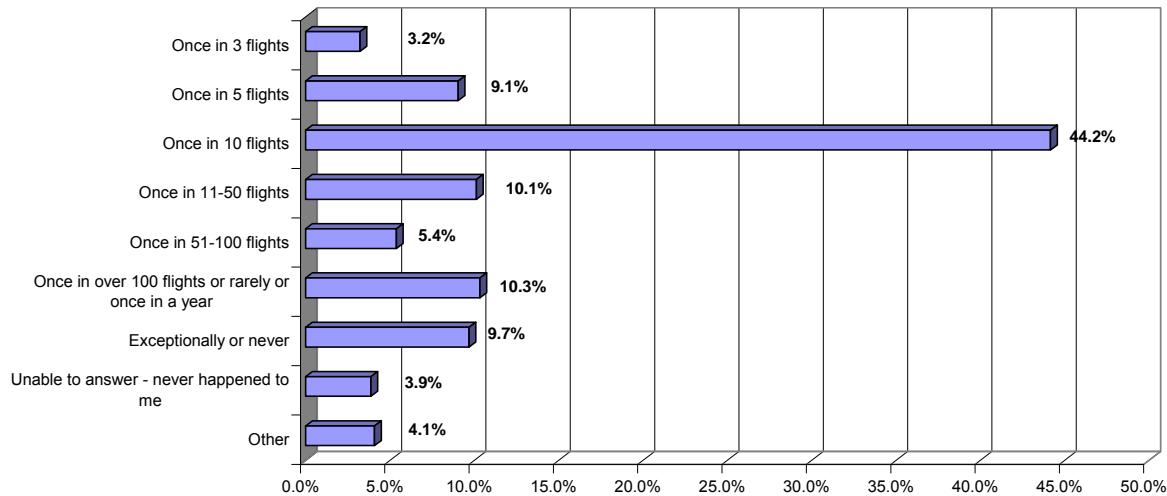
Figure 38

PILOT IS UNABLE TO COMPLY WITH THE CONDITIONS (LIMITS) OF AN ATC CLEARANCE
Have you been in such a situation in the last 12 months?
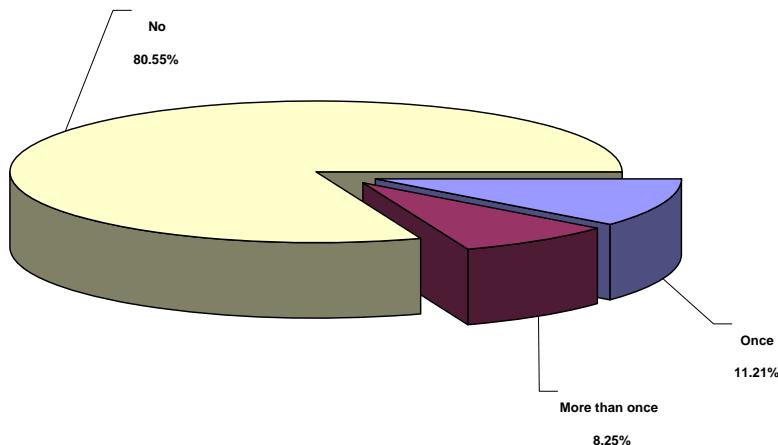
Figure 39

In contrast with the fairly even spread of subjective judgements about the likelihood of occurrence of the precursory situation, pilots' estimates of the likelihood of committing an airspace infringement where unable to comply with ATC clearance limits are grouped around the value 5×10^{-2}. About 25% of pilots believe the likelihood to be even greater than 10^{-1} per situation of this kind (see Figure 40).

PILOT IS UNABLE TO COMPLY WITH THE CONDITIONS (LIMITS) OF AN ATC CLEARANCE
How often might this lead to an airspace infringement?
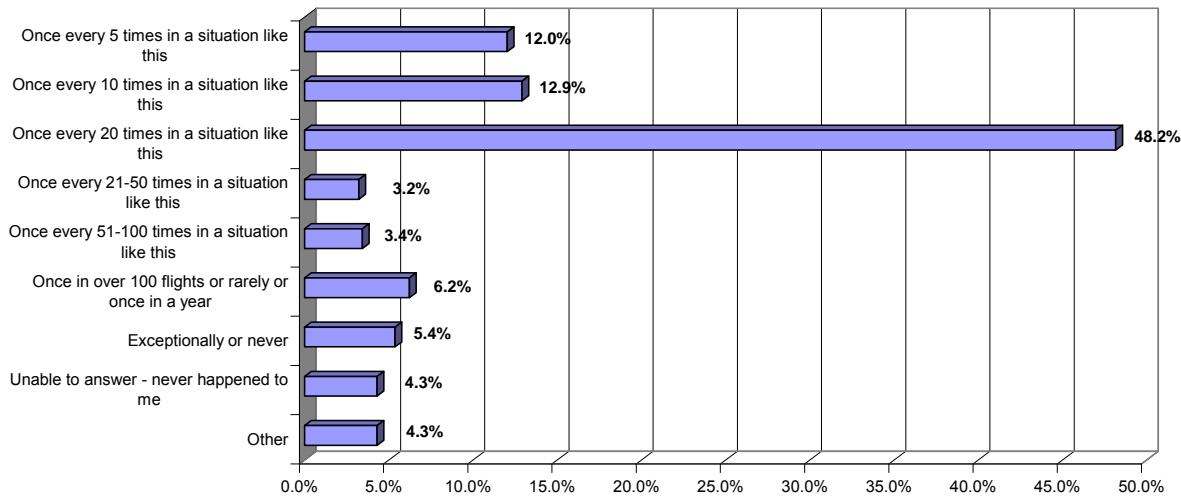
Figure 40

PILOT IS UNABLE TO COMPLY WITH THE CONDITIONS (LIMITS) OF AN ATC CLEARANCE
What could be the explanation? (more than one choice possible)
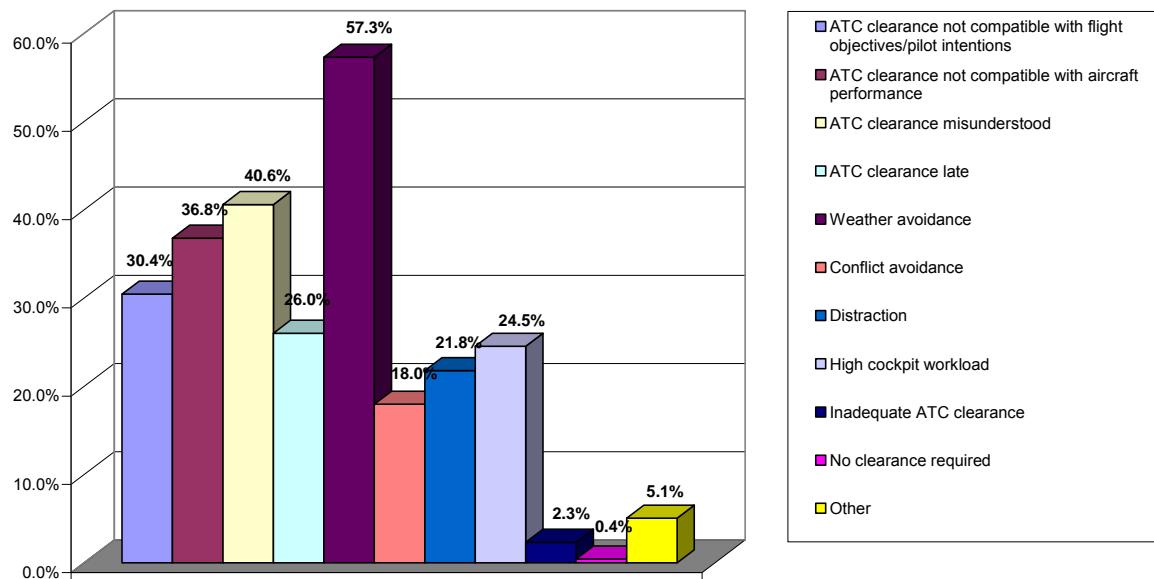
Figure 41

Various factors can prevent pilots from implementing an ATC clearance correctly (see Figure 41). The most common appears to be bad weather, for example turbulence. A major group of factors pointed to by pilots are related to the ATC clearance: it can be incompatible with the flight objectives or aircraft performance, misunderstood, or late. Human-performance-related factors such as distraction and a high workload are also perceived as having a relative high weighting.

PILOT IS UNABLE TO COMPLY WITH THE CONDITIONS (LIMITS) OF AN ATC CLEARANCE
What can be done to avoid such situations?
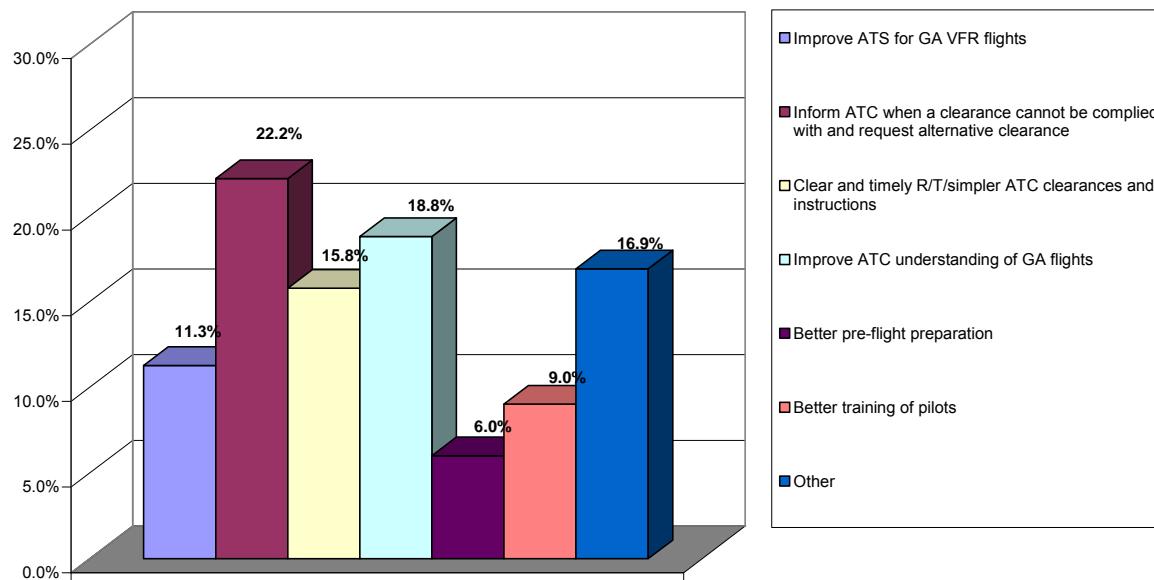
Figure 42

Several improvement areas have been devised: improved air-ground communication – pilots to inform ATC in good time of any inability to follow the clearance, and controllers to issue simple and clear instructions; improved understanding of GA flights by ATS/FIS staff coupled with enhanced services for VFR flights; improved pilot training and pre-flight preparation (better weather briefing; alternate route planning).

The "Other" category includes a variety of "low-scoring'" suggestions, such as simplification of airspace, increased pilot awareness, strict compliance with rules, use of GPS, etc.

3.2.3.4.3 *Entry into controlled or restricted airspace without clearance*

The majority of pilots (73.8%) estimate the likelihood of penetrating controlled or restricted airspace without prior permission from ATC to be in the range 10^{-1} to 10^{-2} per flight. Nearly half the pilots (49.1%) consider the likelihood to be 10^{-1} per flight or greater. More than 20% of pilots estimate the likelihood to be lower than 10^{-2} per flight (see Figure 43 below).

PILOT ENTERS CONTROLLED OR RESTRICTED AIRSPACE WITHOUT ASKING FOR AND OBTAINING CLEARANCE FROM ATC OR THE MILITARY
How often could this happen to a GA pilot?

Category	Percentage
Once in 3 flights	3.6%
Once in 5 flights	9.0%
Once in 10 flights	36.5%
Once in 11-50 flights	13.7%
Once in 51-100 fligths	8.8%
Once in over 100 flights or rarely or once in a year	14.8%
Exceptionally or never	5.6%
Unable to answer/never happened to me	1.7%
Other	6.2%
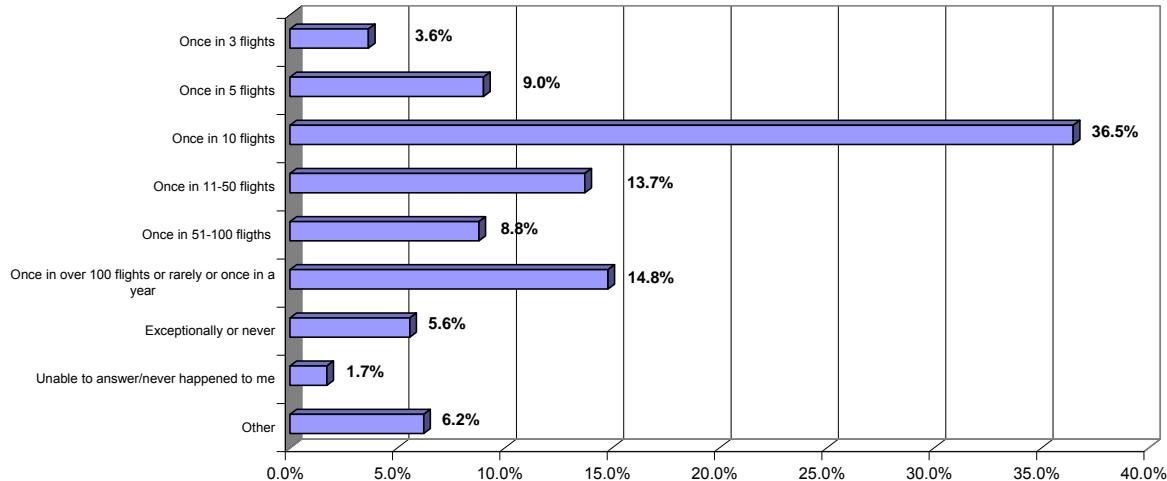
Figure 43

PILOT ENTERS CONTROLLED OR RESTRICTED AIRSPACE WITHOUT ASKING FOR AND OBTAINING CLEARANCE FROM ATC OR THE MILITARY
What could be the explanation? (more than one choice possible)

Legend:
- Avoiding bad weather
- Pilot unaware of the need to obtain clearance
- Communication skills not sufficient
- Frequency not known
- Expected FIS controller to arrange it
- To fly the preferred route (which ATC would not normally clear)
- Distraction
- Workload
- Emergency situation on board
- Navigational error/Unfamiliar airspace
- Unable to contact ATC (busy controller, frequency closed, outside ops hours)
- Poor pre-flight planning
- Poor training/pilot skills/knowledge and airmanship
- Controlled airspace proximity and availability of airspace for GA
- Complexity (airspace/procedures)
- Lack of information/unawareness
- Other

Values: 40.0%, 59.6%, 23.0%, 20.1%, 28.8%, 10.3%, 32.3%, 24.1%, 16.5%, 5.1%, 1.3%, 3.6%, 1.5%, 1.5%, 1.1%, 3.8%

Figure 44

A number of causal factors were considered quite likely to lead to airspace infringements. Pilots' being unaware of the need to obtain a clearance clearly stands out. Several other factors can also help explain the problem, such as insufficient pre-flight preparation, lack of information about the actual status of restricted zones and

areas, and pilot unfamiliarity with airspace. The other important factors cited by pilots can be grouped into a few main categories: bad weather, inadequate communication skills, FIS not meeting pilot's expectations, high workload and distraction (see Figure 44).

PILOT ENTERS CONTROLLED OR RESTRICTED AIRSPACE WITHOUT ASKING FOR AND OBTAINING CLEARANCE FROM ATC OR THE MILITARY
What can be done to avoid such situations?
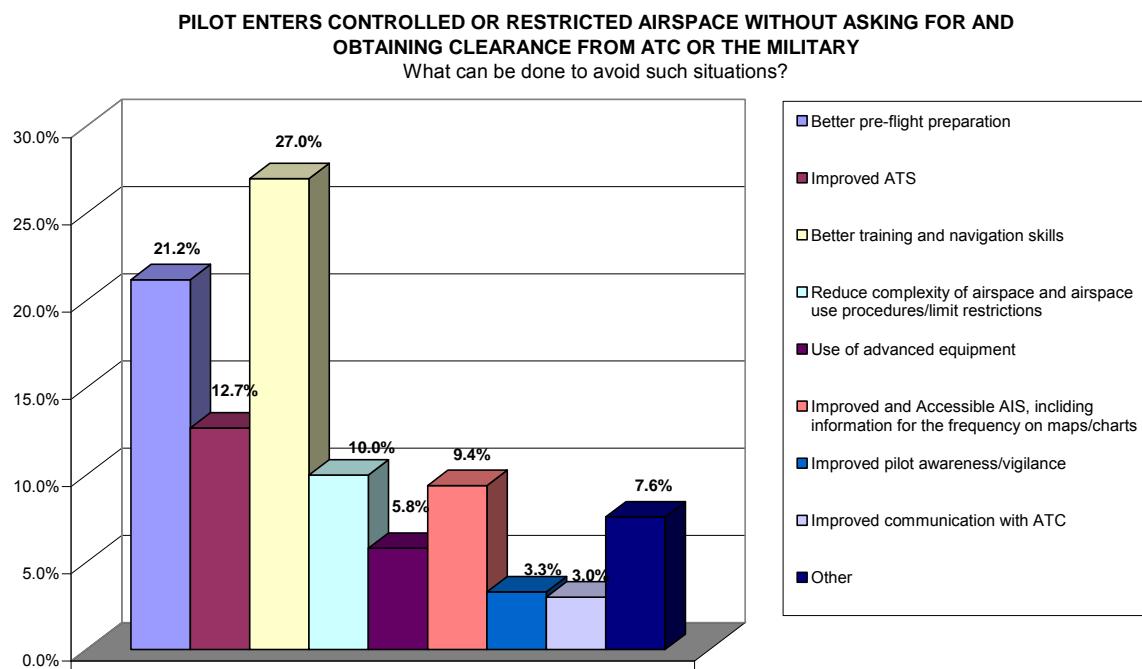
Figure 45

Pilots' answers to the above question acknowledge the need for a balanced set of measures to be implemented at system level to reduce the airspace infringement risk. The major improvement areas were defined as pilot navigation and communication skills training, flight preparation and the associated accessibility and quality of AIS, enhanced ATS and FIS for GA VFR flights, and less complex airspace design and management.

3.2.3.5 Conscious violation of procedures

Three cases were defined to aid the collection and analysis of information relating to the scenario in which the pilot is aware that he is going to enter or is already flying inside controlled or restricted airspace without prior authorisation by ATC:

- airspace infringement due to bad weather or a communication problem;

- infringement of a prohibited zone due to navigation failure;

- "shortcut" through restricted airspace.

The questions were designed to establish the pilots' attitude towards the risk in question and what level of regulatory intervention would be considered justified and fair by the pilot community.

Analysis of the responses to the set of dedicated questions showed a high degree of consistency between the answers related to the three different cases defined above. We therefore consider it reasonable to present only the consolidated results for the

three cases.

A FLIGHT ENTERS A PROHIBITED ZONE WITHOUT CLEARANCE OWING TO NAVIGATION FAILURE
(E.G. USE OF OUT-OF-DATE MAP/CHART)
How serious do you consider such as infringement behaviour to be?

Legend:
- 1 - Not at all serious
- 2
- 3
- 4
- 5 - Very serious
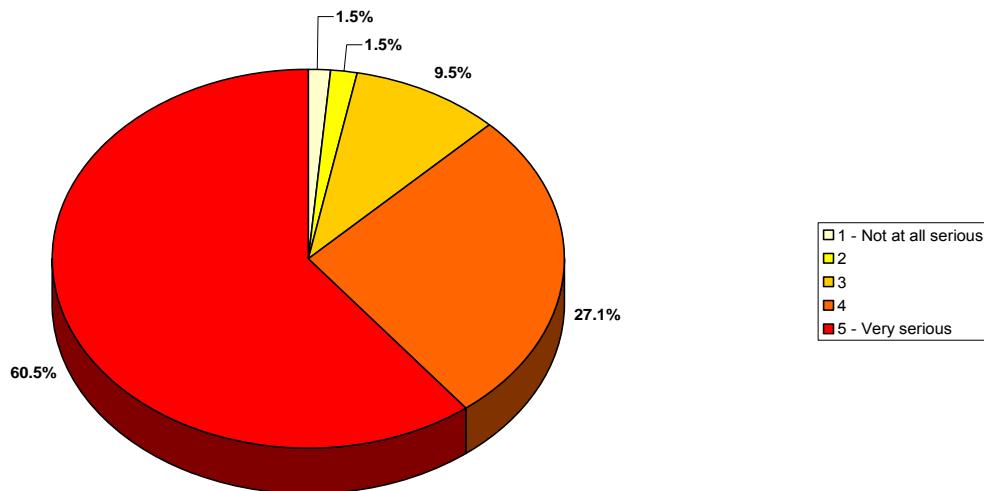
Figure 46

Despite the "well-founded" reasons for committing an airspace infringement, the overwhelming majority of pilots consider it a "serious" violation of established norms and principles (serious includes "4" and "5"). The percentage of pilots who consider the violation serious varies between 77.6% and 87.6% in the three cases.

A FLIGHT ENTERS A PROHIBITED ZONE WITHOUT CLEARANCE OWING TO NAVIGATION FAILURE
(E.G. USE OF OUT-OF-DATE MAP/CHART)
Is this considered to be a violation of existing rules in your country?

Legend:
- 1 - Definitively no
- 2
- 3
- 4
- 5 - Definitively yes
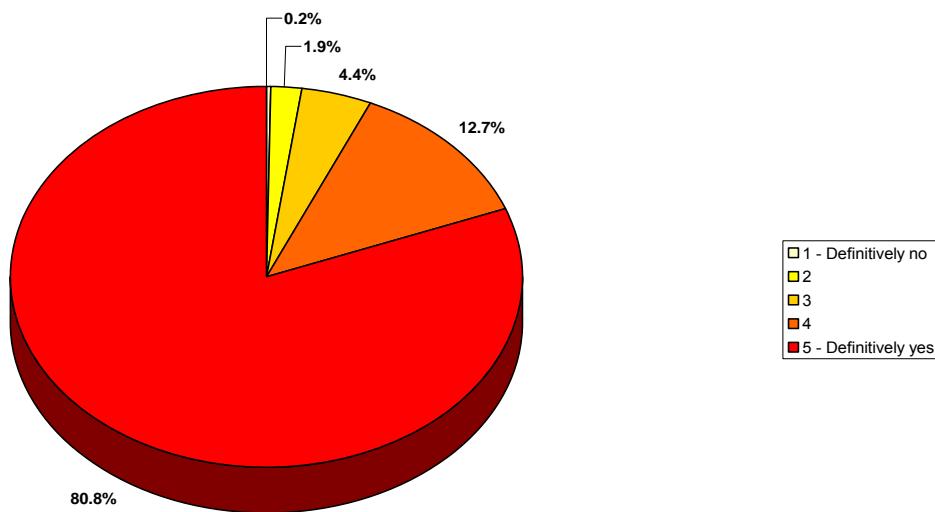
Figure 47

The pilots almost unanimously agree that an airspace infringement is considered to

be a violation of existing rules irrespective of the reasons for it. The percentage of pilots who chose answers "4" or "5" varied marginally in the three cases, 91.7%, 93.5% and 91.6% respectively.

There are several regulatory actions considered pertinent by pilots in the case of conscious infringement of controlled or restricted airspace.

Most popular appears to be the competence check. It scores highest in all three cases (see Figure 48).

A review and change of procedures is the suggestion with the second highest scoring with nearly 17% on average.

An investigation of each infringement case by the regulator and establishment of corrective action appears to meet with rather limited support from pilots, at just over 8% on average.

The idea of the regulator taking administrative action (imposing a fine, warning or reprimand, or punishing the "infringer") is not entirely rejected. Imposing a fine is considered acceptable by 11.5% of the pilots on average for the three situations. It is important to note that the acceptance rate "rises" to 28% in the case of "shortcuts" through restricted airspace. The average support for other forms of administrative action is about 4%.

The distribution of pilot opinions on the regulatory measures which should be taken in one of the discussed cases of conscious violation of procedures is provided below for the purpose of illustration.

A FLIGHT ENTERS CONTROLLED AIRSPACE WITHOUT CLEARANCE OWING TO BAD WEATHER AND/OR LOW QUALITY OF COMMUNICATION LINK WITH ATC

Do you think that the regulator should take any measures in such a case?
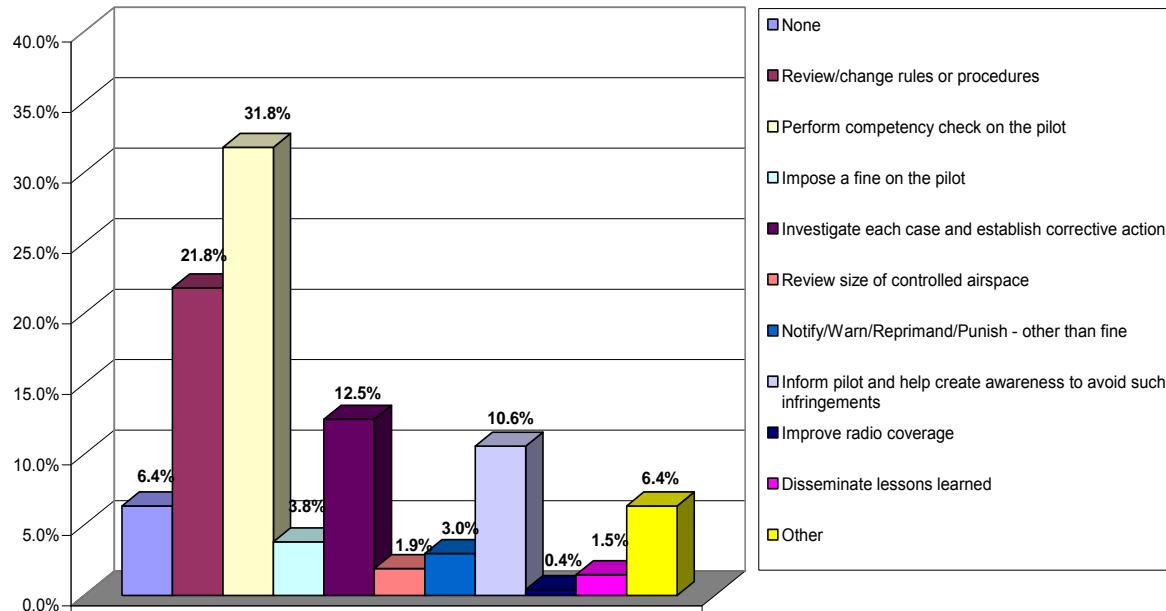
Figure 48

4. ANALYSIS OF RESULTS

This section aims to facilitate a correct understanding of the data collected in the course of the survey and to establish important dependencies and correlations between scenarios, situations and causal and contributory factors.

4.1 Statistical analysis

4.1.1 Dependency between pilot qualification and estimated probability of occurrence of airspace infringements

To aid the analysis, respondents were divided into 5 groups according to their level of qualification: student pilots, PPL, PPL with IFR rating, CPL and other.

The estimated probabilities of occurrence of the precursory situations (designed on the basis of the airspace infringement causal model) and the probabilities of these precursory situations leading to airspace infringements have been calculated using the subjective pilot judgements provided in response to the dedicated questions.

The chi-square value[4] for each question and each level of qualification has been calculated to compare the airspace infringement probability estimates made by pilots belonging to the five qualification groups. The chi-square method is a goodness-of-fit test which compares the observed and expected frequencies in each category. In social sciences, the standard of significance of this test is when the probability of error is not greater than $p = 0.05$. Up to $p = 0.08$ it is still possible to comment tentatively on certain trends.

No significant differences have been identified in the estimation of the probabilities of occurrence of the defined precursory situations by the established pilot qualification groups, except for the three situations discussed below.

The analysis of the results showed that that there was significant association between pilot qualifications and the reported actual equipment failure rate (chi square = 16.40, df = 4) The differences are significant at probability of error level $p = 0.05$. The results show that CPL-holders come in first place in terms of experiencing navigation equipment failure, followed by pilots possessing a PPL with an IFR rating, followed by PPL-holders and student pilots. Of course, when interpreting this result, flying experience should be taken into consideration, since student pilots have the fewest flight hours.

A significant difference was also obtained with regard to the perceived probability that airspace infringements might occur owing to a misunderstanding of an ATC clearance (chi square = 46.74, df = 32) The difference is significant at a probability of error of $p = 0.05$. The data shows that the greatest difference in the estimates is between the least experienced and the most experienced pilots. Thus student pilots tend to overestimate the suggested probabilities of occurrence. For example, 23% of student pilots expect airspace infringements due to misunderstandings to occur once in every 21-50 flights. By contrast only 1.2% of CPL holders estimate that infringements due to misunderstandings to occur once in 21-50 flights.

A tendency towards differentiation in the perceived probability of occurrence could be

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[4] There are basically two types of random variables and they yield two types of data: numerical and categorical. The chi-square statistic compares the tallies or counts of categorical responses between two (or more) independent groups. The chi-square method is used owing to the mixture of qualitative and quantitative answers to a particular question in the survey.

established for the situation "Pilot flies without radio contact with ATC despite the fact it is needed or required" (chi square = 43.64, df = 32, probability of error p = 0.08). The distribution of answers showed that the less qualified the pilot is, the higher is his/her estimate of the probability of this situation occurring. Thus 22% of the student pilots estimate that this situation will occur once in 3 flights, whereas only 7% of the commercial pilots expect this frequency of occurrence.

4.1.2 Dependency between pilot flying experience and estimated probability of occurrence of airspace infringements

Cross-tables have been drawn up for the 8 pilot groups (differentiation according to total number of flight hours logged) and the sets of answers to the questions which required an estimate of the probability of occurrence of airspace infringements. The chi-square value has been calculated for the responses.

The chi-square values obtained were not significant for any set of pilot estimates with regard to a particular situation. *In other words, irrespective of their flying experience, pilots arrived at similar judgements as to the probability of occurrence of the various precursory situations, and, once these had occurred, the probability of their leading to airspace infringements.*

However, examination of the answers referring to pilots' past experience, namely whether they had experienced navigation equipment failure, revealed a significant difference, indicating that the reported navigation equipment failure rate is proportional to the number of flight hours (chi square = 48.72, df =7, p < 0.001).

The next step was to explore the dependence between pilots' logged flight hours in the previous 12 months and their estimates of the probability of precursory situations developing into airspace infringements. A chi-square test was again carried out to reveal the interdependence of the examined variables. Significant differences were obtained for 8 (of the 9 precursory situations defined). In all but one situation, pilots who had logged fewer flight hours in the previous 12 months estimated a greater probability of the precursory situation leading to an airspace infringement than pilots who had logged more flight hours in the previous year. The only difference is regarding the reported rate of navigation equipment failure, which confirmed the validity of the conclusion drawn above that the reported navigation equipment failure rate is proportional to the pilots' number of flight hours.

Also, the analysis of the answers relating to the situation "Pilot enters controlled or restricted airspace without asking and obtaining clearance from ATC or the military" revealed that pilots with fewer than 50 flight hours (in the previous 12 months) pointed more often to the following factors as reasons for infringement: misunderstanding of navigation charts, inability to contact ATC, equipment failure, misinterpretation of ATC clearance. By contrast, pilots with more than 100 flight hours refer more often to poor planning, use of outdated maps/charts and navigation error (chi square = 61.33, df = 44, p < 0.05).

4.1.3 Impact of pilots' personal experience of airspace infringement on the subjective probability estimates

The survey team considered it important to assess the relevance of the defined precursory situations and suggested list of causal factors. We have attempted to do this by measuring and comparing the estimates and suggestions made by those pilots who reported having made an airspace infringement and those who had not. The sample of respondents was therefore split in two between "infringers" and "non-

infringers". To compare their evaluations and probability estimates, airspace infringement/non-infringement was cross-tabulated against all answers to the questions from situations 1 to 9. The chi-square statistic for the cross-tables has been calculated.

The following significant distinctions were obtained:

Only 1.4% of the pilots who had never committed an infringement had been unsure of their aircraft position more than once in the previous 12 months, whereas 10.3% of the pilots who had committed an infringement had faced this situation more than once (chi square = 25.25, df = 2, p < 0.05).

Pilots who have experienced airspace infringements systematically apply a higher estimate to the importance of the mitigation measures which can prevent loss of contact with ATC. However, the following three mitigation measures scoring more than 20% are considered of high importance by both groups of pilots:

- better training and use of R/T;

- better services for GA traffic;

- better pre-flight preparation.

With regard to situations of flying without radio contact with ATC (where it is required) the biggest difference in the judgements of the two groups concerns the importance of better pre-flight preparation as a risk-reduction factor. Whereas 12% of the "infringers" considered it of high importance, 19,6% of the "non-infringers" were of this opinion (chi square = 26.47, df = 10, p < 0.05)

Another distinction between "infringers" and "non-infringers" relates to the number of times they failed to establish radio contact with ATC in the previous 12 months. Whereas 27,3% of "infringers" experienced such failure, the figure for non-infringers is 11.4%. Moreover, 8.3% of "infringers" experienced such failure more than once, as opposed to 5% of "non-infringers" (chi square = 19.88, df = 2, p < 0.05).

Misunderstanding an ATC clearance or flight information happened more than once to 18.6% of "infringers", as compared with 11.8% of "non-infringers" in the previous 12 months. The difference id not significant for the answer "This has happened only once" (19.4% vs. 17.3%) (chi square = 5.16, df = 2, p = 0.07).

Pilots from the two groups tend to differ in their estimate of the likelihood of a pilot's being unable to follow the intended flight path owing to an aircraft control problem. Overall, "infringers" expect this to happen more often than "non-infringers". For example, 8.7 % of "non-infringers" and 13.4% of "infringers" estimate that this situation may lead to an airspace infringement once every 5 times. A further 47.1% of "non-infringers" and 42.4% of "infringers" estimate that that such situation may lead to an airspace infringement once in 20 times (chi square = 13.74, df = 8, p = 0.09).

Another difference in the estimates worth noting concerns the reasons which could lead to an infringement of controlled or restricted airspace, and in particular the likelihood of an emergency situation causing an airspace infringement. Nearly 22% of pilots who have committed airspace infringements consider it likely, whereas only 12.0% of the other group ("non-infringers") are of the same opinion (chi square = 32.93, df = 17, p < 0.05).

The above results should be interpreted with caution. In order to draw reasoned

conclusions, exposure data are needed. Such data could not be obtained and is perhaps not yet available on the required scale.

4.1.4 Perceived probability of occurrence of precursory situations

The derived probabilities of occurrence of precursory situations, presented in section 3 of this report, are entirely based on pilots' subjective estimates. It is therefore recommended that these results be validated and refined with factual data before any further use is made in a quantitative risk analysis.

According to pilots' estimates, misunderstanding an ATC clearance or flight information is the most frequently occurring precursory situation – the probability is judged to be greater than 10^{-1} per flight (supported by 70.9 % of pilots' opinions).

Similarly, a majority of pilots (62%) estimate the probability of being unable to obtain the required flight information or ATC clearance at greater than 10^{-1} per flight.

Nearly the same percentage of pilots (60.4%) agrees on the same probability of occurrence (10^{-1} per flight) of loss of awareness of the exact position of the aircraft with regard to the airspace structures.

Other precursory situations with similar pilot estimates of probability of occurrence include pilot unable to comply with ATC clearance limits, failure to establish radio contact with ATC (though required), and pilot unable to follow the intended flight path owing to aircraft control problems. About half of the pilots' opinions indicate a probability of occurrence in the range of 10^{-1} per flight. However, a significant proportion of estimates (up to a third) point to a probability of 10^{-2} per flight. Consequently, a probability range of 10^{-2} to 10^{-1} appears likely.

The majority of pilots (73.8%) estimate the probability of being unable to obtain ATC clearance prior to entry into controlled or restricted airspace in the range of 10^{-1} to 10^{-2} per flight.

The pilots' subjective estimates of the probability of wrongly taking an ATC clearance meant for another aircraft vary. Nevertheless, the expected probability of occurrence of such situations can be estimated in the range of 10^{-2} per flight, taking account of reported actual experience of a relatively low rate of occurrence of such situations.

4.1.5 Perceived probability of precursory situations leading to airspace infringements

The probabilities of occurrence of airspace infringements presented below are entirely based on pilots' subjective estimates of the probability of occurrence of various precursory situations and of the situations' subsequently developing into airspace infringements. The values used reflect only the majority of pilot opinions. In view of the above, it is recommended that these results be validated and refined with factual data before any further use is made in quantitative risk analysis.

According to two-thirds of pilots, the probability of an airspace infringement due to loss of or reduced situational awareness appears to be between 10^{-2} and 2×10^{-3} per flight. The probability of an airspace infringement due to navigation equipment failure appears to be in the same range.

More than 70% of the pilots consider the probability of airspace infringement due to failure to establish the required radio contact with ATC to be greater than 10^{-3} per flight.

Similarly, more than two-thirds of the pilots (71.7%) consider the probability of an airspace infringement due to inability to follow the intended flight path (aircraft control problem) to be greater than 10^{-3} per flight.

More than 82% of the pilots estimate the probability of an airspace infringement due to a misunderstanding of an ATC clearance to be greater than 5×10^{-3} per flight. It is important to note that half the pilots estimate this probability to be greater than 2×10^{-2} per flight.

Nearly 70% of the pilots estimate the probability of an airspace infringement due to incorrect implementation of a clearance meant for another flight to be greater than $5 \times 10e(-4)$ per flight.

The majority of pilots (72.7%) consider the probability of an airspace infringement due to inability to obtain the required ATC clearance or flight information to be greater than 5×10^{-3} per flight. Nearly a third of pilots believe the likelihood to be even greater than 10^{-2} per flight.

Pilots' estimates of the probability of an airspace infringement in the event of inability to comply with ATC clearance limits appear to be grouped around the value of 10^{-3} per flight. About 25% of pilots believe the probability to be greater - reaching 10^{-2} per situation of this kind.

4.1.5.1 Perceived risk index

In a risk analysis, it is tempting to present the results in terms of the perceived risk as a single indicator. There are methodological difficulties in constructing a precise risk indicator using distributions of subjective opinions. However, it was considered possible to design a comparative index. The index is comparative in that **it can be used only to compare the perceived risk associated with the different precursory situations** (scenarios). The perceived risk index is constructed as a simple product of two elements:

- *perceived frequency* - the sum of the weighted perceived frequencies of the precursory situations, derived from the answers to the question "How often could this happen to a GA pilot?"
- *perceived criticality* - the sum of the weighted perceived conditional probabilities of precursory situations leading to airspace infringements, derived from the answers to the question "How often might it lead to an airspace infringement?"

As the order of magnitude of the addends in the sums is decreasing, it was considered that sufficient accuracy could be achieved using only the first 3 to 4 elements.

The results are presented in the table below:

Precursory situation	Perceived frequency per flight	Perceived criticality	Perceived risk index
Loss of awareness of exact position of aircraft	0.084	0.08368	7.02912×10^{-3}
Failure to establish radio	0.0789	0.08296	6.54554×10^{-3}

contact			
Misunderstanding ATC clearance or flight information	0.10874	0.09024	9.81269×10^{-3}
Pilot takes clearance issued to another aircraft	0.040323	0.07693	3.10204×10^{-3}
Aircraft control problem	0.06954	0.06102	4.24333×10^{-3}
ATC clearance/flight information cannot be obtained	0.093106	0.0671	6.24741×10^{-3}
Non-compliance with ATC clearance limits	0.07508	0.06164	4.62793×10^{-3}

The perceived risk indicator is a useful tool for comparing the results of the answers relating to the various situations. The argument for the feasibility of establishing the relative importance is based mainly on the fact that all the other conditions, biases and distortions in the answers are the same.

The perceived risk indicator is proportionate to the expectation of an airspace infringement per flight due to a given reason (precursory situation).

4.2 Analysis of reported actual airspace infringements

After collecting the pilots' general experience, knowledge and understanding of the airspace infringement risk, a direct question was asked to elicit specific data about airspace infringements actually committed.

HAVE YOU EVER MADE AN AIRSPACE INFRINGEMENT?

No
46.51%

Yes
53.49%
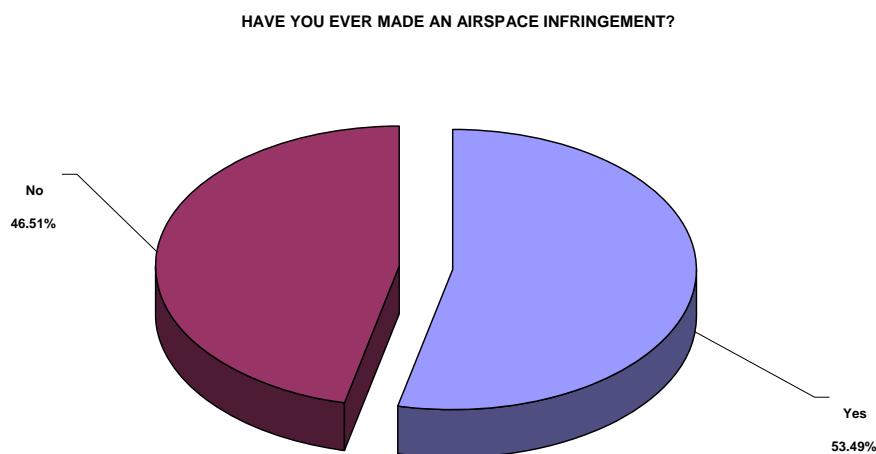
Figure 49

More than half the pilots responding to the questionnaire have committed airspace infringements (see Figure 49). The following graphs illustrating the analysis results

reflect the answers given by the subset of pilots (53.5%) who answered "yes" to the question "Have you ever made an airspace infringement".

HAVE YOU EVER MADE AN AIRSPACE INFRINGEMENT?
What was the nature of flight?
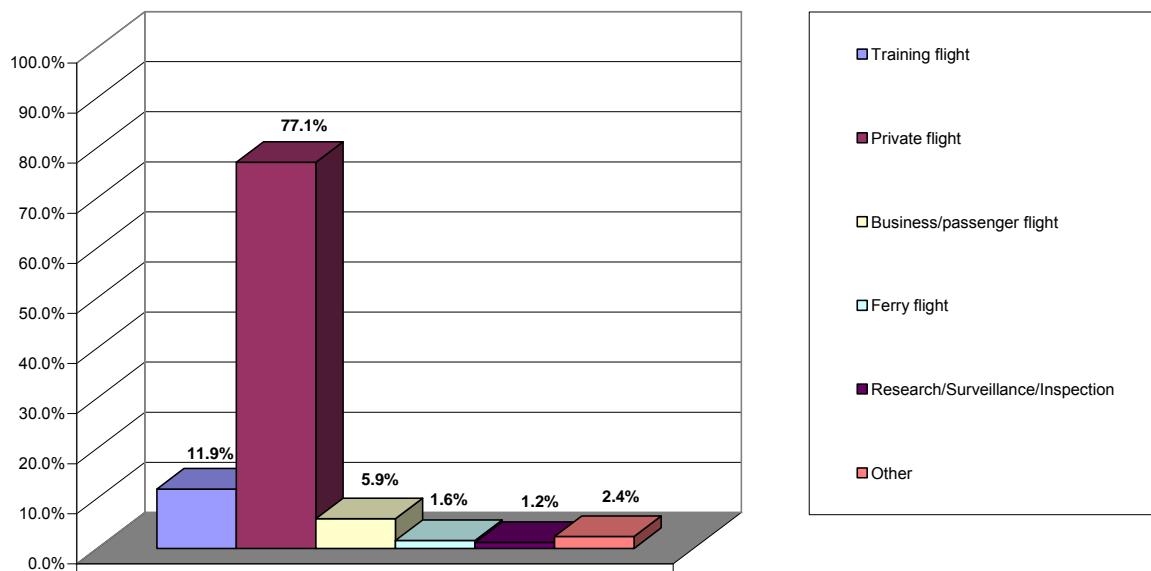
Figure 50

The above graph (Figure 50) substantiates the conclusion from the Safety analysis of airspace infringements in Europe [EUROCONTROL, 2007] that the majority of infringements (77.1%) are committed by recreational VFR flights.

HAVE YOU EVER MADE AN AIRSPACE INFRINGEMENT?
What method of navigation did you use?
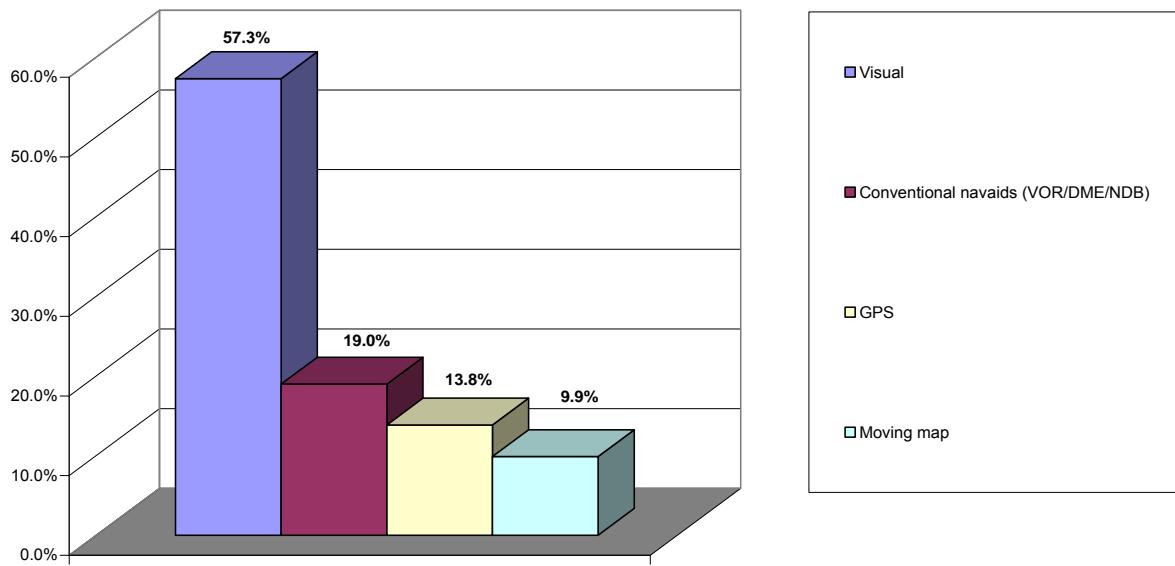
Figure 51

Owing to the unavailability of exposure data, it is impossible to make a reasoned comparative statement about the reliability of the navigation methods used. However, visual navigation appears to be the least reliable method with respect to correct navigation. More than the half of the airspace infringements were committed while using the visual navigation method. It was therefore considered pertinent to collect and analyse the pilots' subjective opinions about the reliability of the visual navigation method by asking dedicated questions.

DO YOU THINK THAT THE "SEE AND AVOID" CONCEPT CAN ENSURE THE SAFETY OF VFR FLIGHTS IN THE FUTURE?
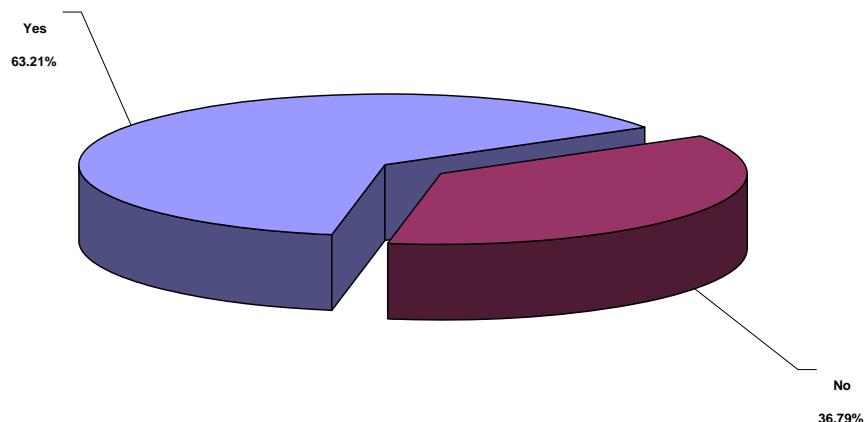
Figure 52

Nearly two-thirds of the pilots believe that visual navigation can safely be applied in the future (Figure 52). Those who answered "no" were asked to provide their arguments.

DO YOU THINK THAT THE "SEE AND AVOID" CONCEPT CAN ENSURE THE SAFETY OF VFR FLIGHTS IN THE FUTURE?
What is the explanation? (If no)
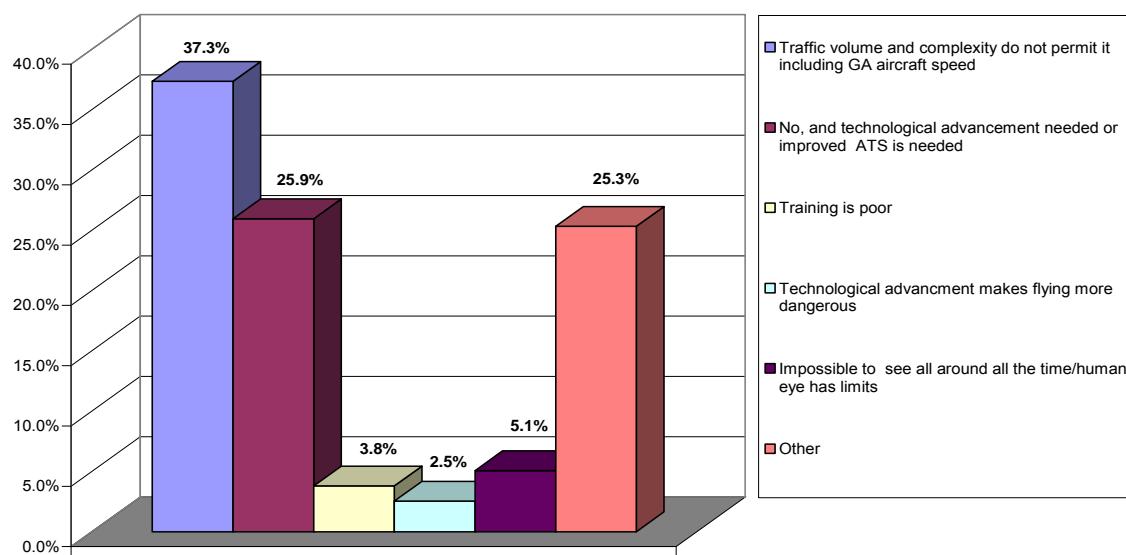
Figure 53

Several important factors cited by pilots may necessitate a review of the role of the visual navigation as a primary navigation method for GA private flights in the future

operational environment (see Figure 53):
- increasing traffic volume and airspace complexity;
- changed aircraft performances (e.g. higher speed, rate of change, etc.);
- availability of new technological solutions which will allow a substantial improvement of navigation capabilities and precision.

In order to obtain information about the safety-criticality of airspace infringements actually committed, pilots were asked to specify whether they had encountered another aircraft in close proximity (Figure 54).

HAVE YOU EVER MADE AN AIRSPACE INFRINGEMENT?
Did this lead to a conflict (close encounter) with another aircraft?

No
95.26%

Yes
4.74%
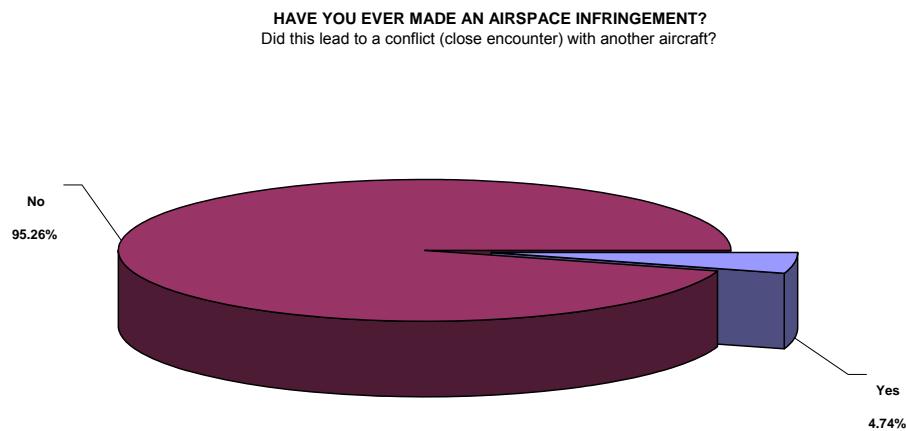
Figure 54

Only a very limited number of infringements (4.7%) involved close encounters with other aircraft. This finding is fully consistent with the results of the statistical analysis of airspace infringement occurrence reports provided by European States to EUROCONTROL. According to the EUROCONTROL Safety Regulation Commission, the percentage of airspace infringement incidents of serious and major severity was as high as 4.5% in 2006 [EUROCONTROL SRC Annual Safety Report 2006].

The next graph (see Figure 55) shows that the majority of reported (known) airspace infringements involve transponder-equipped aircraft. The conclusion is backed by the finding of two other studies into the airspace infringement problem. The Safety analysis of airspace infringements in Europe reports a percentage of cooperative aircraft equal to 53% of the analysed sample, whereas the "Airspace infringement analysis - case study Switzerland" [Skysupport, 2007] reports a higher percentage - 74%.

In view of the above, a reasoned assumption can be made that implementation of automated functions to assist controllers in identifying potential or actual infringements will improve the risk mitigation capability of the ATC system.

HAVE YOU EVER MADE AN AIRSPACE INFRINGEMENT?
Was your transponder switched on?
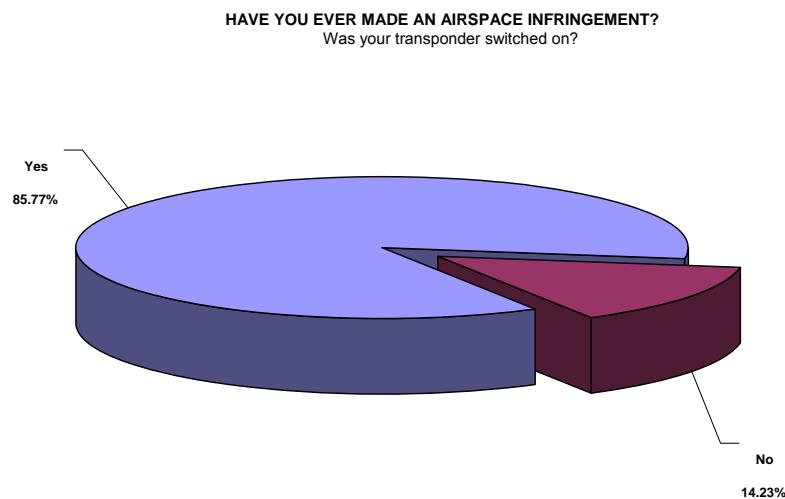
Figure 55

4.3 Comparative analysis

4.3.1 Causal factors

The approach to the survey and the data collection process ensured that it was possible to check the consistency of the answers regarding airspace infringement causal factors provided in the explanations of the various precursory situations with those relating to infringements actually committed by the pilots themselves.

HAVE YOU EVER MADE AN AIRSPACE INFRINGEMENT?
What is the explanation?
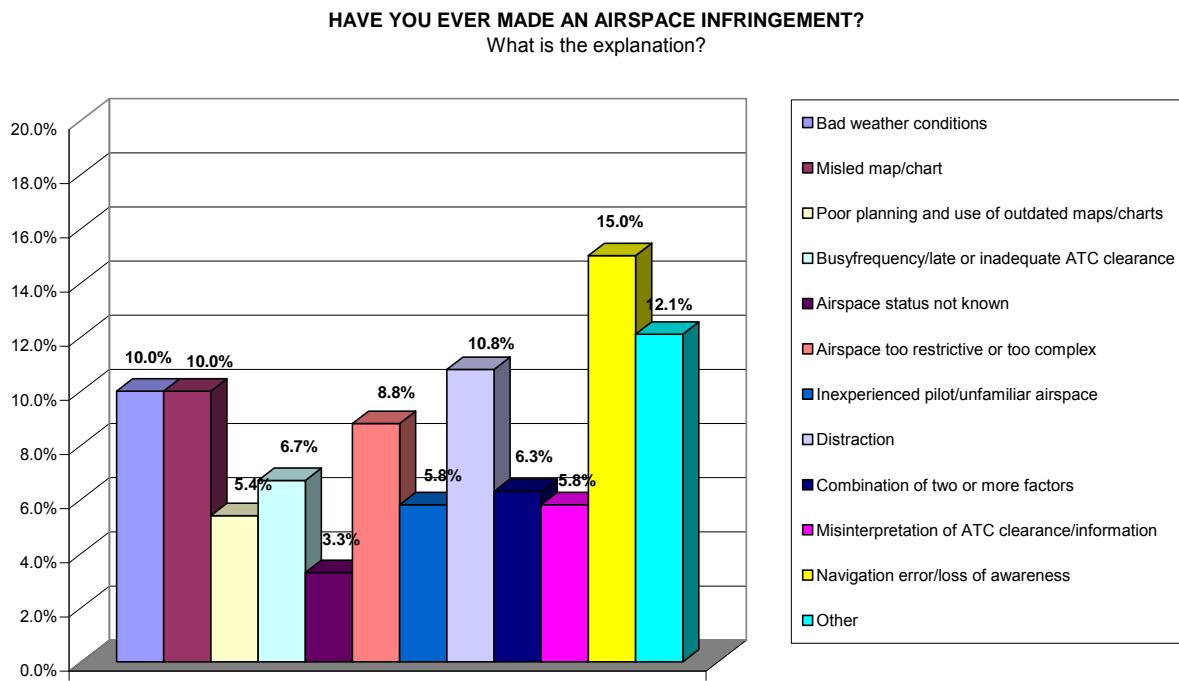
Figure 56

The above graph (Figure 56) shows small percentage differences between the various causal factors reported to have lead to the infringements committed. However, navigation failure (e.g. due to equipment failure or pilot loss of awareness) seems to be the most common causal factor. The "Other" category represents a relatively high percentage, but many of the explanations provided by the pilots which were classified in this category can be associated with high workload (14%), honest mistake (14%), and false expectations about the level of service provided (21%). The above distribution is further confirmation of the need to apply a mitigation strategy aimed at improving not only pilot skills but also ATS/FIS.

Correlation with answers to the question "Pilot enters controlled or restricted airspace without asking for and obtaining clearance from ATC or the military. What could be the explanation?"

In contrast with the more or less even causal-factor distribution presented in the above graph (Figure 56), the weight given to "Pilot not aware of the need to obtain a clearance" is substantially higher than that given to other factors (see Figure 44). However, a closer look at this high-scoring cause reveals that it is linked to loss of awareness of the surrounding airspace configuration, insufficient pre-flight preparation, lack of information about the actual status of restricted zones and areas, and incorrect map-reading, i.e. it is consistent with the causal factors presented in Figure 56. A broader interpretation of "Pilot not aware of the need to obtain a clearance" may also be a possible explanation for the substantial differences in the calculated weight of factors such as navigation error, airspace complexity and poor flight preparation. There is a high level of consistency of other high-scoring causal factors, such as bad weather, inadequate communication, distraction and high workload, and false expectations on the part of pilots.

Correlation with consolidated explanations of the precursory situations

The causal factors indicated by pilots as the most common reasons for the occurrence of the precursory situations have been reviewed and ranked in descending order as presented below, on the basis of the number of times a causal factor appears in the list of high-scoring causal factors relevant to those situations.

1. Communication failure (insufficient skills, equipment failure or frequency problem)
2. ATS/FIS provided failed to meet VFR flights' needs (incl. false expectations on the part of pilots)
3. Bad weather
4. Insufficient pre-flight preparation
5. Pilot unaware of or unfamiliar with airspace
6. Distraction
7. Complex, unclear message or use of non standard R/T by ATS/FIS
8. High pilot workload
9. Insufficient training
10. Navigation failure

A considerable difference can be observed in the weight assigned to communication-failure-related factors. Whereas communication failure is the most frequently cited factor for the occurrence of the precursory situation, only 5% of the reported infringements appear to have communication failure as the direct cause.

Another major difference was noted with regard to the calculated ranking of navigation failure (10). A possible explanation could be that the majority of the pilots considered "navigation failure" to be rather too generic and provided their explanation at a lower (contributory) level, e.g. loss of airspace awareness, false expectations about the service provided, which are in the list of top 5 factors.

Bad weather, distraction, insufficient pre-flight preparation and airspace problems are factors which were consistently assigned a high weighting.

Correlation with the findings of the focus groups meetings
Comparison of the most common causal factors identified by the online survey with the top 10 factors in the focus groups meetings' priority list confirms the high importance of pilots' navigation skills, human-performance-related factors (workload, distraction, honest mistakes), airspace complexity, correct use of maps/charts and the weather factor.

4.3.2   Proposed risk reduction measures

HAVE YOU EVER MADE AN AIRSPACE INFRINGEMENT?
What could have prevented this from happening?
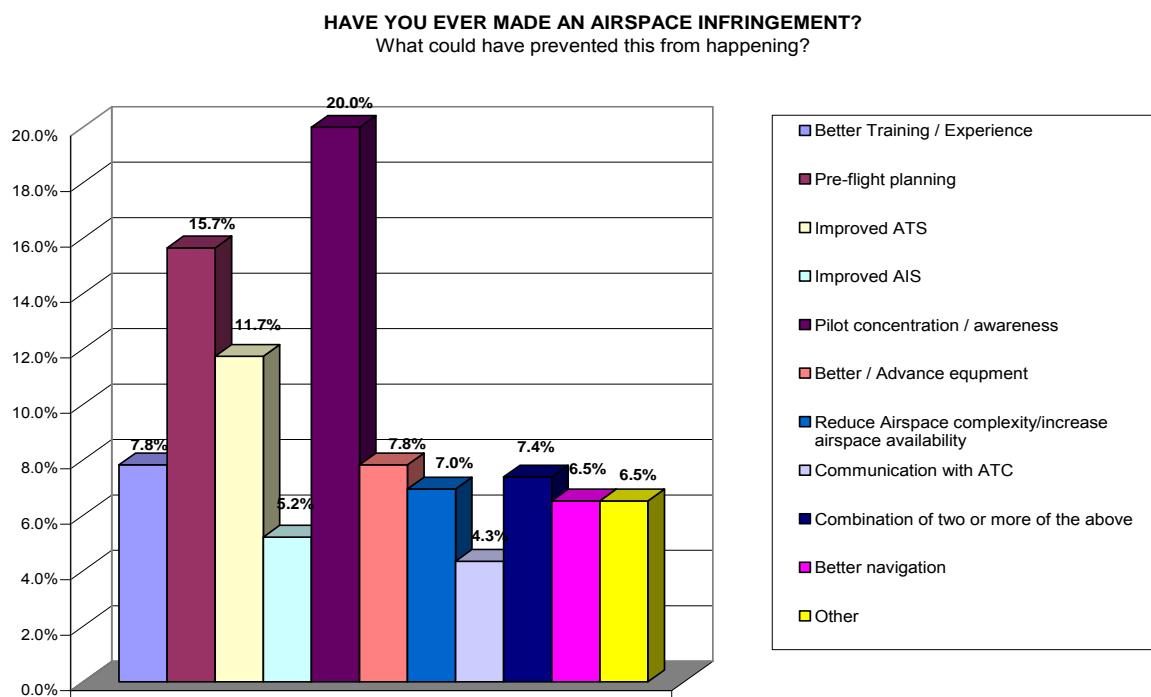
Figure 57

Correlation with answers regarding the situation "Pilot enters controlled or restricted airspace without asking for and obtaining clearance from ATC or the military. What can be done to avoid such situation?"

There is a high level of consistency in the pilots' improvement suggestions collected by the various methods. Pilot navigation and communications training and skills, pre-flight preparation, accessibility and quality of AIS, enhanced ATS and FIS for GA, and airspace design and management were identified as the major improvement areas in both sets of answers. A possible explanation for the low priority given to "Improved communication with ATC" in both sets of answers can be found in the GA pilots' overall

perception of an unfavourable controller attitude towards VFR flights. Pilot vigilance, concentration on navigation tasks and awareness are considered of high importance.

Correlation with consolidated list of proposed prevention measures relating to the precursory situations

The measures proposed by the pilots as the most effective means of preventing precursory situations from occurring have been reviewed and ranked in descending order as presented below, on the basis of the number of times a measure appears in the list of high-scoring preventive measures relevant to those situations.

1. Improved pilot-controller communication (improved R/T skills and discipline)
2. Improved services for VFR flights (ATS, FIS, AIS, staff knowledge and training)
3. Improved pre-flight preparation
4. Improved pilot training, including refresher courses and theoretical training
5. Use of better/advanced equipment (GPS, ADS-B, moving map, data link etc.)
6. Improved pilot vigilance and focus on correct flight execution
7. Improved airspace design
8. Better use of navigation and communications equipment
9. Standardised and improved VFR charts and maps
10. Better use of ATS/FIS services

The comparison between the above list and the answers to the direct question "*Have you made an airspace infringement. What could have prevented this from happening?*" *(see Figure 57)* confirms that the risk reduction measures should aim to improve both pilot communication/navigation skills, and services for VFR flights. However, the focus is slightly different: the answers presented in Figure 57 give priority to pilot training, pre-flight preparation and task management skills (vigilance, awareness), whereas the consolidated list implies a more even level of importance of both sets of factors.

Considerable differences were identified with regard to the perceived risk reduction potential of improved pilot-controller communication. It is the top factor in the consolidated list, but represents less than 5% of the votes as shown in Figure 57. This finding is fully consistent with the results of the causal factor lists comparison made in 4.3.1 above.

Correlation with the findings of the focus groups meetings

Comparison of the main improvement areas identified by the online survey with the pilot recommendations from the focus group meetings indicates an almost complete overlap. However, the focal points of the suggested safety improvement efforts are not the same. The focus group results indicate that improvement of pilot navigation skills and AIS (NOTAMs) should be set as the highest-priority objective. Also, the focus groups considered that inadequate communication between GA pilots and ATS/FIS staff deserves special attention and action, whereas the answers to the direct question "*Have you committed an airspace infringement. What could have prevented this from happening?*" indicate relatively low perceived risk-mitigation potential for improved air-ground communication.

4.4   Analysis of the focus groups' output

The results from the focus groups prove that it is not feasible to single out one (or a

very small number of) major causal factors. On the contrary, many factors are considered to make an essential contribution to airspace infringements. This confirms the need for a balanced approach that seeks to implement improvement measures in many areas which as a whole would ensure the required risk reduction. Analysis of the focus group results established areas of high correlation of pilot opinions about the most important risk factors, despite the differences in the local operational environments.

Pilot navigation skills were identified as the most important factor. This is confirmed by the achieved highest degree of correlation between the answers provided in the first session of the focus group meetings and the results from the prioritisation exercise (the "insufficient navigation skills" factor was ranked number one). Several contributors could be established:

- The initial training process appears to be predominantly focused on teaching student pilots how to fly the aircraft, whereas navigation skill training is secondary.
- Many pilots' navigation skills suffer owing to the low number of flight hours logged in the course of a year.
- Navigation skills are not subject to a dedicated assessment by periodical flight checks.

A number of improvement suggestions were made by pilots participating in this survey. The most common solutions referred to were:

- refresher training (with considerable support for making it mandatory)
- an assessment approach to pilot licence renewal checks.

Similarly, inadequate training is considered to be the root cause of pilot's insufficient communication skills. Underdeveloped skills make pilots feel uncertain and often prevent them from calling ATC or FIS even in a complex situation where an airspace infringement could have been avoided if the pilot had received guidance and support from the ground. The perceived unfavourable attitude of controllers towards VFR flights further reduces the likelihood of pilots' asking for assistance and increases the probability of navigation error. Other contributory factors such as high controller workload and busy ATC frequencies (in cases where FIS are provided by ATC sectors), and high pilot workload also need to be considered when establishing the risk mitigation strategy.

The ATS and FIS contribution to the airspace infringement risk was addressed in detail both at the interview meetings and in the online questionnaire survey. Particular attention was paid to controller-pilot communication. Controllers speaking quickly and the use of complex clearances (giving several instructions in one message) appear to be common problems for GA pilots in Europe. The non-harmonised provision of FIS often creates false expectations on the part of pilots and a false perception of being "under control". A practical effect of this is the false expectation on the part of the pilot that the FIS officer is responsible for advising the next frequency and instructing the pilot to contact the next sector/unit. A variety of means of improving air-ground communications were suggested, ranging from enhancing low altitude radio coverage to using alternative communication means, such as mobile phones. Better R/T communication skills are considered essential. The need to limit the number of times pilots have to change frequency in lower airspace was also mentioned.

The foreign language problem is considered to be a major contributor to the airspace infringement risk. Two contrasting positions have been established by the survey. The majority of pilots are of the opinion that it is essential to improve pilots' and FIS officers'

R/T communications skills in the English language. Another group of pilots consider the use of pilots' native language of paramount importance in order to achieve efficient air-ground communication and an improved understanding of controllers' instructions, which have a direct impact on flight safety. According to the latter group, it is vital for young pilots to understand all clearances and ATS information correctly, and the native language was therefore recommended as the primary language to be used for the initial acquisition of rules, procedures and aviation terminology. The English language should be made mandatory only for pilots who plan to fly abroad.

It is important to note the high ranking of the human-factors-related causes of airspace infringement. The high score for "honest mistake" and "high workload" (2nd and 3rd respectively in the prioritisation exercise), and also "distraction" and "routine"" (ranked 15 and 16) requires an in-depth analysis in order to identify an effective approach and measures which can reduce the likelihood of occurrence or mitigate the impact. Timely alerts and warnings provided by automated functions to pilots and controllers could play an essential role in this respect. Improved flight preparation and pilot skills could also help reduce the probability of occurrence of the above factors.

One set of factors most often cited related to the provision of aeronautical information. In some countries, accessibility appears to be a problem. However, the most common problems referred to by pilots appear to be the readability of NOTAMs and the amount of data irrelevant to VFR flights (and in particular to the intended flight route) which a pilot has to read for the purposes of proper flight preparation. The practical impossibility of digesting this (in the pilots' opinion) excessive volume of aeronautical data is an important contributor to insufficient flight preparation, which in turn can lead to increased stress and high pilot workload in flight, in particular for inexperienced pilots.

Another area of high correlation between the results of the causal factor brainstorming sessions and the causal factor ranking is the complexity of airspace and related airspace use procedures. Optimum use of controlled and restricted airspace, and harmonisation and simplification of airspace classification were recommended as steps required in order to improve safety. The harmonisation aspect is considered of high importance for cross-border flights. The potential risk reduction effect of such harmonisation measures could be even greater, as they should have a positive impact on a further group of causal and contributory factors related to aeronautical charts and maps.

GA VFR flights are seriously affected by the application of the FUA concept in lower airspace. The implementation of more advanced procedures for dynamic management of airspace structures should ensure easy and timely access of GA pilots to information about the actual airspace configuration and status.

Surprisingly, factors related to the quality of ATC and the flight information service were ranked relatively low compared with the feedback provided during the discussion sessions, with only "unfavourable attitude to VFR flights" qualifying in the "top 10" list (calculated rank = 9). One possible explanation could be that pilots do not rely heavily on ground assistance for correct flight navigation. This hypothesis is backed by the online survey results, which show that only 10% of the pilots would seek ATC help in the event of navigation equipment failure. It also correlates with the "reluctance" on the part of GA pilots to contact ATC as discussed above. Improved controller knowledge of light aircraft performance characteristics and pilot limitations may help change this attitude of pilots.

There is a general appreciation of the flight-following service provided to GA VFR flights in the US. A dedicated study of US best practices may help establish a successful airspace infringement prevention strategy for Europe. It corresponds to the proposals for mandatory use of transponders and air-ground communication, and use of available radar information by FICs.

Although bad weather was not included in the top 5 airspace infringement causal factors, it is considered to be a very important contributor to this risk. Weather avoidance may directly lead to airspace infringements, but also contribute to loss of awareness by pilots of the position of their aircraft in relation to controlled or restricted airspace. In combination with other factors (for example inexperience or insufficient flight preparation), this can suddenly raise the level of stress and workload in the cockpit, thus adversely affecting the timely and correct execution of navigation tasks. Two improvement areas were identified which could help reduce the impact of the weather factor, namely improved meteorological products tailored to the needs of VFR flights, and better pre-flight weather briefing by pilots.

The need for regulatory action was also recognised, although to a very limited extent. Mandatory refresher training and proficiency (licence renewal) checks are perceived as promising safety improvement measures. Improved oversight of the pilot training process was also suggested. There is a general acceptance of the application of appropriately scaled administrative measures by the regulator in cases of conscious or persistent violation of rules.

4.5 Airspace infringement from the perspective of social science

This section represents a sharp shift in the approach to the analysis and its scope. Instead of concentrating on the purely professional factors which can impact on the examined behaviour of pilots, namely airspace infringement, the focus is switched to the wider cultural context.

4.5.1 Culture matters[5]: the state of the art

Increasingly in recent decades, social scientists have been referring to cultural factors to explain modernisation, political development, economic growth, military strategy, the behaviour of groups and other aspects of human affairs (Harrison & Huntington Eds. 2000). The term culture, of course, has had multiple meanings in different disciplines. Recently in the social sciences a shared understanding of culture has emerged in purely subjective terms as the values, attitudes, beliefs, orientations and underlying assumptions prevalent among people in a society (Harrison & Huntington Eds. 2000, p. xv).

Geert Hofstede was among the first to use this type of definition of culture. He introduced the notion "software of mind" (Hofstede, 1980) and used it to establish four dimensions of a culture, namely power distance, uncertainty avoidance, masculinity/femininity, and individualism/collectivism, to be considered by cultural studies. His approach was adopted for the present project in an attempt to explain the explored pilots' behaviour.

The objectives of the present study do not require a description of all four dimensions. Flying, and especially airspace infringement, is behaviour which implies taking risks

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[5] The title refers to Harrison and Huntington's famous book.

and facing unexpected ambiguous situations, situations which might cause anxiety. It involves obeying or trespassing rules, norms and codes, and presupposes punishment or reward. The dimension of culture, which matches this type of behaviour, is the dimension "uncertainty avoidance".

Two main types of societies emerge from Hofstede's results on the uncertainty avoidance dimension: societies with low uncertainty avoidance and societies with high uncertainty avoidance. Among the characteristics of societies with *low uncertainty* avoidance are perceiving uncertainty as a normal feature of life, a low level of stress, aggression and emotions not openly expressed, and calmness when facing unexpected, ambiguous situations. In countries with low uncertainty avoidance there is no need for many regulations and prohibitions. The norms and rules are few, but all of them (even the informal ones) are strictly obeyed. By contrast, societies with *high uncertainty* avoidance perceive the inherent ambiguity of life as a permanent threat, against which one has to fight; the level of stress is high and the subjective feeling is that of anxiety; aggression and emotion can be expressed at the appropriate place and time; ambiguous situations are avoided – what is sought is the familiar risk. In this respect, it should be stressed that high uncertainty avoidance does not presuppose risk avoidance. Paradoxically, people from these societies will dash into risk behaviour in order to avoid uncertainty. There are many rules in such societies, and people need structure and specific instructions (Hofstede, 1991).

4.5.2 Methodological approach

Using the above concept and Hofstede's assigned scores on uncertainty avoidance for society in 66 countries, survey respondents were assigned to two groups representing countries with low uncertainty avoidance and countries with high uncertainty avoidance. The s*urvey team expectations* were that unlike pilots from high-uncertainty-avoidance countries, pilots from low-uncertainty-avoidance countries would perceive airspace infringement as more serious misconduct. They would demonstrate a greater adherence to the norms and codes and hence more stringent discipline in cases where these norms were violated.

To test the expectations, the predisposition of the respondents was measured, i.e. their attitude towards breaking rules (e.g. the act of infringement) and towards punishment (e.g. towards the need for and severity of disciplinary measures). Airspace infringement was treated as a specific type of misconduct, which is influenced by three main factors:

- the pilot's knowledge of the specific rules and requirements;

- the pilot's inclination to break rules;

- the expectation of the professional community that the pilot should follow these rules, or in other words the external social pressure.

Three hypothetical case scenarios for airspace infringement were defined in accordance with the framework described above (see 3.2.3.5). The incidents described in the scenarios were not only plausible and common forms of pilot misconduct, but ones that were uncomplicated by details that might introduce ambiguity into either the interpretation of the behaviour or the motive of the pilot depicted in the scenario. The scenarios drew on the experience of the authors. The behaviour of the pilots was evaluated not simply as individual predisposition, but as one related to the culture of the community which the pilots associated themselves with. This implies measuring

how seriously pilots regard misconduct, how amenable are they to incurring punishment, and how willing are they to tolerate misconduct in silence.

4.5.3 Results

To test the correctness of the expectations, the mean scores for low-uncertainty-avoidance nations were compared with those for high-uncertainty-avoidance nations by means of a series of independent sample t-tests. The results showed that although not all differences are statistically significant, low-uncertainty-avoidance nations have higher mean scores than high-uncertainty-avoidance nations across all situations and all questions. This means that pilots from low-uncertainty-avoidance countries treat airspace infringement more seriously, expect that the community will judge it in a more serious way, and believe that it should be sanctioned by the regulator in a harsher way.

The differences between the two groups can be observed clearly in the graph below (Figure 58).

The inferences which can be drawn from these results support the expectation about the influence of culture on pilots' perceptions of airspace infringement. It can be claimed that in low-uncertainty-avoidance countries, GA pilots are more likely to give due consideration to the responsibilities associated to the shared use of airspace, feel part of a community which shares common norms, and expect the relevant authorities to be very strict in applying justice.

In countries with high-uncertainty-avoidance, GA flights are more likely to be considered an adventure and "misbehaviour" to be judged less seriously. The pilot community is perceived rather as a community of "friends", who will "understand" if you deviate from established procedures rather than think that you deserve "punishment". Indicative of this attitude are the answers relating to the most serious of the three situations (pilot flies through restricted (military) zone for practically no reason – just to make a shortcut). Pilots from high-uncertainty-avoidance countries are less inclined to view this as serious misconduct.
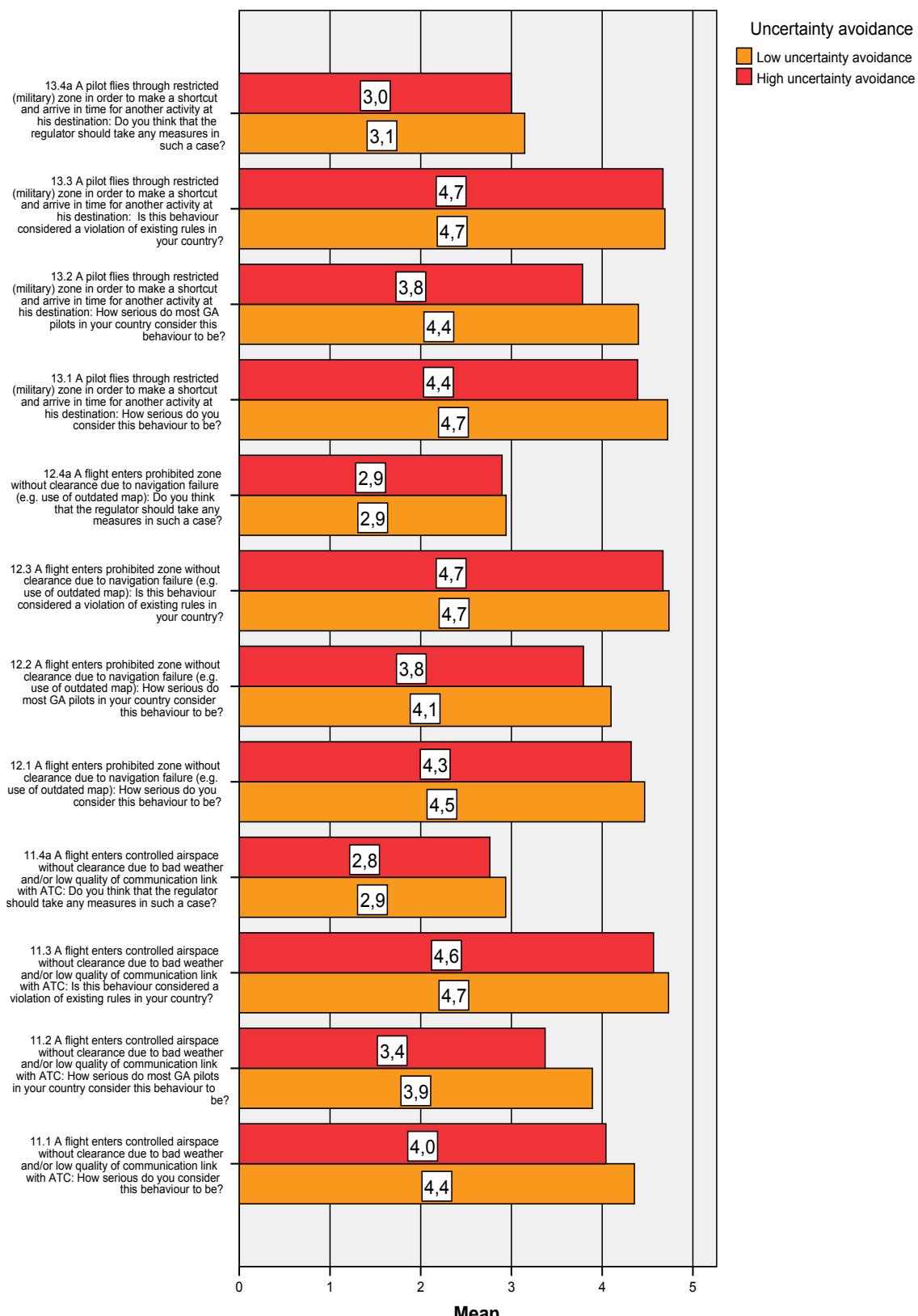
Figure 58

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 General conclusions

The General Aviation Airspace Infringement Survey 2007 allowed the collection of a vast amount of information relating to the airspace infringement risk, but also relating to the safety of general aviation flights in general. Hundreds of pilots (nearly 900) from 24 European countries participated in the survey sharing their experience and knowledge of the causal and contributory factors and suggesting practical safety improvement measures.

The analysis of survey data allowed the establishment of the following general conclusions:

- There is no single factor which can be clearly identified as the major cause of airspace infringements. However, pilots' navigation and communications skills appear to be accorded the highest importance. Although the way in which initial pilot training is provided raises some concerns about the level of acquired navigation and communication skills, it is the gradual diminishing of the skills of pilots with few flight hours which requires serious consideration and measures.

- The flight instructors' role is of major importance in bringing about the required improvement in pilots' navigation and communications skills. Any measures aimed at enhancing FI teaching skills, professionalism and safety culture will have an increased impact on the reduction of the airspace infringement risk.

- There is a general perception in the pilot community of a rather unfavourable attitude towards VFR flights, as opposed to the priority and services given to IFR/commercial flights. Such an attitude is a major contributor to inadequate controller-pilot communication.

- Current AIS products and the dissemination/provision methods applied appear not to be adequately meeting VFR flight needs. Improved availability and accessibility of aeronautical and meteorological data would support better pilot pre-flight preparation.

- Unfavourable weather phenomena are major contributors. Improved pre-flight preparation and in-flight service could reduce their impact on the airspace infringement risk, and the safety of VFR flights in general.

- Improved ATC and FIS for VFR flights, coupled with improved air-ground communications, are considered essential by the pilot community.

- The safety improvement potential of advanced equipment/avionics is fully recognised by the pilot community. However, the cost, and to a lesser extent certain performance parameters of certified advanced equipment appear to be the obstacles preventing GA from taking full advantage from the modern technology available. It is perceived that a more pragmatic and proportionate approach to light aircraft instrument equipment and certification issues would not only ensure satisfactory compliance with general safety requirements, but also allow further safety improvement in various risk areas, such as airspace infringement.

- The variety of causal factors and their relative contributions to the airspace infringement risk established on the basis of pilot experience necessitate a comprehensive approach to risk reduction – encompassing preventive but also mitigation measures (e.g. enhancing airborne and ground-based safety nets).

Pilots provided subjective estimates of the probability of occurrence of various precursory situations and the subsequent probability of the situations' developing into airspace infringements, allowed for the establishment of perceived frequencies of occurrence of the airspace infringement hazard relevant to those precursory situations. These perceived probabilities, estimated in the range of 10e(-4) to 10e(-2) per flight, should be further developed, refined and validated in subsequent studies to aid the quantitative airspace infringement risk analysis.

The survey team took the opportunity to ask the pilots a more general question about the safety of VFR flights.

What can be done to improve safety of VFR flights?
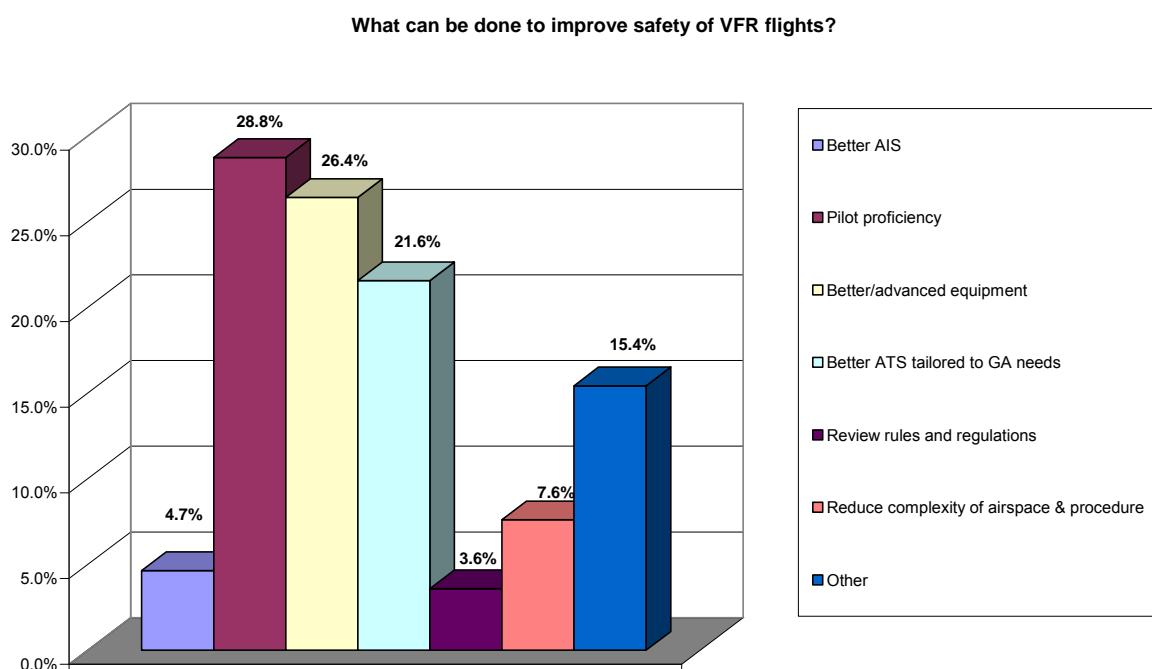
Figure 59

The answers proved once again that risk-reducing solutions should be sought in improved pilot navigation and communication skills, improved navigation methods and systems coupled with optimised airspace design and management, and improved services for VFR flights. A balanced set of measures implemented on a Europe-wide scale will not only reduce the risk of airspace infringements but also improve the safety of VFR flights in general.

5.2 Recommendations[6]

The preventive approaches and measures suggested by the pilots have been consolidated in several groups (named "issues") and related recommendations:

Issue 1: <u>Aeronautical information provision not meeting GA needs</u>

Recommendations:

1. Improve NOTAM readability

2. Ensure graphical visualisation of NOTAMs

3. Improve aeronautical information accessibility

4. Standardise lower airspace maps and charts

5. Implement AI and MET products tailored to GA needs

Issue 2: <u>Airspace complexity</u>

Recommendations:

1. Harmonise and simplify lower airspace classification

2. Review and optimise volume and boundaries of controlled airspace and number of restricted/reserved/prohibited areas

3. Improve management of reserved/restricted airspace structures and related information dissemination

4. Implement dedicated VFR routes, standard VFR entry/crossing points and corridors in controlled airspace

5. Make airspace structure boundaries more prominent (alignment with visually observable ground features and landmarks)

Issue 3: <u>ATC service not meeting GA flight needs</u>

Recommendations:

1. Ensure fair access to airspace and change in attitude towards VFR flights

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[6] The recommendations are presented in alphabetical order

2. Improve ATC staff proficiency in provision of services to VFR flight, including knowledge of light aircraft types and their performance characteristics

3. Implement airspace infringement warning tool

Issue 4: Inadequate communication between pilots and ATC/FIS

Recommendations:

1. Improve pilot R/T skills training

2. Improve pilot and controller R/T discipline

3. Improve pilot knowledge of aviation English

4. Develop generic R/T communication guide for VFR flights

Issue 5: Inefficient use of available technology

Recommendations:

1. Make full use of SSR transponders installed on GA aircraft

2. Implement advanced GPS automated functions (e.g. infringement warning)

3. Implement data link and digital radio communication (medium to long term)

Issue 6: Insufficient pilot navigation skills

Recommendations:

1. Improve navigation skills training, including GPS usage

2. Implement pilot refresher training

3. Improve flight instructor proficiency and safety culture

Issue 7: Quality and scope of FIS not meeting GA needs

Recommendations:

1. Extend FIS coverage and improve service scope and availability

2. Improve FIC staff proficiency

3. Standardise FIS provision in Europe and implement best practices

Issue 8: <u>Regulatory oversight</u>

Recommendations:

1. Improve oversight of private pilot training process

2. Implement mandatory pilot refresher training

3. Implement mandatory proficiency checks

4. Ensure affordable IFR rating requirements for PPL holders

Issue 9: <u>Risk awareness and safety culture</u>

Recommendations:

1. "Open door" days at ATC towers and centres for GA pilots

2. Familiarisation visits to flying clubs and schools for controllers/FIS officers

3. Support for GA organisations safety efforts

4. Encourage pilots to affiliate to GA organisations and flying clubs

ACKNOWLEDGEMENTS

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ABBREVIATIONS

AGL	Above ground level
AI	Aeronautical information
AIS	Aeronautical information services
ATC	Air traffic control
ATCO	Air traffic controller
ATPL	Air transport pilot licence
ATS	Air traffic services
CPL	Commercial pilot licence
FIC	Flight information centre
FIS	Flight information services
GA	General aviation
LARS	Low airspace radar service
MET	Meteorological information
PPL	Private pilot licence
TIS	Traffic information services (up-link)
TSA	Temporary segregated area
VFR	Visual flight rules

ANNEX 1   SURVEY METHODOLOGY

Introduction

The need to conduct empirical research was argued in the previous stage of the Airspace Infringement Initiative, namely the development of the Airspace Infringement Causal Factor Model [EUROCONTROL, 2007]. It was argued that further elaboration of the model was necessary in order to establish the precise relationships between the scenario elements and the explanatory factors, and the potential risk mitigation solutions. It was also pointed out that the model itself, owing to its descriptive nature, does not provide quantitative data about the robustness and the relative importance of its components.

Thus defined, the need to carry out a more extended empirical research among the GA pilot community presupposes the application of both quantitative and qualitative methods.

Quantitative methods are applied in order to obtain information which is easy to analyse statistically and is fairly reliable[7] providing an overall picture of the subject investigated . These methods, however, are not appropriate for eliciting in-depth information about specific aspects of the problem studied. In order to obtain diverse and rich information, it is necessary also to collect qualitative data, which are needed to describe a meaning rather than to draw statistical inferences.

Qualitative approach

The qualitative method to be used is meant to achieve the following objectives:

> to extract deeper and systemic explanations of the reasons for, mechanisms of and contributors to airspace infringements (AIs) *(50% of importance)*;

> to elicit pilots' ideas about potential improvements to the safety of flights and the rationale for such improvements *(40% of importance)*;

> to validate as far as possible the results from the airspace infringement data analysis project *(10% of importance)*.

The **focus group interview** method was considered the most appropriate for collecting qualitative data. Focus groups are structured small group interviews. They are "focused" in two ways. First, the persons being interviewed are similar in some way (e.g. GA pilots). Second, the purpose of the interview is to gather information about a particular topic guided by a set of focused questions. Participants hear and interact with each other and the leader, which yields different information from that which would be obtained if people were interviewed individually. The purpose of focus groups is to develop a broad and deep understanding rather than a quantitative summary. Focus groups are a highly effective method of "listening" to the population on which the project is focused. The emphasis is on insights, responses and opinions. Focus groups combine elements of both interviewing and participant observation. At the same time, focus groups capitalise on group dynamics. The hallmark of focus groups is the explicit use of group interaction to generate data and insights that would be unlikely to emerge without the interaction found in a group. The technique inherently allows observation of group dynamics, discussion, and first-hand insights into the respondents' behaviour, attitudes, language, etc. Focus group participants are typically

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[7]   We understand reliability as the consistency of the measurement, or the degree to which an instrument measures in the same way each time it is used under the same condition with the same subjects.

asked to reflect on the questions asked by the moderator. Participants are permitted to hear one another's responses and to make additional comments beyond their own original responses as they hear what other people have to say. It is not necessary for the group to reach any kind of consensus, nor it is necessary for people to disagree. The moderator will keep the discussion flowing and make sure that one or two persons do not dominate the discussion. As a rule, the focus group session should not last longer than 1½ to 2 hours. The objective is to obtain high-quality data in a social context where people can consider their own views in the context of the views of others, and where new ideas and perspectives can be introduced. Focus groups will consists of 6 to 12 people who share some characteristics relevant to the evaluation.

In contrast to the survey method, the focus group method does not require a representative and statistically adequate sample. To guarantee the validity of the results, the pool of potential participants should contain representatives of all relevant subgroups from the target population. This ensures the registration of as many opinions as possible on the subjects investigated.

It is planned to conduct 8 focus groups in 8 different European countries (Bulgaria, France, Germany, the Netherlands, Norway, Portugal, Switzerland, and the UK) in order to achieve an acceptable level of validity of the results of the present project. The pool of potential participants will be established with the assistance of the local general aviation (AOPA) organisations. The community of GA pilots is considered to be relatively homogenous (fairly standardised training, licensing requirements and "rules of the air"), and because the scope of the interview is limited to a very narrow expert area, extending the number of focus groups/countries involved would not be expected to elicit a greater number of different opinions and ideas or bring added value to the project. The relatively inaccessibility of the studied population, the level of GA development, and project budget limitations were also taken into account when determining the number of groups and choice of countries.

To ensure a structured and efficient process of qualitative data collection, a standardised interview scenario (see Annex 2) and methodological instructions for the field interviewers (see Annex 1, Appendix A) were developed. All group sessions will be audio-recorded. The audio records and the interviewers' notes will be analysed for content. Instructions for data categorisation and analysis (see Annex 1, Appendix B) will be used by the research team. The reported findings will be summarised in a dedicated chapter of the final project report.

Quantitative approach

The following objectives are expected to be achieved by application of quantitative approach:

- to validate as far as possible the results from the airspace infringement data analysis project. The latter is expected to deliver a set of distributions, respective explanations, conclusions and recommendations. It is important to compare and where necessary to complement the study results with the GA pilots' perception of the relative frequencies and importance of the various scenarios and their contributory factors *(40% of importance)*;

- to elicit pilots' ideas about potential improvements to the safety of flights and the rationale for such improvements *(30% of importance)*;

- to extract deeper and systemic explanations of the reasons for, mechanisms of and contributors to airspace infringements *(30% of importance)*.

Quantitative data will be collected by means of a sociological survey. The survey method is the only alternative because the project aims to measure the incidence of various views, opinions and personal experience of GA pilots, and reveal the relative importance of the components of the theoretical airspace infringement causal model.

The surveys produce descriptive or analytical information about a given target population. Their aim is to describe the state of the whole population with respect to the subject matter under examination. In this particular project, the target population consists of several hundred thousand GA pilots from all European countries. Crucial for every sociological survey is the choice of the pool of respondents. This to a very great extent determines the successful testing of the hypotheses posed and the theoretical model adopted. In our research, the target population is clearly defined. However, since it is virtually impossible to examine the whole population, a sample will be drawn. The sample will reflect the key characteristics of the target population.

Sampling procedure

Sampling methods are classified as either *probability* or *non-probability*. In probability samples, each member of the population has a known non-zero probability of being selected. Probability methods include random sampling, systematic sampling, and stratified sampling. In non-probability sampling, members are selected from the population in some non-random manner. These include convenience sampling, judgment sampling, quota sampling, and snowball sampling. The advantage of probability sampling is that sampling error can be calculated. Sampling error is the degree to which a sample might differ from the population. When inferring from the population, results are reported plus or minus the sampling error. In non-probability sampling, the degree to which the sample differs from the population remains unknown.

Random sampling is the purest form of probability sampling. Each member of the population has an equal and known chance of being selected. When there are very large populations, it is often difficult or impossible to identify every member of the population, so the pool of available subjects becomes biased.

Systematic sampling is often used instead of random sampling. It is also called an Nth name selection technique. After the required sample size has been calculated, every Nth record is selected from a list of population members. As long as the list does not contain any hidden order, this sampling method is as good as the random sampling method. Its only advantage over the random sampling technique is simplicity. Systematic sampling is frequently used to select a specified number of records from a computer file.

Stratified sampling is a commonly used probability method that is superior to random sampling because it reduces sampling error. A stratum is a subset of the population that shares at least one common characteristic. Examples of strata might be males and females, or managers and non-managers. The researcher first identifies the relevant strata and their actual representation in the population. Random sampling is then used to select a *sufficient* number of subjects from each stratum. "*Sufficient*" refers to a sample size large enough for us to be reasonably confident that the stratum represents the population. Stratified sampling is often used when one or more of the strata in the population have a low incidence relative to the other strata.

Convenience sampling is used in exploratory research where the researcher is interested in getting an inexpensive approximation of the truth. As the name implies, the sample is selected because it is convenient. This non-probability method is often used during preliminary research efforts to get a gross estimate of the results, without incurring the cost or time required to select a random sample.

Judgment sampling is a common non-probability method. The researcher selects the sample on the basis of judgment. This is usually an extension of convenience sampling. For example, a researcher may decide to draw the entire sample from one "representative" city, even though the population includes all cities. When using this method, the researcher must be confident that the chosen sample is truly representative of the entire population.

Quota sampling is the non-probability equivalent of stratified sampling. Like stratified sampling, the researcher first identifies the strata and their proportions as they are represented in the population. Then convenience or judgment sampling is used to select the required number of subjects from each stratum. This differs from stratified sampling, where the strata are filled by random sampling.

Snowball sampling is a special non-probability method used when the desired sample characteristic is rare. It may be extremely difficult or cost-prohibitive to locate respondents in these situations. Snowball sampling relies on referrals from initial subjects to generate additional subjects. While this technique can dramatically lower search costs, it comes at the expense of introducing bias, because the technique itself reduces the likelihood that the sample will represent a good cross-section of the population.

Multi-phase sampling. This type of sampling depends on a sample of some description already having been taken and simply involves the idea that the researcher takes a "sample from their sample". One reason a researcher might want to do this is to follow up any ideas raised by research on the larger sample and, rather than re-question the whole sample a smaller, more selective, group is chosen to represent the sample of the target population.

In this project a truly representative (random) sample could not be drawn for the following reasons:

1. It is not possible to identify everyone in the target population owing to lack of accessibility to the required personal data and the amount of resources needed to build a truly comprehensive database of all GA pilots in Europe.

2. It is not possible to contact randomly selected pilots owing to the confidential nature of the personal details in the available databases.

3. Budget and time limitations are also important obstacles in drawing a representative sample.

There are, however, important specificities of the target population, which allow the drawing of a representative though small sample. Such specificities are:

- The relative high homogeneity of the population: the GA pilots constitute a community which shares common interests (with regard to flying), are expected to have good communication and exchange of opinions about their flying experience, and have to follow one and the same set of rules and requirements, etc.

- The problem investigated in the project is very important to the community, requires a minimum level of expertise, and recently has been discussed widely and extensively on various occasions at national and international level.

Taking into account the above factors, the pilots can be expected to share common opinions, evaluations and attitudes.

It can therefore be claimed with a sufficient degree of confidence that a convenience sample is appropriate and will not jeopardise the validity of the collected data.

For the purpose of quantitative data collection, a survey questionnaire has been developed (see Annex 3). The questions reflect the main scenario elements and the set causal factors established by the previously developed airspace infringement causal model. The questionnaire is designed in order to collect as wide as possible a set of pilot ideas about the underlying reasons for and contributory factors to airspace infringement, and also about potential improvements to the safety of flights and the rationale for such improvements; pilots' attitudes towards safety-related behaviour, contextual information about pilots' experience, aircraft flown, nationality, airspace infringement and incidents' experience, etc. Closed, semi-open, open-ended type questions, and rating scales will be implemented in the questionnaire. The responses to semi-open and open-ended questions will be coded as closed questions in the process of data analysis. The aim is to collect 300 pilot opinions as a minimum. The preliminary estimated confidence interval for this sample size at a 95% confidence level is 5.6% for a 50% estimate.

The questionnaire will be administered via a dedicated web site, email, telephone, and in groups. The support of GA organisations and establishments in the different European countries will be sought in order to invite the pilots to visit the website and fill in the survey questionnaire. Individual invitations to participate in the survey will be extended to pilots whose personal details are or have been made available to Compass IS. The participants in the focus groups may also be asked to fill in the questionnaire, if this is considered appropriate by the interview moderator. To improve the survey validity, the contextual information is reduced to a minimum. Strict confidentiality rules will also be introduced and applied. Where the questionnaire is administered in groups, the participants will be asked to seal the completed questionnaires in envelopes before returning them to the research team representative.

Quantitative data analysis and presentation. Percentage distributions of the answers to each question will be obtained. The data from the rating scales evaluations will be represented by their means and standard deviations. Where applicable, assessment of the relationships between the survey variables will be conducted by obtaining sets of correlations and association measures. The results will be summarised in tables and charts.

Appendix A

CONDUCTING A FOCUS GROUP

(Instructions for the field interviewers)

Recruitment of participants

Choosing the number and size of the groups. A good size for a focus group is between 6 and 10 participants per session. However, the discussion can still take place if fewer then 6 participants show up. Some authors report good results even with 4 participants. The number of participants per session will be based upon the pool of potential participants.

Assume that some participants will not show up. It is difficult to ensure that all participants show up for the discussion, as some individuals may forget, run into a scheduling conflict, or just decide not to take part. For this reason, it is recommended that approximately 12 participants be selected to take part in the discussion session.

It is likely that a few participants will not show up for the session, which would bring the total number of participants down to around 8 or 10. If all participants do show up, then the discussion session should be conducted with everyone.

Contact potential participants. After obtaining a pool of potential participants, the individuals should be provided with information regarding the discussion session. When making initial contact with the potential participants, remind them that they are agreeing to take part in a discussion group and ask if they are still interested in taking part. If they are still interested, then provide the date, time, and location of the session. Be sure to mention the incentive for taking part in the discussion, as this could influence some individuals to take part.

Do not assume that since you are calling individuals who agreed to take part that you will only need to make 10 to 12 calls. It is often difficult to get a hold of people and if you do, some individuals may not be able to make it to the discussion or some may not want to take part. A good rule of thumb is if you plan on recruiting 12 participants then expect to have to make at least twice that many telephone calls. The quicker potential participants are contacted about taking part in a discussion, the more likely you will be to get a sufficient number of participants.

Follow-up letter. Approximately a week to 10 days prior to the discussion session, a follow-up letter should be mailed to the individuals who agreed to take part. The follow-up letter should thank the person for taking part in the discussion and briefly describe the purpose of the group. The letter should also include information which clearly identifies the date, time, and place of the discussion. Participants should be reminded of the incentive for taking part. Finally, participants should be asked to contact the research team if they are unable to attend, to allow time to find an alternate participant.

Preparation

Reserve time and place. Reserving the time and place to conduct the focus group interview is something which should be done well in advance of the actual date of the discussion sessions. Finding a location quickly will allow time to contact potential participants with the necessary information regarding the time and location of the sessions.

When selecting a location try to find the most convenient and accessible location.

Provide an incentive for participation. We recommend that individuals taking part in a discussion session should receive some kind of compensation (even symbolic) for their participation. When contacting potential participants, use an incentive to encourage or persuade an individual to take part in a discussion session.

Various forms of compensation can be used, the most common being a lunch or dinner. If this is not possible a "glass of wine" meeting after the session may be considered. Snacks and beverages should also be provided at the meeting.

Determine what equipment is needed. If the sessions are to be digitally audio recorded, it is necessary to reserve the equipment well in advance of the sessions. Equipment needed:

    a digital audio recorder;

    a microphone, which should be placed on the discussion table;

    additional memory cards, if needed. The free memory available should be enough for at least 3 hours' recording time.

Session logistics

Room configuration. Participants should be seated around a table. If it is technically possible, it is good idea to use two (or more) microphones. Otherwise, the moderator should remind the participants to speak loudly, facing the microphone. If refreshments are being served, an additional table should be set up in the room. All wires should be taped down or secured to assure that no one trips.

Equipment. It is necessary to arrive well in advance of the start of the discussion to set up and test all equipment.

Refreshments. Refreshments should be placed on a separate table in the discussion room. As participants enter, they may take refreshments and be seated around the table. Depending on the refreshments being served, the research team should allow enough time for setting up and cleaning up.

Other considerations. Other items which need to be considered include name tags or badges, and consent forms. Name tags can be made by folding large index cards in half and writing the participants' names large enough for the moderator to read. This will allow the moderator to address questions to specific individuals during the discussion.

If brochures, flyers, or other marketing information are to be displayed during the discussion, it should be easily accessible to the moderator. One last consideration is that signs with directions to the discussion group may be placed in the hallways to help individuals find their way to the sessions.

Moderating the session - general recommendations

Moderating the discussion is a difficult process, and someone with experience has the ability to draw information out of the participants. The following are a few key points which should be considered when moderating a discussion session. Only the moderator and interview group participants should be in the discussion room during the session. An assistant moderator may also be included to provide technical assistance such as writing on the board, distributing materials, operating a projector, drawing the group outline, or taking notes.

Beginning the discussion. The moderator needs to establish a rapport immediately by thanking the participants for coming. The moderator (or assistant) needs to explain that the notes and audiotapes will be kept completely confidential and that pseudonyms will be used in place of real names. Also, it should be stressed that no other personally identifying information will be used. After the introductions have been made and the general purpose of the discussion group has been reiterated, warm-up questions should be asked in order to facilitate discussion. Following a brief warm-up period, the terms that will be used in the group talk should be mentioned and clarified, if necessary. People should be informed that their responses are neither right nor wrong. The moderator's job is to let the group members know that it is alright to agree or disagree with others' responses.

Keep the conversation flowing. The moderator needs to keep control of the discussion session. If participants get off track or get ahead of the subject being discussed, the moderator must pull the group back together. The moderator should try to keep the discussion as informal as possible and should encourage all participants to say whatever is on their mind. Remember, the moderator is in charge of the discussion, and it is his/her duty to draw information out from the participants. The moderator should ask general, open-ended questions. As participants become more comfortable with contributing questions, the moderator can become more specific. When the time period is almost up or no new ideas are being offered, the moderator should begin to wrap up the session by summarising the discussion to make sure of what the participants have said and how to interpret it. Finally, the moderator needs to provide a significant closing statement, thanking the participants for their time and assuring them that their responses will be kept completely confidential.

Length of the discussion. The discussion session should last approximately 1½ hours. The participants in the discussion session will dictate the length of the sessions, on the basis of the amount of information they have and their willingness to participate.

Be neutral. One of the benefits of having an outside person moderate the discussion is that they can be neutral. Some people may not like the topic being discussed and should be allowed to voice their opinion. Use this opportunity to find out why the person does not like the programme and in addition find out what changes could be made to improve it.

Be careful of participants asking the moderator questions. Remember, the purpose of conducting the discussion session is to gather information about how much the group knows and feels about the subject being discussed. The discussion should not be a place to inform people of a programme or to convince them of any point of view.

Talk to members of the Research team. During the discussion session, the moderator should take time to confer with the members of the research team to determine if further subjects need to be explored. This can be done maybe once or twice during the session. The best time to do this is during a writing exercise or near the end of the discussion. For example, during this study the moderator got up and told participants he had left the writing exercise in the other room. If the research team has additional questions, the moderator may ask those questions upon returning to the discussion.

Appendix B

INSTRUCTIONS FOR GROUP INTERVIEW DATA CATEGORISATION AND ANALYSIS

Review your notes. After a discussion session is completed, take a look at your notes and highlight items you wish to review in greater detail when listening to the tape. When taking notes be sure to have a watch nearby so that you can record the time when a certain topic was discussed.

Listen to the audiotapes. The audiotapes should be listened to shortly after the completion of the discussion session. When listening to the tapes, try to pick out important findings and quotes from the participants. These quotes can be used later to support findings in the report.

Writing the report. The written report should follow the questions contained in the interview scenario. The report can be broken down into four sections including the background and objectives, the methodology, the summary, and the highlights of the findings.

The following provides more detail regarding the various sections:

1. Background and objectives.

The background and objectives section provides basic information regarding the project including the history of the topic, the purpose of the study, and the goals and objectives of the research.

2.2. Methodology.

The methodology section should describe how, when and where the interviews were conducted and who conducted the study. It should describe the characteristics of the discussion groups who were selected. It should inform readers that the results from the interviews are the opinions of a small sample and should be viewed with caution.

2.3. Summary and considerations.

The summary and considerations section is approximately one or two pages in length and provides the reader with a summary of the important findings. The items contained in this section should be in bullet or number format (similar to this page).

4. Highlights of findings.

The highlight of the findings is the section which provides the reader with an in-depth analysis of the questions contained in the discussion guide. This is the section where quotes and comments should be used to support the research findings.

ANNEX 2   INTERVIEW MEETING SCENARIO

OBJECTIVES

- **50% of importance.** To extract deeper and systemic explanations of the reasons for, mechanisms of and contributors to airspace infringements (AIs).

- **40% of importance.** To elicit pilots' ideas about potential improvements to the safety of flights and the rationale for such improvements.

- **10% of importance.** To validate the AI causal factor model developed within the context of the AI safety improvement initiative.

DURATION

The interview session should be managed by the meeting moderator with the objective of achieving an optimal (minimal) duration. It should not exceed half a day (for example an afternoon) and in nominal cases should last around two-and-a-half hours.
On the basis of the indicative timings provided in section 5, the overall meeting duration is estimated at three (3) hours.

PARTICIPATION

The following categories of participants should be represented at the meeting:
- GA pilots

   The recommended number of pilots is between 6 and 8 in order to achieve a balance between the data to be collected and the requirements for meeting efficiency. Participation of pilots with various levels of experience and qualifications is recommended.
- Compass moderator

- EUROCONTROL representative

PRE-MEETING   EXCHANGE   OF   INFORMATION   WITH   ORGANISERS   AND PARTICIPANTS

The following information should be provided to the local meeting organisers (ANSP and/or AOPA representatives):
- Explanation of the interview meeting objectives

   It should also include an explanation of the meeting context – that the GA survey is an integral part of the overall safety improvement initiative delivery process and not a stand-alone survey.
   Reference to other similar initiatives, such as air-ground communications, level bust and their processes and products - action plans, checklists, toolkits to ensure pilots buy in.

   Explanation of the qualitative nature of the survey and considerations such as source identity protection should this apply.

   Assurances of the confidentiality of the collected information.

A model invitation letter reflecting the above requirements for information exchange is provided at **Appendix A**.

<u>Meeting preparation</u>

Meeting arrangements: agenda, venue, time, participants and refreshments.

An agenda outline is provided at **Appendix *B*** for distribution to the meeting participants.

Means of recording the meeting

The use of a digital (tape) recorder is recommended as the most efficient means of recording pilots' views and comments. However, if this proves inappropriate, the meeting should be recorded by the Compass representative supported by the EUROCONTROL representative.

Ensure availability of the required facilities: computer, projector, white board, "post its", microphone, other supporting materials, etc.

INTERVIEW SCENARIO

Step 1: Meeting opening (duration: max. 10 min.)

The following should be covered:
Welcome address by the EUROCONTROL representative

Introduction of survey team members

Meeting objectives

Meeting agenda (slide)

Session rules and proceedings

Assurance of confidentiality

Step 2: Round table (duration: max. 10 min.)

<u>Objective</u>: Collect background information that reflects the descriptive part of the AI model, but also extract some exposure data from pilots.
Each participant (pilot) is asked to:

Present himself/herself by providing the following information as a minimum:

type of GA/pilot licence, number of years with licence

flying experience (total flight hours)

number of flight hours logged in the last 12 months

type of aircraft flown

hours/experience flying in other European countries

Provide any other related information/comments he/she might wish to share at the start

This step should be supported by a slide of bullet points assisting pilots to address the above items.

Step 3: Introduction to the Airspace Infringement Initiative (duration: max. 15 min.)

Present AI initiative (slide on safety improvement process)

Explain GA survey context (position among the other AI ongoing projects and contribution to the overall AI initiative objectives.

Verify pilots' (correct) understanding of the subject.

Step 4: Brainstorming session – causal factors (duration: max. 1 hour)

***Objectives*:**
1. Collect pilots' individual responses to the following basic question:
   What are the 3 main reasons why a GA aircraft enters controlled or restricted airspace without a clearance?
2. Enrich the list of causal factors and prioritise it.

Sub-step 4.1: Introduction to questions (duration: max. 5 min.)

To ensure pilots have correctly understood and trigger the pilots' activity, the question is introduced by a small story which combines factual information with some word-of-mouth and humour elements triggering curiosity.
Example: "Do you know that in Washington, some general aviation pilots are paid to periodically infringe the restricted airspace around the White House? The reason is to test the overall chain of security system reaction. Of course I should not have said the overall chain as if it were the case that there will be only one test. But apart from these intentional and pre-designed entries, what other reasons you think are casing the penetrations to happen?"

Sub-step 4.2: Collection of pilots' responses and discussion (duration: max. 45 min.)

The participants are asked to write down their responses on post-it paper cards, which are distributed in parallel. Each reason should be written on a separate post-it card.

The responses are collected, and posted in a way that ensures visibility for each participant, e.g. on a wall or a white board.

Group discussion is initiated by the facilitator, using the post-its. During the discussion, the facilitator attempts to elicit explanations why the factors written on the post-its are considered most important and why other factors considered in the AI model are not.

A list of questions to facilitate the brainstorming process is provided at **Appendix F**. Its purpose is to help the moderator guide the discussions. It is not a "walk-through" list for use in the plenary session.

Sub-step 4.3: Causal factor prioritisation (duration: max. 15 min.)

The participants are divided into two groups (depending on their actual number).

Cards with the causal factors according to the theoretical AI causal factors model are distributed to each group. Each factor is presented on a separate cardboard.

The list of causal factors to be used is provided at **Appendix E**.
The groups are asked to study the cards and rate the factors according to their importance by choosing the top 10 (the ones that are more likely to lead to infringements) . Suggesting factors that the model might fail to consider is encouraged.

Each group summarises the results on a poster (board, paper sheet), appoints a speaker for the group and presents the results (top 10 factors) to all participants, briefly providing the arguments for the assigned priorities. A flip chart may be used for the purpose if available.

The whole group is asked to think of more ideas and discuss the presented top priority lists.

Coffee break (duration 15-20 min.)

Step 5: Brainstorming session – risk mitigation (duration: max. 45 min.)

Objectives:
1. Collect pilots' individual responses to the following basic question:
   What could be the best 3 measures to prevent airspace infringements?
2. Enrich the list of potential risk-reduction measures.

Sub-step 4.1: Collection of pilots' responses (duration: max. 10 min.)

The participants are asked to write down their responses on post-it paper cards, which are distributed in parallel.

The responses are collected, and posted in a way that ensures visibility for each participant, e.g. on a wall or a white board.

Sub-step 4.3: Discussion on risk-mitigation measures (duration: max. 35 min.)

Each participant is asked explain his/her choice in turn. The facilitator may ask questions to specify the suggestions.

Group brainstorming is initiated by asking questions like: "Now, seeing all the responses, what is the answer you are missing? Can you add to this? Do you remember a story that does not fit in?"

A list questions to facilitate the brainstorming process is provided at **Appendix *F***. Its purpose is to help the moderator guide the discussions. It is not a "walk-through" list for use in the plenary session.

The list of potential risk-reduction measures is elaborated during the plenary session. Feasibility (ease of implementation, cost, etc.) and effectiveness aspects may be discussed.

Important note: The time assigned to brainstorming sessions (steps 4 and 5) is indicative only. It might be reduced or extended by the moderator (in coordination with the EUROCONTROL representative) at each individual meeting depending on the group dynamics.

Step 6: Summary of the meeting (duration: max. 15 min.)

The moderator presents the main findings of the brainstorming sessions and the set of conclusions that can be made so far, seeking by this means the GA pilots' confirmation.

Participants are informed of the way in which and the means by which feedback will be provided (e.g. e-mails, EUROCONTROL and Compass websites).

Participants' further involvement and support for the Airspace Infringement Initiative is sought by proposing to send them deliverables for comments, filling in the questionnaire (see Step 7 as well), providing EUROCONTROL AII contact point details.

Pilots' e-mail addresses are collected for subsequent feedback and questionnaire distribution (provision of the hyperlink to the relevant website). Pilots are asked to invite their friends and colleagues to fill in the questionnaire.

End of meeting

Step 8: Meeting report

The Compass representative writes up the discussions and the findings in a meeting report
An outline structure of the meting report is provided at **Appendix *G***.

Appendix A – Invitation letter

Dear Sir/Madam,

I am writing to invite you to the ***general aviation pilot survey meeting*** which will take place on … at ….

The objective is to improve understanding of the airspace infringement problem and identify potential preventive strategies and means. This survey is part of the Airspace Infringement Safety Improvement Initiative launched by EUROCONTROL in 2006. The main goal of the initiative is to develop and implement effective risk-mitigation measures in a large area of European airspace.

Information on this safety initiative is available at:
http://www.eurocontrol.int/safety/public/standard_page/infrigements.html.

A large sample of infringement data collected by ATS providers has been analysed as a first step towards achieving the goal of the initiative. However, this could not ensure the required in-depth understanding of the reasons that make GA pilots fly into controlled or restricted airspace without a clearance. The specificity of the airspace infringement problem requires the active involvement and cooperation of pilots in order to enable us to establish the systemic factors and underlying reasons which can lead to airspace infringements, and to identify the most promising action we can take to reduce their number and lower their safety impact.

The G***eneral aviation survey*** team considers your expertise and experience in the subject extremely valuable and important. It will be very helpful to the survey in particular, and to the whole GA community as a whole, if you share your observations on the reasons and explanations for airspace infringements - the way you regard them from your perspective in your own flying environment. Your suggestions regarding possible safety and risk-mitigation measures will also be greatly appreciated.

The success of our initiative depends on your support. We kindly ask you to contribute to the ***general aviation pilot survey*** by taking part in the survey working session. Your answers will be kept confidential and will be used solely in support of the airspace infringement risk analysis and mitigation.

We look forward to seeing you on … … 2007

Yours faithfully,
Alexander Krastev
Airspace Infringement Initiative Coordinator
EUROCONTROL

Appendix B – Meeting agenda outline
(for distribution to participants)

1. Opening of meeting
Objectives:
> To achieve an in-depth understanding of the reasons for and contributory factors to a GA pilot's flying into controlled or restricted airspace without clearance.
> To identify the most promising actions we can take to reduce the number of airspace infringements and their adverse impact on the safety of flights.

Presentation of the survey team
Presentation of the participants and collection of expectations

2. Introduction to the Airspace Infringement Initiative
(Short briefing by EUROCONTROL representative)

3. Brainstorming session
Objective: Collect and discuss responses to the following basic questions:

- What are the 5 main reasons why a GA aircraft enters controlled or restricted airspace without a clearance?

- What could be the best 3 measures to prevent airspace infringements?

4. Summary of responses and conclusions
Wrap-up session
Follow-up and feedback means

Appendix C – AI presentation

Slide 1 - Background

Slide 2 – Benefits for GA

Slide 3 – How to realise the benefits
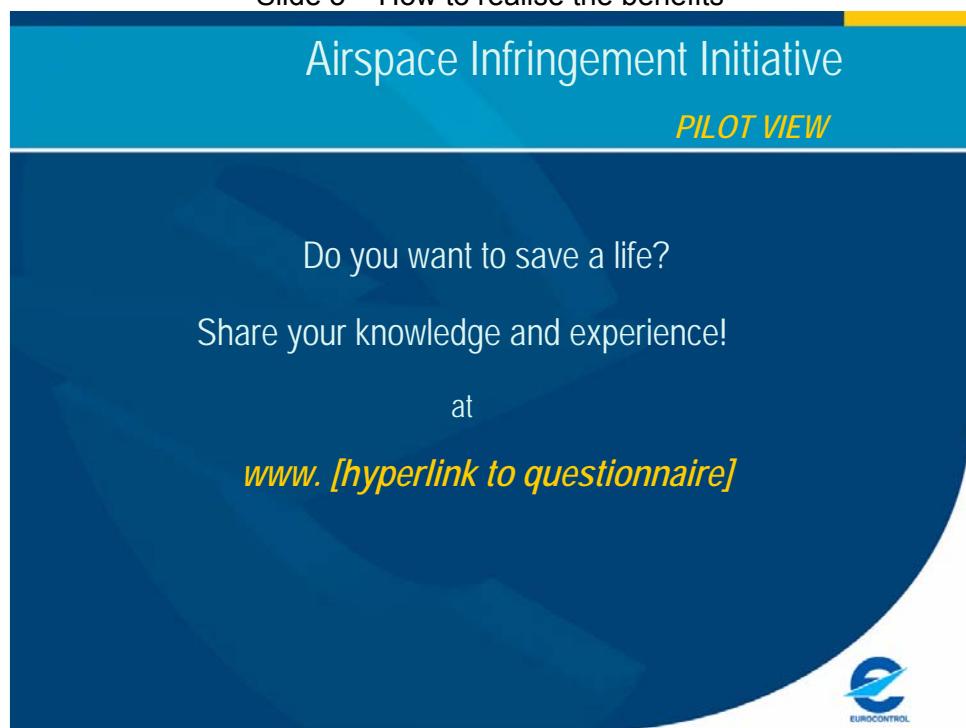
Slide 4 – Link to questionnaire

Appendix D – Case study example

I was navigating using VOR backed up by GPS, en route to AAA. I had been receiving FIS from BBB and was still using their squawk but was speaking to AAA at the time of the infringement. Having crossed XXX VOR, I set course roughly east to intersect the GA1 arrival route, intending to follow it for a left base join at AAA.

This "digression" to the east was done purely visually. I greatly underestimated the wind and was blown into CCC CTR. They contacted BBB who contacted AAA who contacted me and told me of the infringement. I spoke by phone to CCC ATC on the ground, who were very friendly about the matter. This incident was basically an erosion of dead-reckoning skills as a result of navigating by VOR and GPS and not thinking about the wind. Had I known enough about my GPS, I could have had it set to warn me of the proximity of controlled airspace as it has this feature.

However, the infringement was communicated to me and thus prevented from becoming worse by the fact that I had just been in receipt of FIS from BBB and retained their squawk.

Appendix E – Airspace Infringement causal factors

Causal factor category	Causal factor / Contributor
Aircraft	Equipment failure
	GPS problem
Airspace	Airspace structure difficult to identify in flight
	Military airspace (status) not known
	VFR routes close to restricted/controlled airspace
	Lack of dedicated VFR maps
	Lack of published VFR routes
ATS	Delayed reply to pilot call-in
	Direct route given through unknown airspace
	Unfavourable attitude towards VFR flights
	Late refusal of entry into airspace
	Busy ATC frequency
	Complex or unclear airspace use procedures
	Unclear or saturated maps/charts
	NOTAMs difficult to understand
Environment	Bad weather
Pilot	Avoiding congested area
	Distraction
	High workload
	Honest mistake
	Inadequate knowledge of airspace and procedures for its use
	Inadequate R/T skills and discipline
	Inadequate (training) navigation skills
	Inadequate piloting
	Misinterpretation of "standby" instruction
	Use of out-of-date map/chart
	False expectations about the level of ATC service
	Training flight (student pilot)

Table 2 – AI causal factors

Appendix F – Full set of plenary brainstorming support questions

Q1: What are the 5 main reasons why a GA aircraft enters airspace without a clearance?

Generic questions:
- How often do you have problems when you fly?

- What are the types of problems you have?

- How many times (or relative, in percentage terms) do the problems have something to do with FIS or ATC?

- Is it "easier" to infringe controlled airspace than restricted airspace?

  What is the difference? Airspace design, commercial operations, the military? Flight into foreign airspace? What is the reason - better/worse service? Easy/difficult access to required information? Just terrain or weather?

Navigation-related causes: Did these result in an AI?
Have you ever been lost? How many times you have been lost? Did this result in an airspace infringement?

Do you use GPS? Is GPS your primary means of navigation? How do you ensure that your GPS database is up to date? Do you know its limitations?

Do you always know what airspace is around you when you are flying?

How often have you been unsure of your position? Why did it happen (e.g. unable to identify the airspace boundaries)? Did this cause an infringement?

Aeronautical-information-related causes: Did these result in an AI?
What sources of aeronautical information do you use? What are the usual problems you have with aeronautical information?

Can you get information about active military zones/areas? Do you search for this information before taking-off? While in flight?

What maps/charts do you use? What are the problems you have encountered using the maps/charts? Can you obtain the maps/charts you need, and how easily?

Do you need dedicated VFR routes? Are such route defined in your country? Do you use them? Does this solve the AI problem?

Do you search for and read NOTAMs? Is it difficult to get the NOTAMs? Is it difficult to understand them?

Piloting-(airmanship-)related causes: Can these lead to an AI?
How often do you deviate from your intended flight path because you are unable to fully control the aircraft? For what reason?

Do you have problems with pressure-setting? What kind? What can this can lead to?

What can get you tired in flight? Are you always aware of being overloaded or tired?

Have you ever intentionally flown into controlled/restricted airspace without a clearance? For what reason?

Weather-related causes. Did these result in an AI?
What is your experience with bad weather? Can you easily obtain up-to-date MET
information before and during a flight?

ATS-related problems: Can such problems contribute to an AI?
Do you get the information you need from ATS? What problems have you encountered?
What information do you need most? Do you get it?

Do you always try to contact FIS/ATC when you fly? Do you always know the frequency to
contact? For what reasons will a GA pilot not contact FIS/ATC? Is there any difference
between flying in your own country and flying any other country?

Where do infringements happen most often (types of airspace, combinations thereof, choke
points)?

Have you ever received incorrect information or clearance from ATS? How did you establish
that? What was the impact on your flight?

How often does the ATC give you a "direct to"? Do you always know where to fly to? Could
this lead to AI?

What is the difference between GA and commercial aviation communications with ATC? How
can these differences can be explained?

GA-regulation-related problems: Can these contribute to an AI?
Do you know how GA is regulated in your country (mandatory equipment, use of SSR,
communications, etc)?

Do you always use the transponder (if equipped)? Are the procedures clear, any difficulties
encountered?

Q2: What could be the best 3 recommendations to prevent airspace infringements?
Aspect - Regulation
Do we want more/improved regulation

      Airspace and related procedures,

      Avionics: Make SSR/ADS-B transponders mandatory? What type of equipment can
        "save the day"? Is it too expensive? What price is affordable?

      Is training sufficient? Any enhancement in terms of curriculum and duration of
        different disciplines (e.g. navigation, communication) needed?

      Licensing requirements - Do you have regular proficiency checks? What do they
        include? Can they be made better?

Aspect – Aeronautical information
What information can really make a difference? What and when is the best time and place?

What is the best way to know the current airspace organisation? What is the best way to get
it?

Aspect - Navigation
When you fly in unknown airspace/abroad what you do differently? How we can make this
"difference" work for us all the time?

Aspect – In-flight FIS

Do you know whether in the USA, GA is different? What is the difference?

Have you flown in German airspace? Do you know that there is feedback for very good FIS in Germany? What effects might have – German GA pilots are "spoilt" and then they make more mistakes abroad? Reducing the number of infringements in Germany?

Aspect – Safety culture

Do you know to whom airspace infringements have to be reported and what to report ?

Do you share personal lessons learnt from situation like AI? With whom?

Appendix G – Report structure outline

1. General information about participants in the interview session

   Location of the interview
   Date
   Duration
   Number of pilots participating
   Profile of the pilots based on
        type of GA/pilot licence, number of years with licence
        type of aircraft flown
        number of flight hours on average per month/year,
        number of flight hours logged in the last 12 months
        hours/experience flying in other European countries
   Name of Compass IS moderator
   Name of EUROCONTROL representative

2. Description of the overall interview situation – level of readiness to respond; visibility of the participants during the brainstorming sessions; identification with the exemplary case studies presented; expectations

3. Report from the brainstorming session

   • Data from the interviewees' responses to the main question of the session: ***What are the 3 main reasons why a GA aircraft enters controlled or restricted airspace without a clearance?***

      - Summary of the priority list of causal factors which has emerged from the session
      - Comparison between the theoretical AI causal factor model (Annex E), presented to the pilots, and the factors which have emerged from the interviewees (based on the responses to questions from Annex F)
      - Quote a case study example based on the pilots' experience that contributes to the priority list of causal factors (optional)

   • Data from the brainstorming session on the mitigation of risk, responses to the main question: ***What could be the best 3 measures to prevent airspace infringements?***

      - Presentation of the priority list of measures which has emerged from the session

      - Review of the discussion on the risks of AI and the status of the measures used so far (based on the responses to questions from Annex F)

      - Quote a case study example based on the pilots experience (optional)

3. Summary of pilots' recommendations on the various aspects of improvement of procedures, regulations and equipment for the reduction of risk from AI

ANNEX 3   QUESTIONNAIRE

What is this survey about

This survey is an important step in the realisation of the latest EUROCONTROL safety improvement initiative which aims to reduce the risk of mid-air collisions owing to airspace infringements.

EUROCONTROL (the European organisation for the Safety of Air Navigation) is an international organisation of European states with its headquarters located in Brussels.

The objective of the survey is to collect and use pilots' experience and expertise in order to identify the most common causes which may lead to airspace infringements and the most promising actions which could be taken to reduce the number of infringements, as well as their impact on the safety of flight operations.

An active response from GA pilots is essential to meet this objective and make the sky safer for all of us.

What is an airspace infringement

A flight by a pilot into notified airspace (controlled, restricted, dangerous, or prohibited areas or zones) without his/her previously requesting and receiving approval from the controlling authority of that airspace.

Filling in the questionnaire

You are asked to answer the questions asked with regard to 14 basic situations which may lead to airspace infringements. The total number of questions is 70.

Some of the questions are multiple choice. However, the number of "ticked" answers to any one question must be kept to a reasonable minimum. The criterion to be applied is the highest likelihood of occurrence - in other words the most common reasons which may cause an infringement.

It will take you only 20 minutes to save somebody's life. Isn't it worth it?

Confidentiality

The information and personal views collected will be kept confidential and will be used solely in support of the airspace infringement risk analysis and mitigation.

GENERAL INFORMATION

G.1 What is your country of residence? .....

G.2 What is your native language? .....

G.3 What type of aircraft do you fly? .....

G.4 What is your qualification?

□ Student pilot

□ Private pilot

□ Private pilot with IFR rating

□ Commercial pilot

G.5 What is you flying experience (approximate number of flight hours recorded)?

Please, specify: .....

G.6 How many flight hours have you logged in the last 12 months?

Please, specify: .....

Situation 1: PILOT IS UNSURE OF AIRSPACE (he/she is flying in) OR OF AIRCRAFT POSITION OR IS LOST

1.1 How often could this happen to a GA pilot? (your best judgment)

□ Once in 3 flights

□ Once in 5 flights

□ Once in 10 flights

□ Other – please specify: ………

1.2 What could be the explanation (most common)?

 (more than one choice possible)

□ Not familiar with the airspace

□ Misidentified airspace (area, zone) boundaries

□ Flying direct route on ATC instruction

□ Lack of published VFR routes

□ Avoiding bad weather

□ Other - Please, specify: …………………………………………………………….

1.3 How often might this lead to an airspace infringement (your best judgment)?

□ Once every 5 times in a situation like this

□ Once every 10 times in a situation like this

□ Once every 20 times in a situation like this

□ Other – please specify: ………

1.4 What can be done to avoid such situations?

 Please specify: …………………………………………………………………………

1.5 Have you been in such a situation in the last 12 months?

□ Once   □ More than once   □ No

Situation 2: NAVIGATION EQUIPMENT FAILURE

2.1 Have you ever suffered a navigation equipment failure?

□ Yes   □   No

2.2 What was the failure?

□ GPS

□ Portable GPS

□ VOR

□ DME

□ NDB

□ Other - please specify: …………………………………………………….

2.3 How often might this lead to an airspace infringement (your best judgment)?

□ Once every 5 times in a situation like this

□ Once every 10 times in a situation like this

□ Once every 20 times in a situation like this

□ Other – please specify: ………

2.4 What can be done to avoid such situations?

Please specify: …………………………………………………………….

2.5 Have you suffered a navigation equipment failure in the last 12 months?

□ Once   □ More than once   □   No

Situation 3: PILOT FLIES WITHOUT RADIO CONTACT WITH ATC DESPITE THE FACT IT IS NEEDED OR REQUIRED

3.1 How often could this happen to a GA pilot? (your best judgment)

□ Once in 3 flights

□ Once in 5 flights

□ Once in 10 flights

□ Other – Please, specify: ………

3.2 What could be the explanation (most common)?

(more than one choice possible)

□ Radio failure

□ Busy frequency

□ No R/T coverage

□ Frequency not known

□ Wrong frequency selected

□ Stayed on FIS frequency (should have changed to ATC)

□ Unfavourable controller attitude

□ Other - please specify: …………………………………………………….

3.3 How often might this lead to an airspace infringement? (your best judgment)

□ Once every 5 times in a situation like this

□ Once every 10 times in a situation like this

□ Once every 20 times in a situation like this

□ Other – Please, specify: ………

3.4 What can be done to avoid such situations?

Please, specify: …………………………………………………………………

3.5 Have you been in such a situation in the last 12 months?

□ Once   □ More than once   □ No

Situation 4: PILOT MISUNDERSTANDS AN ATC CLEARANCE OR FLIGHT INFORMATION

4.1 How often could this happen to a GA pilot? (your best judgment)

□ Once in 3 flights

□ Once in 5 flights

□ Once in 10 flights

□ Other – Please, specify: ………

4.2 What could be the explanation (most common)?

 (more than one choice possible)

□ Distraction

□ Insufficient knowledge of R/T phraseology

□ Misinterpretation

□ Complex, unclear message

□ Language problems

□ Not familiar with the airspace

□ Other - please specify: …………………………………………………..

4.3 How often might this lead to an airspace infringement? (your best judgment)

□ Once every 5 times in a situation like this

□ Once every 10 times in a situation like this

□ Once every 20 times in a situation like this

□ Other – please specify: ………

4.4 What can be done to avoid such situations?

 Please specify: ………………………………………………………………….

4.5 Have you been in such a situation in the last 12 months?

□ Once   □ More than once   □ No

Situation 5: PILOT TAKES AND FOLLOWS A CLEARANCE MEANT FOR ANOTHER AIRCRAFT

5.1 How often could this happen to a GA pilot? (your best judgment)

□ Once in 3 flights

□ Once in 5 flights

□ Once in 10 flights

□ Other – Please, specify: ………

5.2 What could be the explanation (most common)?

 (more than one choice possible)

□ Distraction

□ Fatigue

□ Call-sign confusion

□ Language problems

□ Unclear message

□ Mistake

□ Other - Please, specify: …………………………………………………..

5.3 How often might this lead to an airspace infringement (your best judgment)?

□ Once every 5 times in a situation like this

□ Once every 10 times in a situation like this

□ Once every 20 times in a situation like this

□ Other – please specify: ………

5.4 What can be done to avoid such situations?

 Please specify: ………………………………………………………………….

5.5 Have you been in such a situation in the last 12 months?

□ Once   □ More than once   □ No

Situation 6: **PILOT IS UNABLE TO FOLLOW THE INTENDED FLIGHT PATH**

OWING TO AIRCRAFT CONTROL PROBLEM (vertical or lateral plane)

6.1 How often could this happen to a GA pilot? (your best judgment)

□ Once in 3 flights

□ Once in 5 flights

□ Once in 10 flights

□ Other – please specify: ………

6.2 What could be the explanation (most common)?

(more than one choice possible)

□ Turbulence

□ Cloud build-up (CB)

□ Icing

□ Too many tasks at the same time

□ Mislead by GPS

□ Other - please specify: …………………………………………………….

6.3 How often might this lead to an airspace infringement? (your best judgment)

□ Once every 5 times in a situation like this

□ Once every 10 times in a situation like this

□ Once every 20 times in a situation like this

□ Other – Please, specify: ………

6.4 What can be done to avoid such situations?

Please specify: …………………………………………………………………

6.5 Have you been in such a situation in the last 12 months?

□ Once   □ More than once   □ No

Situation 7: PILOT CANNOT OBTAIN THE REQUIRED FLIGHT INFORMATION OR ATC CLEARANCE

7.1 How often could this happen to a GA pilot? (your best judgment)

☐ Once in 3 flights

☐ Once in 5 flights

☐ Once in 10 flights

☐ Other – Please, specify: ………

7.2 What could be the explanation (most common)?

(more than one choice possible)

☐ Don't know where to find it

☐ Difficult to access/not available free of charge

☐ Busy frequency

☐ Service provided is not tailored to VFR flight needs

☐ ATS staff not familiar with aircraft performance

☐ Other - please specify: ……………………………………………………

7.3 How often might this lead to an airspace infringement? (your best judgment)

☐ Once every 5 times in a situation like this

☐ Once every 10 times in a situation like this

☐ Once every 20 times in a situation like this

☐ Other – Please, specify: ………

7.4 What can be done to avoid such situations?

Please, specify: ……………………………………………………………………..

7.5 Have you faced such a situation in the last 12 months?

☐ Once   ☐ More than once   ☐ No

Situation 8: PILOT ENTERS CONTROLLED OR RESTRICTED AIRSPACE WITHOUT ASKING FOR AND OBTAINING CLEARANCE FROM ATC OR THE MILITARY

8.1 How often could this happen to a GA pilot? (your best judgment)

□ Once in 3 flights

□ Once in 5 flights

□ Once in 10 flights

□ Other – please specify: ………

8.2 What could be the explanation (most common)?

(more than one choice possible)

□ Avoiding bad weather

□ Pilot unaware of the need to obtain clearance

□ Communication skills not sufficient

□ Frequency not known

□ FIS controller expected to arrange it

□ To fly the preferred route (which ATC would not normally clear)

□ Distraction

□ Workload

□ Emergency situation on board

□ Other - please specify: …………………………………………………….

8.3 What can be done to avoid such situations?

Please specify: ……………………………………………………………………

Situation 9: **PILOT IS UNABLE TO COMPLY WITH THE CONDITIONS (LIMITS) OF AN ATC CLEARANCE**

9.1 How often could this happen to a GA pilot? (your best judgment)

□ Once in 3 flights

□ Once in 5 flights

□ Once in 10 flights

□ Other – Please, specify: ………

9.2 What could be the explanation?

(more than one choice possible)

□ ATC clearance not compatible with flight objectives/pilot intentions

□ ATC clearance not compatible with aircraft performance

□ ATC clearance misunderstood

□ ATC clearance late

□ Weather avoidance

□ Conflict avoidance

□ Distraction

□ High cockpit workload

□ Other - please specify: …………………………………………………………….

9.3 How often might this lead to an airspace infringement? (your best judgment)

□ Once every 5 times in a situation like this

□ Once every 10 times in a situation like this

□ Once every 20 times in a situation like this

□ Other – Please, specify: ………

9.4 What can be done to avoid such situations?

Please specify: …………………………………………………………………………….

9.5 Have you been in such a situation in the last 12 months?

□ Once   □ More than once   □ No

10. HAVE YOU EVER MADE AN AIRSPACE INFRINGEMENT?

□ Yes □ No

If "Yes", then

10.1 What was the explanation for it?

Please specify: …………………………………………………………………

10.2 Did this lead to a conflict (close encounter) with another aircraft?

□ Yes □ No

10.3 How did you discover that you had committed an infringement?

□ Warned by ATC

□ Other – please specify: …………………………………………………..

10.4 What was the nature of flight?

□ Training flight

□ Private flight

□ Business/passenger flight

□ Other – please specify: …………………………………………………..

10.5 What method of navigation were you using?

□ Visual

□ Conventional navaids (VOR/DME/NDB)

□ GPS

□ Moving map

10.6 Was your transponder switched on?

□ Yes □ No

10.7 What could have prevented this from happening?

Please specify: ………………………………………………………………….

Three infringement scenarios are presented below. Please, use your best judgement and give the rating (from 1 to 5) you consider appropriate to answer the questions.

Situation 11: **A FLIGHT ENTERS CONTROLLED AIRSPACE WITHOUT CLEARANCE OWING TO BAD WEATHER AND/OR A POOR-QUALITY COMMUNICATION LINK WITH ATC**

11.1 How serious do you consider this to be?

Not at all serious   Very serious

□ 1   □ 2   □ 3   □ 4   □ 5

11.2 How serious do most GA pilots in your country consider this to be?

Not at all serious   Very serious

□ 1   □ 2   □ 3   □ 4   □ 5

11.3 Is this considered a violation of existing rules in your country?

Definitely not   Definitively yes

□ 1   □ 2   □ 3   □ 4   □ 5

11.4 Do you think that the regulator should take any measures in such a case?

□ None

□ Review/change rules or procedures

□ Perform competency check on the pilot

□ Impose a fine on the pilot

□ Other – please specify: ………………………………………………………….

Situation 12: **A FLIGHT ENTERS A PROHIBITED ZONE WITHOUT CLEARANCE OWING TO NAVIGATION FAILURE (E.G. USE OF OUT-OF-DATE MAP/CHART)**

12.1 How serious do you consider this to be?

Not at all serious   Very serious

□ 1   □ 2   □ 3   □ 4   □ 5

12.2 How serious do most GA pilots in your country consider this to be?

Not at all serious   Very serious

□ 1   □ 2   □ 3   □ 4   □ 5

12.3 Is this considered a violation of existing rules in your country?

Definitely not   Definitively yes

□ 1   □ 2   □ 3   □ 4   □ 5

12.4 Do you think that the regulator should take any measures in such a case?

□ None

□ Review/change rules or procedures

□ Perform competency check on the pilot

□ Impose a fine on the pilot

□ Other – please specify: ……………………………………………………………

Situation 13: **A PILOT FLIES THROUGH A RESTRICTED (MILITARY) ZONE IN ORDER TO MAKE A SHORTCUT AND ARRIVE IN TIME FOR ANOTHER ACTIVITY AT HIS DESTINATION**

13.1 How serious do you consider this to be?

Not at all serious   Very serious

□ 1   □ 2   □ 3   □ 4   □ 5

13.2 How serious do most GA pilots in your country consider this to be?

Not at all serious   Very serious

□ 1   □ 2   □ 3   □ 4   □ 5

13.3 Is this considered a violation of existing rules in your country?

Definitely not   Definitively yes

□ 1   □ 2   □ 3   □ 4   □ 5

13.4 Do you think that the regulator should take any measures in such a case?

□ None

□ Review/change rules or procedures

□ Perform competency check on the pilot

□ Impose a fine on the pilot

□ Other – please specify: …………………………………………………………….

14. **DO YOU THINK THAT THE "SEE AND AVOID" CONCEPT CAN ENSURE THE SAFETY OF VFR FLIGHTS IN THE FUTURE?**

□ Yes   □ No

14.1 What is the explanation?

Please specify: …………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

14.2 What can be done to improve the safety of VFR flights?

Please specify: …………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

End

ANNEX 4   INTERVIEW MEETING REPORTS

Interview meeting with GA pilots in Egelsbach, Germany
Meeting report

1. General information about participants in the interview session

Location of the interview	Egelsbach, Germany
Date	17 July 2007
Duration	3.5 hours
Number of pilots participating	seven (7)

2. General information

The interview was hosted by AOPA Germany at the Egelsbach airport. It took place in the seminar room of the AOPA office, which was equipped will all necessary facilities for the smooth following of all steps in the interview scenario. The pilots present were open and cooperative, the overall tone of the interview was friendly, and the answers came out of a fruitful discussion during the brainstorming sessions.

3. Participants' profiles

Pilot 1:
- Licence: CPL, IFR, instructor (at commercial flight school)
- Flying experience: 30 years, 2,500 hours
- Experience abroad: USA and Central Europe

Pilot 2:
- Licence: ATPL, CPL, instructor, retired pilot examiner, simulator engineer at Lufthansa
- Flying experience: 25 years, 120 hours/month
- Type of aircraft flown: From gliders to B737s (also DC 3s)
- Experience abroad: USA and Europe

Pilot 3:
- Licence: CPL IFR, instructor
- Flying experience: 18 years, 600 hours, 20 hours/year
- Type of aircraft flown: Cessna 152/172, Piper Seneca
- Experience abroad: USA and France

Pilot 4:
- Licence: PPL - leisure pilot
- Flying experience: 24 years, 500 landings; flying with tourists; 10 hours/month
- Type of aircraft flown: Cessna 152/172, Piper Seneca
- Experience abroad: Nordic seas, Scandinavian countries and France

Pilot 5:
- Licence: PPL VFR,
- Flying experience: 38 years, 500 hours; holiday flying;10 hours/year
- Type of aircraft flown: single-engine aircraft
- Experience abroad: France and Italy

Pilot 6:
- Licence: CPL IFR
- Flying experience: 15 years, 30 hours/year
- Type of aircraft flown: single-engine aircraft
- Experience abroad: France, Northern and Southern Europe

Pilot 7:
- Licence: ATPL CPL, instructor
- Flying experience: 30 years, 10,000 hours; 600 hours/year
- Type of aircraft flown: Cessna
- Experience abroad: USA and Europe

4. Brainstorming session I – causal factors

This section provides a summary of the interviewees' responses to the main question of the session:
What are the 3 main reasons why a GA aircraft enters controlled or restricted airspace without a clearance?
The session lasted two hours and the interviewees were active in providing a long list of causal factors. In the lively discussion, the pilots gave various examples of their in-flight experience, which were good illustrations of the factors given.

The pilots were united in stating that airspace infringements are not committed with bad intentions, but when intentionally committed it was because the pilot wanted to:
- avoid heavy traffic areas;
- make a shortcut;
- avoid bad weather.

4.1. Human-factors-related problems
- Distractions

Distraction in-flight may be caused by passengers, time pressure, complex procedures or the fact that the pilot is alone.
- Heavy workload

- Cost of flying

On several occasions the pilots referred to the cost factor. They considered the cost of a flight hour as an important (prohibitive) factor which makes a lot of recreational pilots reduce their flights to a bare minimum, thus preventing them from maintaining their piloting and navigation skills at the required level.
The cost factor is also vital for getting regular aeronautical information updates in an easier way through a dedicated subscription. It was pointed out that many pilots terminate their subscriptions owing to the associated high fees. The cost of new required equipment (e.g. transponders) is significant, and last but not least it determines the choice of where to fly and land, because landing charges at big airports seem too high for GA pilots.

4.2 Aeronautical-information-related problems

- Lack of standardised maps and charts

Differences in standards was pointed out as a reason which can contribute to poor flight preparation and distract a pilot in-flight from recognising an object on a map/chart. In addition

to the difference in colours and symbols, one pilot mentioned that choice of scale is also sometimes impractical.

- Insufficient flight planning

The pilots were of the opinion that poor flight planning (preparation) is due to either inexperience or neglect. Good practice in flight preparation is gradually being abandoned and beginner pilots do not develop the habit of doing proper flight planning.

- Lack of a single integrated aeronautical information facility

There is no single source of aeronautical information which could provide the required data for any flight. A pilot spends a lot of time searching in various sites and sources. The pilots provided as an example of best practice the free call number for aeronautical information in the US.

- NOTAMs difficult to understand

It is difficult and time-consuming to filter out information relevant to VFR flights. In addition, the descriptions of active danger and restricted airspace in numerical form (Lat/Long-s) make it practically impossible for GA pilots to understand the actual dimensions and location of such areas. Graphical presentation was considered essential.

4.3 Pilot skills (airmanship) problems

- Unfavourable attitude of instructors

As far as training is concerned, the pilots found JAR requirements fairly sufficient, but the instructors (safety) attitude unfavourable. In some flight schools, the instructors do not transfer the knowledge to the students if they find it impractical. They do not teach the students how to call/contact/use the FIS. The initial training is focused on teaching the basic flying skills (e.g. how to land the aircraft safely). Navigation and R/T training is secondary. There is no obligation for a pilot to switch on the transponder when equipped with one, and some instructors therefore teach the student not to do so.

- Language problems abroad

A general observation was made during the interview that especially in France and Spain, FIC controllers are reluctant (or do not know how) to speak English.

- Insufficient recreational pilot training

As far as continuous training was concerned, the pilots discussed the lack of assurances of being a "safe pilot". Once the regular check has been passed, no one examines the pilot if he is prepared to make a long cross-country flight by himself.

4.4 ATS-related problems

- Inadequate ATC service for VFR pilots

ATCOs do not want trainees in their sector. Pilots often face ATC instructions such as "avoid all restricted airspace" .

4.5. Navigation-related problems

- Problems of using GPS

For a pilot who has been trained to use ordinary paper maps/charts, the GPS system

sometimes provides less information about the current airspace than an ordinary map/chart. This is the case when the GPS does not have a graphical display of the airspace but shows only the route which the aircraft should follow. The pilots are unsure of and unconfident about their position, because if they rely only on the GPS system, they do not know what lies between the first and the last point of their route.

- Lack of knowledge of airspace structure

The pilots referred to the fact that there are differences in the standards used and classifications of airspace structure in the various European countries. When a pilot flies from one country to another, he/she is not sure of the class of airspace that he/she is flying in.

- Too many military zones.

4.6. Environment

- Bad weather

All pilots considered the weather to be a major problem, especially in terms of increasing the level of stress in the cockpit. It was pointed out as a reason for unintentional infringements. However, specific weather characteristics, such as "wind", "thunderstorm", "icing" or "low cloud-base" were not mentioned as separate problems.

5. Causal factor prioritisation

The participants were divided into two groups. Each group was given a set of cards with causal factors printed on them and asked to choose 10 factors which could most likely cause an airspace infringement. The list of causal and contributory factors developed by the AI causal factor modelling study was used for this purpose.

Group 1 prioritised list:
1. Inadequate training/navigation skills

2. Unfavourable attitude to VFR flights

3. High workload

4. Bad weather

5. Airspace structure difficult to identify in flight

6. Inadequate knowledge of airspace structure status

7. Complex or unclear airspace use procedures

8. Honest mistake

9. Use of out-of-date maps/charts

10. NOTAMs difficult to understand

The pilots from that group were of the opinion that the problem of training is essential for the GA community. Many GA pilots do not have the proper navigation and flying skills, which increases the risk of infringements.
Also, the group believed that among controllers there is an unfavourable attitude towards VFR flights. One participant spoke of a common joke that the unwritten rules in the German ATC say that if a controller has misbehaved he is assigned to provide services to VFR flights.

Behind the joke laid the conviction that there is tension between the pilot community and the controller community, which sometimes leads to lack of air-ground communication.

The importance of the high workload factor is to a great extent linked to the fourth factor – bad weather which along with other sources of stress or distraction can lead to an infringement.

Group 2 prioritised list:

1. Use of out-of-date maps/charts

2. NOTAMs difficult to understand

3. Inadequate knowledge of airspace use procedures

4. Inadequate training/navigation skills

5. Bad weather

6. High workload

7. Insufficient experience

8. GA sites situated close to CAS

9. Distraction

10. Low quality (unclear maps/charts)

Group 2 considered the inadequate sources of aeronautical information - maps/charts and NOTAMs - as two major reasons for AI. The third factor is connected with the role of training, which the group considered important for becoming a safe pilot.

6. Brainstorming session II – mitigation measures

This section provides a summary of the interviewees' responses to the main question of the session: ***What could be the best 3 measures to prevent airspace infringements?***

6.1. Regulation-related problems

- European AIS for GA free of charge

- Licence validation checks

The flight check should include an assessment "satisfactory/not satisfactory" and the training course should also include some basic theory.

6.2. Navigation-related problems

- Mode S transponders

They are very costly and do not benefit GA because the TIS is not supported (provision of radar information from the ground station to the cockpit)

- Periodical refresher training/checks for pilots

- Dedicated training of flight instructors

- Focus on navigation training

A pilot has to learn how to use the map/chart properly. Using the correct map/chart also means also knowing how to mark and note the route on it. It was also recommended that the pilot should monitor the plane's position at 3-minute intervals, in order to have situational awareness.

- Harmonised training curriculum for GA pilots

The training should also include flights in the airspace of foreign (neighbouring) countries.

6.3. Aeronautical-information-related problems

- Standardised VFR charts across Europe, including more appropriate scales (e.g. 1:250 000)

- Digital radio – as a simple and universal means of contact between controllers and pilots

- Integrative software which can download and uplink information in-flight

- Improved pre-flight briefings (integrated briefing facilities and package – "one-stop shop")

6.4. ATS/FIS-related problems

- Improve FIS

- Harmonised training of ATCOs to handle VFR flights

6.5. Safety culture problems

- Develop a dedicated GA website for the sharing of experience and lessons learnt

7. Conclusions

The meeting produced considerable input in a number of areas. It showed the pilots' interest in and readiness to respond to this safety improvement initiative. The pilots expressed an interest in receiving feedback from this study.

Interview meeting with GA pilots in Amsterdam, Netherlands
Meeting report

1   General information about participants in the interview session

Location of the interview	Amsterdam Schiphol, NL
Date	24 July 2007
Duration	3.5 hours
Number of interviewees	8

2   General information

The interview was held in the building of the Dutch ATM service provider (LVNL) at Schiphol, Amsterdam (LVNL). There were 7 pilots and on ATCO participating in the discussions. The sample of profiles ranged from very experienced pilots with CPLs to beginners who had held a PPL for only a year or were still under training to get a licence. All of them showed readiness to take part in the brainstorming sessions and offered a number of recommendations for the reduction of the risk from airspace infringements (AIs).

3   Participants' profiles

FIC Controller:
FIC controller at Amsterdam ACC, providing FIS, TIS (traffic information service) and alerting service for VFR flights in Dutch airspace and over an area of the North Sea
Pilot 1:
- Licence: CPL, IFR, instructor
- Flying experience: 44 years, 2,000 hours
- 80 hours in the last 12 months
- Type of aircraft flown: over 40 different types including gliders, powered fixed-wing aircraft and helicopters
- Experience abroad: Almost all over Europe, in the USA, Asia, Northern Africa

Pilot 2:
- Licence: PPL
- Flying experience: 20 years, 300 hours
- 30 hours in the last 12 months
- Type of aircraft flown: PA 28
- Experience abroad: joining flying cruises across Europe organised by his flying club for the last 4 years

Pilot 3:
- Licence: CPL (ATPL), chief flight instructor and examiner at an flying club
- Flying experience: 37 years, 9,000 hours
- 200 hours in the last 12 months
- Type of aircraft flown: more than 100 types, including powered gliders and microlights
- Experience abroad: all over Europe, Arabic countries, Asia, Qatar

Pilot 4:
- Licence: PPL; previous experience as a controller in The Hague

- Flying experience: 20 years, 500 hours
- 15 hours in the last 12 months
- type of aircraft flown: Cessna, Piper
- Experience abroad: none

Pilot 5:
- Licence: PPL
- Flying experience: 9 years, 200 hours
- 10 hours in the last 12 months
- Type of aircraft flown: Cessna, Piper F 21; aerobatics
- Experience abroad: Germany, France, the UK, Belgium

Pilot 6:
- Licence: student pilot
- Flying experience: 40 hours
- 40 hours in the last 12 months
- Type of aircraft flown: Diamond Aircraft Katana
- Experience abroad: none

Pilot 7:
- Licence: PPL
- Flying experience: 1 year, 70 hours
- 25 hours in the last 12 months
- Type of aircraft flown: Cessna 152/172, Diamond Aircraft Katana
- Experience abroad: none

4   Brainstorming session I – causal factors

This section provides a summary of the interviewees' responses to the main question of the session:
What are the 3 main reasons why a GA aircraft enters controlled or restricted airspace without a clearance?

The participants were aware that most of the causes of AI are intricately interrelated and one often leads to another. The interviewees started by pointing out several factors, but ended up by combining reasons and explaining the points of intersection (chains of contributory factors linked together).
The factors listed below were considered by the participants to have contribute most to airspace infringements.

4.1   Human-factors-related problems

A large group of factors which the pilots and controllers attributed to human performance and behaviour during the flight and the flight preparation (briefing) phase. The following factors were immediately pointed out as very common reasons for entering controlled space without a clearance:
- High workload

- Honest mistake

- Distraction

- Stress

The pilots attributed stress to a "series of concurring events that can distract them from following the route. Navigating, communicating to ATCOs, and coping with bad weather can raise the level of "pressure in the cockpit". It was pointed out that inexperienced pilots are more likely to be exposed to high stress. Often the stress is a result of inadequate flight planning. The participants agreed that careful flight preparation is a pilot's responsibility, which has to be taken seriously irrespective of the level of experience.

4.2   Aeronautical-information-related problems

- Insufficient flight preparation

    It was pointed out that pilots were not in the habit of preparing for flights. Preparation for a flight by thoroughly checking the route, the weather and the airspace structures along the route is not performed by every GA pilot. Consequently, unexpected changes may not be taken into account, which can lead to an infringement.

- Routine

    The habit of flying the same route to the same destination for a long time was pointed out as a factor which can give pilots false confidence. This increases the likelihood that unexpected in-flight changes may lead to airspace infringements.

- Difficulty of reading NOTAMs

    An important problem is the difficulty of reading NOTAMs and the time needed to do so. The abundance of abbreviations and the large number of NOTAMs irrelevant to VFR flights often make the pilots skip this important flight preparation activity, thus ignoring important information for their flight. It is difficult and time-consuming to filter out relevant information, and this is often not possible owing to the lack of graphical presentation (e.g. activation of a military zone described by lat/long coordinates).

- Use of out-of-date maps/charts

    A GA pilot has various means of getting up-to-date information about his/her flight and prepare a flight plan. Maps and charts are a problem, however, with lots of pilots cancelling their subscriptions owing to financial considerations and the large amount of information to be replaced at each update cycle, which in most cases does not concern VFR flights.

- Cluttered maps and charts

    The problem is often linked to the airspace design. Too many bits of information in a limited space make it difficult to identify important/required information, especially when time is short during a flight.

4.3   Pilot skills (airmanship) problems

- Insufficient navigation skill training

    An extensive discussion took place when the human factors problem was linked to the question of education and training of the pilots. The experienced instructors insisted on a phased training which starts with developing skills to fly visually, continues by training the use of conventional navigation aids (VOR/DME/NDB), and then teaches pilots how to handle GPS, transponders and TCAS. One of the pilots mentioned the practice of some flying schools to provide not only practical flying lessons, but also limited information about airspace classification.

- Insufficient communication skill training

    Pilots receive insufficient training for air-ground communication with ATC or how to communicate with ATCOs. Especially the less experienced pilots insisted on the fact that

anxiety and stress during flights caused by this insufficient training can give the feeling of being lost and cause AIs. Some pilots got better training simply by having the chance to depart and arrive through controlled airspace during their initial training.

- Communication procedures (with ATS) not known

- Use of foreign language

The communication problem was raised both by the FIS controller present and a few of the pilots. Besides anxiety, another factor that makes air-ground communication difficult is the language problem. Special complaints were received about French ATCOs, who do not respond to the calls of the GA pilots made in English (except in emergency situations).

4.4   ATS-related problems

- Unfavourable attitude towards VFR flights

The pilots agreed that there are several aspects of the problems of communication between pilots and controllers, and sometimes it is not so much the language and the pilots' personal anxiety about contacting the tower when he/she has made a mistake, but the unfavourable attitude of the ATCOs towards VFR flights. It was mentioned that in some situations VFR flights are assigned a lower priority even by FIC. The controller in the group of participants described the responsibilities of his job and the readiness to provide information if he receives a request in the first place.

- Insufficient FIS (in terms of scope)

One factor connected with the difficulty of identifying for example the airspace structure in flight is that pilots consider FIS insufficient to provide all information they need. The amount of information provided to pilots varies depending on the FIS controller skills, workload and training. The provision of traffic information (or failure to provide such information) was given as an example of the above.

- Non-standard FIS

Provision of FIS is not at a common level even among the FIC controllers in the same centre.

- Inefficient use of transponders

In certain areas of airspace and situations, pilots are asked by ATC to switch off the transponder to prevent unwanted TCAS alerts.

4.5   Navigation-related problems

- Complex airspace design

The pilots regard the complexity of airspace as a major problem which can contribute to situations in which pilots get lost in the air. A pilot from the group called for a change of approach towards airspace – the design criteria should also include the user perspective and needs.
Another related problem is the lack of information about the current changes in the airspace structure, e.g. activation/deactivation of segregated airspace.

- Pilots not trained to use GPS

The pilots were united on the principle that once a GA pilot has learned to fly using visual navigation, he/she has to be trained to use modern navigation techniques as much as possible in order to avoid any infringements.

5   Causal factor prioritisation

The participants were divided into two groups. Each team was given a set of cards with causal factors printed on them and asked to choose 10 factors which could most likely cause an airspace infringement. The list of causal and contributory factors developed by the AI causal factor modelling study was used for this purpose.

The two groups chose and prioritised the relevant factors. A speaker from each group provided arguments why they had chosen that specific factor to be a major reason for infringements. There was a suggestion that the priority list can change if there is a change of perspective, e.g. a GA pilot's prioritised list will differ from a controller's list, and also from a commercial pilot's list, etc.

Below are the priority lists and the logic of the team for arranging their list as they did:

Group 1 prioritised list:
1. Honest mistake

2. High workload, especially for inexperienced pilots

3. Airspace structure difficult to identify in flight

4. Complex or unclear airspace use procedures

5. Inadequate (training) navigation skills

6. Low quality of maps/charts

7. Navigation equipment failure

8. Use of out-of-date maps/charts

9. Distraction

10. Inadequate knowledge of navigational data and aids

The pilots shared the opinion that airspace infringements are not intentional, but often the result of pilots' mistakes. The problem of high workload had already come up in the previous session and the group related it to the complexity of managing the flight and of communicating with ATCOs. The third most important reason includes as contributory factors the problems related to the use of maps/charts and other flight information which is difficult to understand (NOTAMs).

Group 2 prioritised list:
1. High workload

2. Complex or unclear airspace use procedures

3. Busy ATC frequency

4. Wrong expectations about the level of ATC service

5. NOTAMs difficult to understand

6. Honest mistake

7. Inadequate R/T skills and discipline

8. Low quality of charts

9. Low cloud-base

10. VFR routes close to restricted/controlled airspace

Group 2 gave another perspective to the importance of "high workload" as a causal factor. It can prevent the pilot from proper execution of the flight, when time or passengers put pressure on the pilot. Similarly to group 1, very high priority was given to "complex or unclear airspace use procedures". This factor was related to the use of maps/charts and the complex airspace classification. As for the third most important factor – "busy ATC frequency" – this group (in which there were two working instructors) considered it important for beginner pilots but not so important for experienced ones.

6   Brainstorming session II – mitigation measures

This section provides a summary of the interviewees' responses to the main question of the session:
What could be the best 3 measures to prevent airspace infringements?

6.1   Airspace-design-(regulation)-related problems

- Reduce airspace complexity

  This was considered to be of major importance by all participants. It includes reviewing and updating airspace design criteria and priorities, taking due account of the fact that users will need to fly in this airspace.

- Harmonisation and simplification of airspace classification

  The participants all agreed on the need for harmonisation and simplification of airspace classification in Europe, and its use procedures will contribute to better and safer regulation of air traffic.

6.2   Aeronautical-information-related problems

- Standardisation and simplification of maps and charts

  A common recommendation which appeared in the list of almost every participant was the need for identical, standardised charts. There was a call for the charts to be redesigned and made easier to understand.

- Implement NOTAM selection (prioritisation) tool

  The idea of grouping NOTAMs by topic, allowing for the generation of "type-of-user-tailored briefing packages" was subsequently articulated in the first and second brainstorming sessions. In addition, one pilot suggested creating user-type-based NOTAM update packages (e.g. for GA VFR flights) and adding a short descriptive document which would outline changes in traffic schemes and airspace.

- Integrated aeronautical briefing facility

  For the sake of more concise airspace information, the pilots suggested the creation of a "one-stop shop" allowing a pilot to all information he/she needed for his/her flight preparation on one site in a user-friendly manner.

6.3   ATS/FIS-related problems

- Improve FIS : extend scope and harmonise FIS provision across Europe

Another major group of recommendations which emerged throughout the discussions was the improvement of the FIC service. This included addressing the problem of misunderstandings between pilots and controllers and the provision of warnings to pilots of any unfavourable factors, including airspace infringements and traffic warnings. The FIS level needed to be raised to proactive prevention of potential conflict situations.

6.4   Pilot skills (airmanship) problems

• Refresher training for recreational pilots

• Improve pilot proficiency checks beyond simple aircraft handling

The experienced instructors suggested more serious training for pilots intending to make cross-country flights.

• Improve pilot navigation skill training

The pilots agreed that in order to gain proficiency in flying VFR, pilots have to acquire knowledge of the basic ("primary") navigation aids and then gradually learn the use of GPS systems and new-technology navigational aids.

6.5 Navigation-related problem

• Use of modern technology

A measure which one pilot considered feasible to reduce AI was "mandatory use of technology" in air navigation, given that the pilots are well trained in visual navigation beforehand. The use of Mode S transponders is still not considered to be of benefit to GA, but there is awareness that it will improve FIS and will help in the mitigation of risks during flights.

6.6. Safety culture problems

• Improve the safety culture

The participants were on the opinion that awareness materials have limited and temporary effect, but efforts have to be made to raise the safety awareness of instructors at flying schools.

7   Conclusions

The meeting produced considerable input in a number of areas. It showed the pilots' interest in and readiness to respond to this safety improvement initiative. Pilots expressed an interest in receiving feedback from this study.

Interview meeting with GA pilots in Lisbon, Portugal
Meeting report

1   General information about participants in the interview session

Location of the interview	Lisbon, NAV Portugal Training Centre
Date	30 July 2007
Duration	3.5 hours
Number of interviewees	11

2   General information

The interview meeting was held in Lisbon in the building of the Training Centre of NAV Portugal, the Portugal Air Navigation Service Provider. Eleven pilots accepted the invitation of NAV and EUROCONTROL and participated in the discussions. The sample of profiles ranged from very experienced pilots with CPLs to beginners who had held PPLs for only a year or were still being trained for their licences. All of the pilots were cooperative, took part in the brainstorming sessions and offered a number of recommendations for reducing the airspace infringement risk. An interest was expressed in receiving feedback information about the progress of the initiative and the agreed European recommendations.

1   Participants' profiles

Pilot 1:
Licence: CPL, PPL

Flying experience: 75 years, 19,600 hours

None in the last 12 months

Experience abroad: France

Aircraft: HS-748

Pilot 2:
Licence: CPL, PPL, instructor

Flying experience: 16 years, 3,000 hours

450 hours in the last 12 months

Experience abroad: none

Aircraft: ULM

Pilot 3
Licence: CPL, PPL

Flying experience: 15 years, 2,500 hours

350 hours in the last 12 months

Experience abroad: in Europe, France, Germany

Pilot 4:

Licence: PPL

Flying experience: 17 years, 3,000 hours

500 hours in the last 12 months

Experience abroad: none

Pilot 5:

Licence: student PPL

Flying experience: N/A

N/A

Experience abroad: N/A

Pilot 6:

Licence: PPL, ATPL

Flying experience: 13,000 hours, 1,200 in microlights

750 hours in the last 12 months

Experience abroad: no

Aircraft: A310, microlights

Pilot 7:

Licence: PPL

Flying experience: 100 hours

3 hours in the last 12 months

Experience abroad: no

Aircraft: Ultralight

Pilot 8:

Licence: PPL

Flying experience: 3,000 hours

150 hours in the last 12 months

Experience abroad: Brazil

Aircraft: Ultralight

Pilot 9:

Licence: PPL, CPL

Flying experience: 3,000 hours

900 hours in the last 12 months

Experience abroad: France, Italy

Aircraft: Cessna

Pilot 10:

Licence: PPL, CPL

Flying experience: 150 hours on twin-engine, 2,000 hours on single-engine, 150 hours on ultralights, 200 hours on gliders, 500 hours on IFR, 1,300 hours as an instructor

350 hours in the last 12 months

Experience abroad:

Aircraft: single-engine, twin-engine and ultralights

Pilot 11:

Licence: PPL

Flying experience: 250 hours as an instructor

40 hours in the last 12 months

Experience abroad: Switzerland, France

Aircraft: Piper

2   Brainstorming session I – causal factors

This section provides a summary of the interviewees' responses to the main question of the session:

What are the 3 main 3 reasons why a GA aircraft enters controlled or restricted airspace without a clearance?

In a two-hour discussion, the pilots provided their explanations for the causes of airspace infringements. The participants most frequently addressed several factors that belonged to three major groups – (1) airspace management and the Aeronautical Information Service, (2) training and regulatory oversight and (3) human factors. Within the other factors, the most frequently mentioned was pre-flight preparation, although the reasons for sub-optimal preparation were spread between training to establish reliable habits and availability of facilities, including Internet-based tools.

2.1   *Airspace management and the Aeronautical Information Service*

- Restricted but unused airspace

Some pilots expressed the opinion that it is a generally known fact within the GA community that particular airspace is restricted but actually very rarely used. The explanation of this fact is historical – the airspace was reserved for certain military operations or for search and rescue activity in periods when it was much more frequently used than nowadays. This has a negative influence on the pilots' morale, and they have started developing a lack of respect with regard to the restrictions. However, the restricted airspace is still used, albeit rarely, and if the periods of use coincide with violations, then dangerous situations can develop. An example was given of a search and rescue squadron which does not operate but maintains a huge restricted area.

- High volume of restricted airspace

There is a subjective feeling that not only is use of such airspace in terms of time very marginal, but also that there are much more restricted areas than are actually needed. There is feeling that the airspace is "over-crowded" with restricted areas.

There is perceived feeling that the military authorities actually hold the key to the allocation of airspace.

There were some reports from the participating pilots of actual situations like the one described above, including a story of actual infringement. As reported: "*the areas may operate only 5 times a year, but they are protected all the time*".

- Availability of airspace status information

A related question which could also be classified within the area of aeronautical information management was about the less-than-efficient system for a clear, simple and reliable chain of information delivering the actual status of airspace to the GA users.

A discussion took place on the accessibility and usefulness of information allowing efficient pre-flight preparation. One pilot stated: "*I am not going to devote three hours to prepare for a half-hour flight*".

- Difficulty of reading NOTAMs

It was stated that very often the NOTAMs are 12 pages long, which means a lot of reading, and the actual outcome is that they are not read at all or not read properly.

It is not only the volume of information but also the user-friendliness and ease of understanding which are a problem. It was stated that it would be good practice to post the relevant NOTAM/other information at the exact geographical position to which it referred on a wall map. Another idea was that this could be done even better electronically, as it already is in some States.

- Availability of current aeronautical VFR maps/charts

It is generally difficult to get current updated maps/charts - "*We use very old navigation maps – 15 years old*". This impairs the quality of the pre-flight preparation. It was reported that pilots use different web sites to obtain aeronautical information, but it is not always easy to get Internet access at the place of pre-flight preparation.

- Outdated GPS information

Some pilots acknowledged the fact that "*99% of the time we fly with old information in the GPS*". Not all the changes and restrictions are entered in the GPS. Some pilots may only look occasionally in a semi-systematic way for changes and keep them in mind – such as knowing that a frequency has changed, etc.

- Availability of GA-relevant meteorological information

It was firmly stated that the information available is not aimed at GA operations, and therefore of little use. The meteorological office considers commercial aviation to be their main "clients" and the service is totally customised for them. Some US sites were mentioned as sources of information about Portugal.

2.2 *Training and regulatory oversight*

- Regulatory control of training and licensing

There is perceived lack of regulatory control over GA both in rule-making and in actual oversight. Licences of parachutists and paragliders are issued by their respective federations. Ultralight aircraft are licensed by the authority. The regulators do not control the schools for microlights and paragliding. Some examples were given about ultralights.
It was reported that sometimes "*after initial training, people still do not know the actual capabilities of the aircraft*". The training is not really considered to be an ongoing process – rather to obtain the licence only.

- No system for ongoing oversight

In some cases, there is no guaranteed minimum level of knowledge and skills, and in others

there is a deterioration in those initially acquired. Also, the emphasis is sometimes put in the wrong place – not on navigation but on flying the aircraft, and "*at this stage they should already know how to fly*".

- Familiarisation of pilots who are not local

It was stated that pilots (newcomers or based in another region) do not know the local circumstances and there is no way of transferring the knowledge systematically. Sometimes a briefing/reception is organised, but these tend to be on an ad-hoc basis. Examples were given of an area where wind shear is almost always present, and of some good local practices.

2.3 *Human factors*

- False expectations about the service

Military authorities provide services in Class G airspace. It was stated that they are not busy servicing air transport and can pay attention to GA flights. Communication is a problem, as military staff are not trained in and do not practice English. On the other hand, there is generally a very high appreciation of the level of service provided – "*Very good flight following. Not normal flight following like in other countries. They ask us for more reports, and it (service) is so good that it make us feel that we are controlled and we even ask for clearances".*

- Flying abroad

There is a tendency to expect the same environment when flying abroad as in Portugal. This affects the rigour with which information is collected and flight-preparation is carried out for flying abroad, and this can contribute to airspace infringement scenarios.

- Understanding of separation provision

Inside TMAs, service is provided by NAV, but sometimes GA is confused whether and where they are separated from other VFR flights. "*ATC gives us descent instructions and headings, but we do not know if we are separated*".

- "Can do" attitude

There is sometimes an attitude problem – a "can do mentality" or situations of actively seeking the thrill of flying. The area around Cascais is known for local meteorological phenomena characterised by strong winds. Some pilots come to fly there, virtually with the same mentality as surfers looking for "the big wave". This is due to the nature of certain GA flights – flying for pleasure. It was stated that some pilots are "*radical"* - they are not highly skilled and motivated commercial pilots but take more risks in-flight.

- Fatigue

The pilots reported frequent situations of "*being tired*" – mainly tired during the flight because of weather or turbulence especially "*after lunch*".

- Losing situational awareness in-flight

GPS is improving knowledge of the current position, but because this information is received readily and not "*worked for by the pilot*", this decreases situational awareness – what is around, how did the pilot get there, where to go next. It only increases the (current) position awareness.

- Deliberately switching off communications equipment

Pilots reported a few cases of switching off communications equipment – for example to listen to music.

- Wrong interpretation of maps/charts

The misinterpretation of maps/charts was more associated with workload peaks and lack of skills.

2.4 *Other*

- Power supply failure

One problem often cited was failure of the power supply/batteries/antennas of the GPS. This triggered a focused discussion about the knowledge of and skills in using the equipment, including settings. There is neither training in how to use it at flying schools, nor are pilots trained to pay attention to and maintain the batteries, antennas, etc. This all goes back to training and practising. Ultralights and gliders have limited space, if at all to have transponders, batteries, etc. installed and monitored properly.
In the pilots' experience, failures of instruments such as VOR, DME and NDB are very rare.

- Flight preparation

Flight preparation was very often mentioned as one of the reasons explaining airspace infringements. It is particularly true for paragliders. The emphasis was placed on:
- how to train pilots for pre-flight preparation;

- how to practise it and distinguish it as an important part of the flight itself;

- provision of adequate facilities and tools.

2.5 *Weather*

Weather is generally favourable for GA flights, but there are reported local phenomena, mainly turbulence. Generally the places are known - particular areas close to the mountains and to the coast. It is pretty much expected by experienced pilots, but not necessarily by pilots with limited flying experience. Areas with such weather phenomena are not published.

3   Causal factor prioritisation

The participants were divided into two groups. Each group was given a set of cards with causal factors printed on them and asked to choose 10 factors which could most likely cause an airspace infringement. The list of causal and contributory factors developed by the airspace infringement causal factor modelling study was used for this purpose.

Group 1 prioritised list
1. Inadequate training and navigation skills

2. Bad weather

3. Airspace structure difficult to identify in flight, (also vertical limits are defined above ground level, and in flight you cannot easily use this)

4. NOTAMs difficult to understand (not graphical and coded, and geographical positions difficult to identify, translate text into graph in flight)

5. VFR routes close to restricted or controlled airspace

6. Inadequate radio skills and discipline

7. Honest mistake

8. Use of out of date maps/charts

9. Training aboard - (Cessna can be very complex machine, stress, workload, etc.)

10. Navigation equipment failure

Group 2 prioritised list
1. Inadequate training

2. Unfavourable attitude towards VFR flights, unfortunately very common

3. NOTAMS difficult to understand, and also people do not take time to familiarise themselves

4. Use of out-of-date maps/charts

5. GPS problems

6. Airspace structure difficult to identify in flight

7. Inadequate knowledge of navigational data and aids

8. Inadequate knowledge of airspace use procedures

9. Complex airspace use procedures

10. Inadequate radio skills and discipline

4   Brainstorming session II – mitigation measures

This section provides a summary of the interviewees' responses to the main question of the session: ***What could be the best 3 measures to prevent airspace infringements?***

4.1   Regulation-related problems

"Authorities should see GA as aviation; it (GA) should be considered in the same way as transport aviation".

- Strengthen the regulatory oversight of training, training schools and licensing

- Strengthen the regulatory control of refresher training

- Call for more recurrent training

- Refreshment courses to be mandatory for licence renewal

- Better controls by the authorities of the need for and actual use of restricted areas

- Segregate GA, but allocate sufficient airspace for aircraft that naturally cannot be equipped with communication and/or transponders

- Increase visibility of GA needs and specifics

The State and controllers should regard ultralight aircraft, gliders, and GA in general as aviation, not just commercial aviation

- Launch initiatives by the national authorities - to be in the loop and improve safety if needed

- Introduce firm control of instructor qualification

4.2   Navigation-related problems

- Equip aircraft with transponders, including all ultralight aircraft and gliders

- Use technology such as GPS moving map

4.3 *Aeronautical-information-related problems*

- Standardisation and simplification of maps and charts

- Simplification of the information in NOTAMs

- More accessible NOTAMs, maps, current weather information, including user-friendly visualisation in an intuitively understandable way

- Clarify, simplify, and make reliable and fast the chain of information that delivers the actual status of airspace to the GA users

- Flight preparation using better resources, including the Internet, aerodrome Reporting Offices, established communication means and points of contact with ATS to call if needed and obtain information, for example active areas. Build a GA "briefing kiosk"

- Improved sharing of knowledge and experience among GA pilots

4.4 *ATS/FIS-related problems*

- Service free of charge

- Improve communication with ATS/FIS

- Better civil-military coordination in order to improve the information for GA

- Improve ATS procedures and introduce safety nets via the ATS in order to provide timely alerting of airspace infringements

- Investigate good practices, for example the good attitude of and service provided by the military, NAV English language proficiency and try to multiply them

5. Conclusions

The meeting was extremely well appreciated by the participants. They have expressed an interest in receiving updates about the further development of the Initiative and the safety recommendations and good practices agreed at European level.

Interview meeting with GA pilots in London, UK
Meeting report

1   General information about participants in the interview session

Location of the interview	**London, UK**
Date	27 July 2007
Duration	3.5 hours
Number of interviewees	11

2   General information

The meeting took place in the seminar room of AOPA UK in London. Among the 11 pilots present there were representatives of the CAA, instructors, experts in aviation with a broad range of experience of many types of aircraft. All showed a readiness to take part in the brainstorming sessions and offered a number of recommendations for the reduction of the risk of airspace infringement (AIs).

3   Participants' profiles

Pilot:
- Licence: UK PPL, with IMC/IR
- Flying experience: 20 years, 630 hours
- Flight hours in last 12 months: 35 hours
- Type of aircraft flown: Piper Cherokee
- Experience abroad: France

Pilot 2:
- Licence: UK CPL, with IMC/IR flight instructor on single- and multi-engine aircraft, examiner
- Flying experience: 31 years, over 10,000 hours
- Flight hours last 12 months: 550 hours
- Type of aircraft: From light aircraft to airliners (Airbus family)
- Experience abroad: Germany, France, Italy and Spain

Pilot 3:
- Licence: CPL, with IMC/IR
- Flying experience: 17 years, over 1,300 hours
- Flight hours in last 12 months: 550 hours
- Type of aircraft: Piper PA 28 Cherokee
- Experience abroad: France

Pilot 4:
- Licence: PPL-1969, with IMC/IR single and multi engine aircraft, CPL-1979
- Flying experience: 38 years, over 2,800 hours
- Flight hours in last 12 months: 45 hours
- Type of aircraft: Piper Pa-28 Cherokee
- Flying experience: Belgium, Switzerland, France, Spain, Ireland

Pilot 5:
- Licence: UK PPL, with IMC/IR single- and multi-engine aircraft, CPL
- Flying experience: 48 years, 21,000 hours
- Flight hours in last 12 months: 185 hours
- Type of aircraft: mostly gliders
- Experience abroad: Spain, Germany, France, Switzerland

Pilot 6:
- Licence: UK PPL
- Flying experience: 54 years, 600 hours
- Flight hours in last 12 months: 30 hours
- Type of aircraft: PA 18
- Experience abroad: France

Pilot 7:
- Licence: UK PPL IMC/IR PPH – helicopter licence 3 years, 70 hours
- Flying experience: 24 years, 9,200 hours
- Flight hours in last 12 months: 150 hours
- Type of aircraft: PA 22, PA 44
- Experience abroad: France, Italy, Portugal, Ireland

Pilot 8:
- Licence: UK PPL IMC/IR
- Flying experience: 15 years, 950 hours
- Flight hours in last 12 months: 65 hours
- Type of aircraft: Light aircraft, amateur built aircraft
- Experience abroad: Most of the European countries

Pilot 9:
- Licence: UK PPL
- Flying experience: 29 years, 400 hours
- Flight hours in last 12 months: 12 hours
- Type of aircraft: C.130, C.142, PA 28, others
- Experience abroad: France, Italy, Belgium, the Netherlands, Switzerland and Yugoslavia

Pilot 10:
- Licence: UK PPL
- Flying experience: 19 years, 500 hours
- Flight hours in last 12 months: 6 hours
- Type of aircraft: PA 18
- Experience abroad: France, Italy, Greece, Russia

Pilot 11:
- Licence: UK PPL
- Flying experience: Less than 1 year, 70 hours
- Flight hours in last 12 months: 50 hours
- Type of aircraft: Piper PA 28 Cherokee
- Experience abroad: None

4   Brainstorming session I – causal factors

This section provides a summary of the interviewees' responses to the main question of the session:

What are the 3 main reasons why a GA aircraft enters controlled or restricted airspace without a clearance?

In a one-hour discussion, the participants placed a lot of emphasis on the impact of aeronautical-information-related problems and navigation-related problems. Although the level of airmanship and the influence of human factors were mentioned several times, their status among the airspace infringement factors was considered obvious and therefore less important for discussion. Several ATS/FIS-related factors were also mentioned and a comparison was made with the French ATS.

4.1 *Aeronautical-information-related problems*

- Insufficient flight preparation

The pilots agreed on the major importance of flight preparation for a safe and smooth flight. The reasons for poor flight planning were seen to lie not only in the fact that GA pilots are not in the habit of checking the information available before flight, but also in the difficulty of handling information from NOTAMs and other AICs.

- Difficulty reading NOTAMs which are not visual

The structure and type of information provided in NOTAMs was considered difficult to understand, and the pilots admitted giving up reading them. However, they remain aware that they may lack pieces of information, which could result in changes in the planned route.

- Lack of standardised maps and charts

This reason was pointed out as the most significant one for entering a controlled or restricted airspace without a clearance. Right at the beginning of the brainstorming session, a pilot suggested trying to search for best practices worldwide in order to standardise European airspace charts and maps.

4.2 *Navigation-related problems*

- Incorrect use of GPS

The instructors present in the discussion pointed out the tendency on the part of young pilots to rely on the information from the GPS more than on their visual navigational skills. The use of GPS was considered necessary, but it should not yet be seen as a "primary" means of navigation.

- Complex airspace design

The pilots regard the complexity of airspace as a major problem that can contribute to situations where pilots get lost in the air. This problem was mentioned on a number of post-it cards and was discussed throughout the whole meeting. The participants linked this problem to misidentification of ground features and recurrent lack of situational awareness.

- GA choke points located close to CAS

The pilots were referring mainly to the structure of controlled airspace in their country and the presence of many hotspots from which the pilots can decide to diverge and possibly enter a controlled area without a clearance.

4.3 *ATS-related problems*

- Unfavourable attitude towards VFR flights

The pilots were aware that the level of communication between themselves and ATCOs is low. They saw the reason for this in the attitude towards GA pilots compared with that towards commercial pilots, especially in the approaches to big airports. In one participant's experience, military ATCOs are more accurate than civil ATCOs when providing FIS for GA flights.

- Complex or unclear ATCOs instructions

The example given for this problem related to French ATCOs, whose instructions were not clear owing to a reluctance to respond or to language problems. The English pilots nevertheless spoke with respect about the high level of organisation of French ATC throughout the country. The reason given for the accuracy of service provide was that French air traffic is not privatised.

- High workload of ATCOs

Sometimes when there is a lot of traffic, the air traffic controllers owing to their high workload can delay a call or give early ATC instructions, which might lead to infringement of controlled airspace.

- Lack of radar service

The pilots complained that in UK there is no full radar coverage, which can easily reduce situational awareness and lead to an infringement of controlled or restricted airspace.

4.4   Pilot skills (airmanship) problems

- Insufficient GPS training

In order to learn how to use GPS and other new technological updates, the pilots need some more post-graduation training because the methodology at most of the courses places the emphasis on developing the skills to fly visually rather than on the use of technology.

- Inadequate navigation skills.

- Inadequate knowledge of airspace use procedures.

An experienced pilot called this lack of knowledge "ignorance", implying that it is a pilot's responsibility to learn the procedures of how to use the airspace when flying VFR. His opinion was that if an infringement was committed intentionally, then this was a result of such "ignorance".

- Inadequate R/T skills

- Insufficient refresher training for recreational pilots

    The pilots who do not fly regularly experience "skill fade", which might not be observed during the regular check flights but could suddenly cause a problem in flight.

4.5   Human-factors-related problems

- Honest mistake

- High workload and stress

There are a number of reasons which can raise the level of stress, and the pilots shared the

experience that especially when the aircraft is near to controlled or restricted airspace, any possible distraction can lead to an infringement.

5   Causal factor prioritisation

The participants were divided into two groups. Each team was given a set of cards with causal factors printed on them and asked to choose 10 factors which could most likely cause an airspace infringement. The list of causal and contributory factors developed by the AI causal factor modelling study was used for this purpose.

Group 1 prioritised list:
1. Flight planning

2. Routine

3. Inadequate training/navigation skills

4. Distraction

5. High workload

6. Early/late ATC instructions

7. False expectations about the level of ATC service

8. Airspace structure difficult to identify in flight

9. Honest mistake

10. NOTAMs difficult to understand

The first factor chosen by Group 1 did not appear on a separate card, but the group insisted that it should be included as a separate causal factor because it is a major cause of airspace infringements. The second factor was again not included in the cards, and the group explained that often when a pilot combines routine and familiarity of a route with lack of personal responsibility, infringements are most likely to happen. Pilots saw the third most important cause of AI as lying in the level of training, which plays a decisive role in ensuring that pilots have the skills and abilities to fly and follow procedures.

Group 2 prioritised list:
1. Honest mistake

2. Inadequate training/navigation skills

3. R/T skills and discipline

4. High workload

5. Busy ATC frequency

6. Complex or unclear airspace use procedures

7. Inadequate knowledge of navigational data and aids

8. NOTAMs difficult to understand

9. Unfavourable attitude towards VFR flights

10. Use of out-of-date maps/charts

The second group focused more on factors related to the human condition, assuming that it is in the hands of the pilots to confess a mistake and to improve his/her training. A few words were said about the instructors, who should provide adequate training and who also need courses and instructions regularly.

6   Brainstorming session II – mitigation measures

This section provides a summary of the interviewees' responses to the main question of the session:
What could be the best 3 measures to prevent airspace infringements?

6.1 Regulation-related problems

- Review of airspace design

- Additional training for pilots with few flight hours

The pilots suggested that flying clubs should introduce a practice of encouraging pilots with few flight hours to take part in rallies and cross-country tours.

6.2. Navigation-related problems:

- Low airspace radar service (LARS) to be provided by a national provider and not private ones

- LARS to be comprehensive

- Strengthen the use of SSR for GA pilots

- Introduce a special syllabus for GPS training for post-graduate student pilots

6.3. Aeronautical-information-related problems

- Standardisation and simplification of maps and charts

A common recommendation that appeared in the list of almost every participant was the need for standardised charts. There was a call for the charts to be redesigned and made easier to understand.

- Graphical presentation of NOTAMs where applicable (e.g. area/zone depiction)

6.4 ATS/FIS-related problems

- Improve FIS

The improvement of FIS should follow the logic of the market – if there is a demand, there should be a supply. The pilots strongly agreed that if air traffic politics is concerned with introducing fees and taxes, then it should provide fair FIS.

6.6. Safety culture problems

- Building awareness of safety in flight among the pilots

Seminars and discussions as well as fora on the Internet should be used to enhance the level of awareness of the AI risk. The participants referred to US experience in organising

such seminars and the active participation of the GA community in the US in those seminars.

- Efforts to strengthen the AOPA organisations in Europe

- A policy of strengthening the voice and impact of GA pilot organisations could contribute to better communication between members of AOPA at institutional and national level. Furthermore, it could have an impact on the safety culture by allowing for campaigning on various safety issues on national and international grounds.

7   Conclusions

The meeting produced a considerable input in a number of areas. It showed the pilots' interest in and readiness to respond to this safety improvement initiative. Pilots expressed an interest in receiving feedback from this study.

**Interview meeting with GA pilots in Oslo, Norway
Meeting report**

1   General information about participants in the interview session

Location of the interview	Oslo, Norway
Date	23 August 2007
Duration	4 hours
Number of interviewees	8

2   General information

The meeting was held at AVINOR HQ in Oslo. Eight pilots responded to the invitation from Compass Innovative Solutions (Bulgaria) and EUROCONTROL(Brussels) to take part in the pilot survey. The meeting started with a brief presentation of the project goals and mission, followed by a round-table presentation of the professional background of all the participants. During the brainstorming sessions the pilots were very cooperative, and in the final discussion they readily provided various comments and recommended a variety of measures which should be taken to prevent AIs (airspace infringements). The pilots were interested in the progress of the project and its final outcome and readily took note of the facts and observations shared by their fellow pilots.

3   Participants' profiles

Pilot 1:
- Licence: PPL
- Flying experience: 25 years, 800 hours
- Flight hours in last 12 months: 60-70 hours
- Type of aircraft flown: light aircraft, vintage planes, aerobatics aircraft
- Experience abroad: France, Denmark, Sweden and the United Kingdom

Pilot 2:
- Licence: PPL , air traffic controller's licence
- Flying experience: 9 years, 235 hours
- Flight hours in last 12 months: 45 hours
- Type of aircraft flown: single-engine aircraft
- Experience abroad: Norway and the USA

Pilot 3:
- Licence: PPL and instructor rating
- Flying experience: 34 years, 15,000 hours as pilot-in-command; 4,000 hours on light aircraft
- Flight hours in last 12 months: 50 hours
- Type of aircraft flown: light aircraft
- Experience abroad: almost all European countries

Pilot: 4:
- Licence: CPL/ATPL
- Flying experience: 24 years, 10,000 hours, (7,200 hours in commercial aviation

(SAS), 2,800 in single-piston-engine aircraft)
- Flight hours in last 12 months: 400 hours on Boeing 737; 82 on single-engine and aerobatics aircraft
- Type of aircraft flown: from light aircraft to airliners
- Experience abroad: Scandinavia, Poland, the Czech Republic, New Zealand, Argentina and the USA

Pilot 5:
- Licence: PPL, glider pilot licence and instructor rating, competition pilot
- Flying experience: 9 years, 700 hours
- Flight hours in last 12 months: 120 hours, 40 hours as an instructor
- Type of aircraft flown: single-seater gliders, powered gliders
- Experience abroad: Scandinavia and the United Kingdom

Pilot 6:
- Licence: military, CPL, glider, taking part in glider championships
- Flying experience: 37 years, 15,000 hours (SAS) in commercial aviation, 2,500 on gliders
- Flight hours in last 12 months: 340 hours
- Type of aircraft flown: Piper, commercial aircraft (A340), gliders
- Experience abroad: France, Germany, the Netherlands, Asian countries and the USA

Pilot 7:
- Licence: PPL, glider pilot licence, instructor rating, working in Norwegian Airsports Federation
- Flying experience: 28 years as a glider pilot and 25 years as a pilot of single-piston-engine aircraft, 2 years skydiving, total flight hours: 900 hours
- Flight hours in last 12 months: none
- Type of aircraft flown: Piper, gliders
- Experience abroad: France, Germany, the Netherlands and Asian countries

Pilot 8:
- Licence: PPL
- Flying experience: 12 years, 800 hours
- Flight hours in last 12 months: 30 hours
- Type of aircraft flown: light aircraft and microlights
- Experience abroad: Scandinavia

4   Brainstorming session I – causal factors

This section provides a summary of the interviewees' responses to the main question of the session:
What are the 3 main 3 reasons why a GA aircraft enters controlled or restricted airspace without a clearance?

In a two-hour discussion, the pilots provided their explanations for the causes of AIs (airspace infringements). The participants spoke most frequently of several factors belonging to two major groups - the quality of the ATS/FIS and the quality of the sources of aeronautical information. The pilots also took into consideration the insufficient training of both pilots and instructors as a reason for committing AIs. Comparatively less relative weight was attributed to the knowledge of navigational aids and the debate about the potential use of GPS as a "primary" means of navigation.

4.1 Aeronautical-information-related problems

- Use of out-of-date maps/charts

The pilots acknowledged the difficulty of getting updated maps and charts as one of the most significant factors for incorrect flight preparation. According to them, the problem of receiving updated maps has several aspects. An important one is that it is comparatively speaking more difficult to obtain regularly updated paper maps in Norway than in other countries in Europe. For this reason, the pilots look for updates to the airspace design on the Internet. There are a number of ongoing projects at the moment to develop aeronautical information websites and webpages. However, the problem associated with using Internet pages is that their webmasters have to find effective means of promoting them and of "advertising" the new updates. The fact that pilots are not in the habit of checking for updates "every four weeks" may increase the risk of infringement. This requires further efforts to "advertise" the changes by various means of communication.

- Difficulty of reading NOTAMs

The pilots shared the opinion that NOTAMs contain too much and too complex information for the average GA (general aviation) pilot. The pilots flying commercial aircraft also complained that NOTAMs are getting more and more detailed and more difficult to read. Moreover, the NOTAM briefing packages delivered to pilots in the pre-flight briefing phase contains a lot of irrelevant data (which was actually not needed). The pilots admitted an unwillingness to go thought all the pages. They explained their reluctance by the fact that when a pilot becomes more experienced, his/her habit of checking for updates "fades".
The pilots considered graphical presentation in NOTAMs as essential for a better understanding of the integrated updates.

- Lack of a special VFR (visual flight rules) guide for GA pilots

Those participants with a great deal of experience flying in other countries and continents explained that in Norway there is no special annual VFR guide as there is in other countries (such as France and New Zealand). Such a source of aeronautical information could contribute to a reduction in the number of airspace infringements.

- Insufficient flight preparation

A couple of problems were raised in this respect. As a matter of routine, pilots of hang gliders and paragliders do not do a pre-flight briefing. The complicated FPL filing procedures for cross-border flights to Sweden were also referred to. Negligence was also mentioned as a contributory factor.

- Difficulty of accessing the Internet in flying clubs for GA pilots

One participant shared the experience that there is a need for better access to the Internet at flying clubs.

4.2 Pilot skills (airmanship)

- Insufficient navigation skills training

The potential risk of AIs more often comes from inexperienced pilots, and especially from those who have been trained at small airports. Less experienced pilots cannot effectively use the available tools in the pre-flight briefing phase.
Moreover, inexperienced pilots usually fly with a very high workload and focus mainly on

flying the aircraft, not having time to pay attention to correct navigation, which increases the risk of airspace infringements.

- Insufficient experience of instructors

Part of the problem of inadequate training of young pilots is that the instructors at flying clubs are sometimes also young and quite inexperienced. It is hard and expensive for a flying club to find and recruit experienced instructors. The pilots acknowledged the fact that the broad experience of the instructors presupposes a high level of safety on board.

- Insufficient communication skills training

Many GA pilots have received their flight training using only a relatively small segment of uncontrolled airspace and therefore have not developed the skills of position-reporting and communicating with air traffic controllers. Such pilots are reluctant to call ATC and this is a factor that which might possibly increase the risk of airspace infringements.
Another communication problem that was mentioned was false belief by pilots that, following establishment of communication with ATC, they have been granted clearance to continue on the intended flight path.

- Pilots' false expectations about the level of ATS

The pilots gave examples of situations in which they were not sure whether of not the position they had reported (or the entire message they had transmitted) to ATC/FIS had been taken into account. The reason for this can be high controller workload, but for the pilot it causes anxiety and stress during the flight.

- Inadequate R/T skills and discipline

A pilot from the group explained the lack of discipline by using the term "ignorance". The whole group of participants agreed that there are pilots in the GA community who combine "ignorance with over-confidence": they do not follow the rules and procedures for communicating with ATS.

- Routine

In the pilots' view, routine can cause ignorance, i.e. pilots decide not to check for airspace changes or other aeronautical information updates. Another example linked to routine flying in a well known volume of airspace is cutting corners of TMAs in the expectation (based on experience) that commercial aircraft will not be in close proximity.

4.3 Environment-related problems

- Bad weather

The Norwegian pilots pointed to "bad weather" and "low visibility" as common reasons for getting lost in airspace. This is likely to happen if the pilot's flying experience is limited. Flying abroad was given as a common reason for losing awareness of one's position because of bad weather/visibility. In such cases, the pilots are re-routed and they can get disoriented and become unaware of their current position and cause an AI.

4.4 ATS/FIS-related problems

- Unfavourable attitude towards VFR flights

The "rude" attitude of ATCOs was widely discussed and pointed to as a reason for the lack of communication between GA pilots and ATS/FIS. The pilots were optimistic that the situation could be improved by mutual understanding between the pilots and controllers, especially when the ATCOs have experience as GA pilots and look at the airspace structure from a different perspective (that of the users).

- ATC clearance not matching aircraft performance

A glider pilot and instructor said that he could understand why ATCOs sometimes do not have a good understanding about gliders and their flying characteristics, and they then issue clearances which are not appropriate for the gliders' performance.

- Complex or unclear ATCOs instructions

Language problems were given as a reason for unclear instructions and communication with ATC. Reluctance to respond in English was mentioned, for example in connection with French ATS/FIS.

4.5 Navigation-related problems

- Costly equipment and its efficient use by GA pilots

Training the pilots to use GPS is included in the training programme. However, updating the GPS system can be costly and this can be another reason for not receiving recent information, which contributes to navigation error and loss of orientation. There is a similar attitude to the use of transponders, the price of which is still very high for GA pilots, especially for those pilots who do not fly regularly.

- Use of mixed measurement units

Use of QFE/QNH and meters by glider flights was pointed to as a factor contributing to an increased risk of AIs.

- Transponders

With regard to the planned implementation of Mode S in core European airspace, pilots agreed that use of technology should be encouraged, but the instruments should be appropriate to the type of aircraft. The glider pilots shared their opinion that the transponder has high battery consumption and high radiation in transmission. It is a problem installing one in very light aircraft and gliders owing to lack of space. Concerns were expressed about its impact on pilots' health. Pilots were convinced that the transponder must be switched on when "powered aircraft" fly in CAS (controlled airspace), although examples of deliberate switching-off of transponders were also mentioned.

- VFR routes close to restricted/controlled airspace

The pilots spoke about the characteristics of airspace boundaries, discussing the notion "soft" and "hard" borders between CAS and uncontrolled zones. Very often there was no buffer zone between controlled and uncontrolled airspace, providing the possibility of sudden unintended penetration of controlled airspace without a clearance. A less rigid interface was considered important in reducing the risk of infringements.

5. Causal factor prioritisation

The participants were divided into two groups. Each group was given a set of cards with causal factors printed on them and asked to choose 10 factors which could most likely cause an airspace infringement. The list of causal and contributory factors developed by the AI

causal factor modelling study was used for this purpose.

Group 1 prioritised list:

1. VFR routes close to restricted/controlled airspace

2. NOTAMs difficult to understand

3. Inadequate knowledge of airspace use procedures

4. Honest mistake

5. Unfavourable attitude towards VFR flights

6. Inadequate R/T skills and discipline

7. Late airspace entry refusal

8. Airspace structure difficult to identify in flight

9. Use of out-of-date map/chart

10. Inadequate training/navigation skills

The pilots in this group had experience flying single-engine aircraft, commercial aircraft and gliders. They argued that the priority assigned to the causal factors can vary depending on pilot experience and type of aircraft flown, for example a "glider pilot" will have a different priority list compared with a "single-engine aircraft pilot". In their final decision, they combined the factors in a single list, putting on top the problem of "VFR routes close to restricted/controlled airspace". The pilots explained that this factor is linked to airspace design and the "hard" borders between controlled and uncontrolled zones.
The second and the third factors in their priority list were explained briefly by a repetition of the arguments given in the previous session. NOTAMs were difficult to read because of their heaviness in terms of structure and layout. As for the "inadequate knowledge of airspace use procedures", this was linked to what one pilot referred to as "ignorance" in the previous session.

Group 2 prioritised list:

1. Inadequate training/navigation skills

2. High workload

3. Low cloud-base

4. Distraction

5. Honest mistake

6. Pilots' false expectations about the level of ATC service

7. Use of out-of-date map/chart

8. Complex or unclear airspace use procedures

9. Airspace structure difficult to identify in flight

10. VFR routes close to restricted/controlled airspace

This group of pilots agreed that the highest importance should be assigned to training and refresher training of pilots. The periodical flying checks should be more detailed and thorough to ensure a pilot's level of skills and knowledge.

It is worth noting that the group placed on top of the prioritised list factors related to human performance – distraction and honest mistake. Weather conditions and the problem of visibility were also considered to play a significant role as causal factors of AIs.

6. Brainstorming session II – mitigation measures

This section provides a summary of the interviewees' responses to the main question of the session: ***What could be the best 3 measures to prevent airspace infringements?***

6.1 Regulation-related problems

- Mandatory refresher training for pilots

- Mandatory licence validation checks

- "Tailored" training courses for pilots

The recommendation was for the improvement of certain skills and techniques in the flight training process depending on the type of aircraft and experience of the pilot. In addition, one pilot spoke of "focused training" on the agenda of his flying club as an example of good practice. In the previous year, the club had discovered weaknesses in the way the instructors taught landing techniques. The managers of the club reorganised the training syllabus and for the coming year they were including more hours for the improvement of the pilots' landing techniques.

6.2 Pilot skills (airmanship)

- Improved R/T skills and use of radio

- Better training

One pilot recommended that instructors should teach student pilots to respect rules and follow the procedures.

6.3 Navigation-related problems

- Mode S transponder

The pilots made the observation that use of the Mode S transponder should be mandatory only for those light aircraft which fly in controlled airspace.

- Better use of technology

Best possible use should be made of available technological means and solutions such as the GPS moving map and other applications which can alert the pilot to deviations from the "safe flight path", for example flight alarm (FLARM).

6.4 Aeronautical-information-related problems

- Standardisation and simplification of maps and charts

This recommendation very often appeared in the pilots' answers. There was a call for maps and charts to be redesigned in order to make them easier to understand.

- Improved NOTAM readability, including graphical presentation of NOTAMs where

applicable (e.g. area/zone depiction)

- Briefing stations at flying clubs

- Improved dissemination of map updates (and aeronautical data in general) to pilots ("alert" type of notification recommended)

Pilots considered it very important to maintain both the electronic and hard copy (paper) sources (versions) of aeronautical information in order to provide the preferred means to the different generations of GA pilots.

- Single portal for aeronautical and MTO information in Europe

6.5 ATS/FIS-related problems

- Improve communication with ATS/FIS

Throughout the meeting, there was a recurrent recommendation for "more friendly ATCO behaviour" and a more accurate response to GA pilots' calls. Periodical meetings between ATC/FIS controllers and GA pilots were proposed as a means of improving the understanding of one another's problems and concerns. Pilot associations and flying clubs could play a role in improving the interface with ATC.

- Courses for ATCOs to improve their knowledge of light aircraft and their performance characteristics

6.6 Airspace design problems

- Keep controlled airspace to the minimum possible

A comment was made by an experienced pilot that if this principle is not followed, pilots would lose respect for the use procedures and would "cut corners" more often, without asking clearance form ATC.

6.7 Safety culture problems

- Organisation of seminars and meetings which can raise the safety culture of GA pilots

- Raise pilots' awareness of the importance of pre-flight preparation (e.g. dedicated leaflets)

7.   Conclusions

The meeting produced a considerable input in a number of areas. It showed the pilots' interest in and readiness to respond to this safety improvement initiative. Pilots express an interest in receiving feedback from this study.

Interview meeting with GA pilots in Lesnovo, Bulgaria
Meeting report

1   General information about participants in the interview session

Location of the interview	**Lesnovo, Bulgaria**
Date	13 September 2007
Duration	3 hours
Number of interviewees	seven (7)

2   General information

The meeting was held at the small airport of Lesnovo near Sofia, the capital of Bulgaria. The majority of the pilots present were anxious to finish the meeting quickly and get back to their usual work as instructors or as pilots of private taxi flights. The interview was held in Bulgarian. The pilots preferred to express themselves and use the aviation terminology in their mother tongue. However, a lot of their statements included terms used widely in English. The meeting started with a brief presentation of the project's goals and missions, followed by a round-table presentation of the professional background and flying experience of all the participants. Most of the pilots voiced their risk reduction recommendations early on during the first brainstorming session, when they listed the causal factors of airspace infringements, and they were certain of the order of priority in the list of factors asked for in the second task. They were willing to participate in such seminars and looked forward to receiving a feedback about the progress of the project.

Participants' profiles
Pilot 1:
- Licence: CPL
- Flying experience: 30 years, 8,500 hours
- Flight hours in last 12 months: 300 hours
- Type of aircraft flown: light aircraft
- Experience abroad: Sudan, Egypt, Ethiopia, Russia, Serbia

Pilot 2:
- Licence: PPL
- Flying experience: 14 years, 300 hours
- Flight hours in last 12 months: 50 hours
- Type of aircraft flown: light aircraft
- Experience abroad: Greece, Serbia, Hungary, Germany, France

Pilot 3:
- Licence: CPL
- Flying experience: 14 years in the military, 6 months as a GA pilot – 100 hours
- Flight hours in last 12 months: 100 hours
- Type of aircraft flown: light aircraft
- Experience abroad: Bulgaria

Pilot 4:
- Licence: CPL

- Flying experience: 15 years, 800 hours
- Flight hours in last 12 months: 50 hours
- Type of aircraft flown: light aircraft
- Experience abroad: Serbia

Pilot 5:
- Licence: CPL
- Flying experience: 30 years, over 10,000 hours
- Flight hours in last 12 months: 100 hours
- Type of aircraft flown: light aircraft
- Experience abroad: all around the world

Pilot 6:
- Licence: BG PPL and US PPL, instructor
- Flying experience: 20 years, 400 hours
- Flight hours in last 12 months: 50 hours
- Type of aircraft flown: light aircraft
- Experience abroad: the USA, Spain ,Italy

Pilot 7:
- Licence: CPL , test pilot, instructor
- Flying experience: 35 years, 8,000 hours
- Flight hours in last 12 months: 300 hours
- Type of aircraft flown: light aircraft
- Experience abroad: Greece, Serbia, Macedonia, Russia

3   Brainstorming session I – causal factors

This section provides a summary of the interviewees' responses to the main question of the session:
What are the 3 main reasons why a GA aircraft enters controlled or restricted airspace without a clearance?
In a 1-hour discussion, the pilots provided their explanations about airspace infringements. The participants most frequently spoke of factors related to aeronautical information problems and the level of ATS (air traffic services). Factors such as "weather conditions", "knowledge of navigational aids", and "pilot training and routines" were mentioned only rarely and occasionally.

3.1   *Aeronautical-information-related problems*

- Lack of dedicated VFR maps

The biggest problem for GA pilots in Bulgaria was claimed to be the lack dedicated VFR maps and routes. The maps and charts that are used at the moment are either old (obsolete) military maps from the Soviet era or foreign maps (published by organisations in foreign countries) and do not have official approval from the Bulgarian regulator. The pilots complained that there is no single pilot shop in the country where they can buy the required maps and charts, and nothing is being done by the responsible institutions to solve this problem. The pilots have the sense that the lack of dedicated maps and updated charts for VFR flights is not on the priority list of all governmental institutions responsible for the publication of aeronautical information in Bulgaria.
- Lack of a single integrated aeronautical information facility
There is no single source of aeronautical information which could provide the required data

for any flight. Pilot spend a lot of time searching in various sites and sources and cannot receive updates about the changes to the airspace structure. One pilot, who has experience flying in the USA, provided as an example of best practice the free call number for aeronautical information in the USA.

- NOTAMS difficult to obtain

Owing to restructuring and relocation of the ATM (AIS) administration in its new building in Sofia, it has become more difficult to access the NOTAM briefing office, and sometimes pilots do not manage to obtain the required meteorological information from the staff in charge.

- Difficulty reading NOTAMs

The pilots shared the opinion that the NOTAMs contain too much and too complex information for a GA pilot of average experience.

3.2 ATS/FIS related problems

- Unfavourable attitude towards VFR flights

All the pilots complained about the lack of proper communication between controllers and GA pilots. The problem is not so much the accuracy of response of the controllers; they do not delay clearances, but just give inadequate clearances and pay more attention to the service provided to commercial aviation flights.

- Insufficient knowledge of ATCOs about the characteristics of VFR flights and aircraft performances

One of the underlying reasons for the lack of communication between GA pilots and controllers is that controllers do not receive dedicated training to provide ATS/FIS to GA flights and are not familiar with the characteristics/performances of light aircraft. Some pilots explained that owing to their previous experience in military aviation they are trained to follow all procedures and requirements, and comply with all clearances given. They therefore consider that they should receive greater respect and more understanding from ATCOs. The pilots confirmed their readiness to participate in special meetings aimed at improving understanding and developing the relationship between the GA pilot establishments and the ATS providers.

3.3 Pilot skills

- Inadequate knowledge of airspace use procedures

As some of the pilots present were also flight instructors, they were aware of the fact that pilots with few flight hours still do not have an adequate knowledge of the airspace structure and procedures and can easily infringe controlled airspace, especially if they also feel over-confident.

- Language problems

A major problem concerning the skills of Bulgarian GA pilots is the knowledge of foreign languages. The pilots strongly argued for the idea that the training of young pilots should be done in their mother tongue and as a further step they should then be trained to use English as the universal language of aviation. Lack of English language knowledge and resistance to speak English (in the lower airspace) should not be sanctioned. Use of the pilots' mother tongue is a premise for safety in flight and for a better understanding of ATC instructions.

3.4 Navigation related problems

- Complex airspace design

During the meeting, the participants often referred to the problem of Bulgarian airspace design having too many controlled and restricted zones/areas, and too little uncontrolled airspace. They were aware that this situation is inherited from the past, when the entire airspace of Bulgaria used to be classified as controlled airspace. However, the new legislation, rules and market principles require optimal application of the flexible use of airspace concept. Too many TRAs (temporary restricted areas) or RAs (restricted areas) which are kept "active" for too long can easily result in the pilots' decision to take shortcuts and thus infringe such airspace.

- VFR routes close to restricted/controlled airspace

The pilots explained that the position of Lesnovo airport (airspace Class C) makes VFR routes pass close to or even through controlled airspace. Lesnovo ATZ is located inside Sofia CTR, but it appears that no ATZ or other type of aerodrome zone has been established yet.

3.5 Human factor problems

- Honest mistake

Many of the post-its used in this session indicated the pilots' "honest mistake" in flight as a common reason for airspace infringements.

- High workload

Pilot inexperience was referred to as the most common reason for increased stress in the cockpit. In addition, passengers can also distract the pilots from flying tasks. Last but not least, high pressure can also be caused by the controller, who sometimes speaks too fast and the clearances remain unclear.

5. Causal factor prioritisation

The participants were divided into two groups. Each group was given a set of cards with causal factors printed on them and asked to choose 10 factors which could most likely cause an airspace infringement. The list of causal and contributory factors developed by the airspace infringement causal factor modelling study was used for this purpose.

Group 1 prioritised list:

1. NOTAMs difficult to understand

2. Use of out-of-date maps/charts

3. Lack of dedicated VFR maps

4. Inadequate knowledge of airspace use procedures

5. Insufficient experience

6. Unfavourable attitude towards VFR flights

7. Lack of dedicated VFR routes

8. Complex or unclear airspace use procedures

9. Military airspace not known

10. Honest mistake

The priority list summed up the views shared during the first brainstorming session. Again the factors explaining the insufficient and impractical aeronautical information came in at the top of the priority list. The problem of experience and that of the level of ATS were also placed fairly high on the list.

Group 2 prioritised list:

1. Airspace structure difficult to identify in flight

2. Honest mistake

3. VFR routes close to restricted/controlled airspace

4. Complex or unclear airspace use procedures

5. Bad weather

6. Pilot's' false expectations about the level of ATC service

7. Ineffective aircraft control (owing to turbulence or bad weather)

8. Lack of dedicated VFR routes

9. Insufficient experience

10. High workload

The main concern of this group was the airspace structure. Pilots agreed on the high probability of a flight unintentionally entering a restricted area owing to poor meteorological conditions or inadequate FIS/ATS.

6. Brainstorming session II – mitigation measures

This section provides a summary of the interviewees' responses to the main question of the session:
What could be the best 3 measures to prevent airspace infringements?
In the final session all participants were agreed on three types of problem: "improvement of the aeronautical information sources", "improvement of ATS/FIS" and "development of a safety culture". Problems related to navigational aids, technology and training were not subject to discussion.

6.1. Regulation-related problems

- Use of a foreign language

The pilots claimed that use of the pilots' native language is of paramount importance for efficient air-ground communication and understanding, and is directly related to flight safety. It is vital for young pilots to understand clearly all clearances and ATS information, and pilots therefore recommended the use of the native language as a primary language for the initial acquisition of rules, procedures and aviation terminology. The English language should be mandatory only for pilots who plan to fly abroad.

- Regulations for glider pilots

With reference to gliders and glider pilots, participants claimed that the existing regulations are inadequate for this type of GA, and this can cause serious problems for the safety of all other flights. They suggested cooperation between the various flying schools, one practical means being cross-training (familiarisation flights) for glider pilots and light aircraft pilots.

6.2. Aeronautical-information-related problems

- New standard VFR maps and charts

The pilots used this interview session as an opportunity to refer to all the institutions responsible for the publication of official VFR maps. They predicted (with great confidence) the rapid development of GA traffic in Bulgaria in the coming years. Pilots were sure that this might have a disastrous effect on aviation safety in the country as a whole, if such maps are not made available in the near future.

- Graphical presentation of NOTAMs where applicable (e.g. area/zone depiction)

6.3. ATS/FIS-related problems

- Improve communication with ATS/FIS

Throughout the meeting, there was a recurrent recommendation for "more friendly ATCO behaviour" and a more accurate response to GA pilots' calls.
- Theoretical and practical training for ATCOs to serve VFR flights

It is vital for ATCOs to improve their knowledge of light aircraft and their performance characteristics in order to understand and communicate appropriately with GA pilots. Dedicated programmes aimed at GA pilot and VFR flight controller training and exchange of experience (e.g. "flight following" for controllers) were proposed as steps in the right direction.

6.4. Safety culture problems

- Knowledge exchange programmes

On several occasions, the pilots suggested the practice of sharing knowledge on airspace and aircraft by initiating knowledge exchange programmes, which should include controllers and GA pilots holding carious types of licence, e.g. pilots of light aircraft, glider pilots, helicopter pilots, etc.

- "Open-door" days

The pilots suggested adopting the widely applied best practice in the USA of "open-doors days" to improve communication between GA pilots and ATC. Such events should be held at ATC facilities, flying schools and flying clubs.

- Seminars and workshops

In addition to the initiatives organised within the different civil aviation sectors, the pilots recommended better cooperation between civil and military aviation. This would enable both sides of national aviation to be "familiar with one another's needs, both active and effective" in terms of following rules and regulations which ensure the safe use of national airspace.

7. Conclusions

The meeting produced a considerable input in a number of areas. It showed the pilots' interest in and readiness to respond to this safety improvement initiative. Pilots expressed an interest in receiving feedback from this study.

**Airspace infringement
causal factors and potential for prevention**
(Summary of Swiss pilot responses to a telephone interview)

The telephone interview was conducted in the second half of September 2007 with the crucial support of Philippe Hauser, Chief Executive Officer of AOPA Switzerland.

I. Reasons for infringement of Class C and D airspace

1) Unawareness of airspace structure
   a) Changes to well-known structures
   b) Outdated maps/charts
   c) Inaccurate maps/charts
   d) Inappropriate maps/charts
   e) Possible failure to read NOTAMs

2) Unawareness of exact position of aircraft
   a) Excessive workload during difficult flights
   b) Misinterpretation of the terrain
   c) Absence of clear airfield markings

3) Insufficient knowledge of procedures
   a) XPDR on, entry clearance assumed
   b) VHF contact made, entry clearance assumed
   c) Deviation from foreign procedures

4) Problems with radio navigation
   a) Incorrect or inappropriate operation of navigation aids
   b) Incorrect interpretation of navigation aids

5) Environment (meteorological phenomena effects)
   a) Cloud avoidance
   b) Flying on top (above ground fog or stratus cloud)
   c) Thermals for gliders

6) Human-factors-related
   a) Stress resulting from inadequate flight planning
   b) Erratic flying at high altitude without oxygen
   c) SS-related pressure
   d) General work overload (e.g. complex aircraft)

7) Deliberate illegal entry of airspace
   a) Convenience
   b) Arrogance and overconfidence

8) Emergency situations

II. Notes on the individual points

1a) There have been too many changes. Every year the airspace structure is different. Efforts should be made not to introduce changes too often. In this way, local pilots in particular will be able to get used to the airspace structure.

1b) Although it has become established practice to change airspace structures every March in Europe, new charts are constantly required for European flights.
This is problematic not only in terms of quantity, but also financially. The despatching of foreign maps should be harmonised across Europe.

1c) The situation arises where certain charts are simply no longer available. This leads many pilots to resort to using outdated charts, because they are unable to get hold of the new ones.

1d) Similarly, the airspace structure is divided up in such a way that a 1:500 000 ICAO chart is no longer clear (for example Zurich TMA). The chart manufacturer spelled this out in a letter. AOPA therefore requested a 1:250 000 Terminal Chart for Zurich TMA. However, this request was rejected.
The ICAO chart of France no longer shows the airspace structures at altitudes above 5,000 ft AMSL or 2,000 ft AGL (whichever is the higher). Thus pilots assume that they are in Class E airspace, whereas in fact they are in Class C or D. France should therefore be invited to restructure its ICAO charts.

1e) In Switzerland NOTAMs are available only at aerodromes (free of charge) or on the Internet (subject to charges). Moreover, NOTAMs can be very difficult to decode, because uncommon abbreviations are sometimes used. The distribution free of charge of legible and clearly structured NOTAMs would bring about the desired improvements.

2a) This applies in particular to flights in unfamiliar areas (especially abroad). Added to this is the varying application of ATC in general and FIS in particular.

2b) Certain rivers, towns and other landmarks cannot always be clearly identified.

2c) It would be preferable for airspace structures to be mapped out showing the corresponding relief. This is not always possible, however, which is why identifying an exact position with regard to airspace boundaries is not easy. Wherever possible, existing landmarks should be taken into account when the airspace structures are drawn up.

3a) Unfortunately, more and more pilots regard the receipt of a transponder code as entry clearance into Class B, C or D airspace. An awareness-raising campaign would probably be useful. It should also be pointed out that not all countries use the same VRF codes. It would make sense to harmonise these codes.

3b) Furthermore, many pilots believe that with their transponder switched on and contact having been made with an FIS they will automatically be warned that they are about to enter airspace requiring clearance.

3c) The FIS in the UK provides perfect flight following, which is impossible in Switzerland (Swiss FIS controllers have no licence for vectoring and provision of altitude data). Europe-wide harmonisation is essential.

4a) A certain amount of experience is required for the operation of radio navigation equipment and not all pilots have this experience. Nor is the operation of GPS universally standardised. It sometimes happens that a pilot takes over a flight plan filed previously by a colleague without being aware of this. Here too, an awareness-raising campaign should be launched.

4b) Correct interpretation of radio navigation aids is therefore possible only if, in addition to the relevant training, the databases and frequency specifications are up to date.

5a)   No further information necessary

5b) Although strictly private VFR flights are permitted in most countries, such flights are much more navigationally complex. A special (possibly computer-based) training course might help

5c)   No further information necessary

6a) Irrespective of how precise a flight plan might be, if at short notice the route is changed because of the weather, even experienced pilots find themselves under stress - not only do they have to navigate, they also have to stay within limits dictated by the weather, and these may be unfamiliar or entirely new to them.

6b) Pilots with turbocharged engines are especially likely to be tempted to overfly the bad weather. This sometimes results in a lack of oxygen.

6c) This is not only a phenomenon of airspace violations, but also a direct or indirect cause of air accidents (in particular CFIT).

6d) Many aircraft manufacturers equip their aircraft with fantastic avionics. While it is a pleasure to fly with equipment such as moving maps, you need long and comprehensive training courses to operate avionics of this kind. Those hiring out aircraft do not always give this fact enough consideration.

7 + 8) No further information necessary

III.   Conclusion

Faced with the variety of reasons mentioned above, one might get the impression that every VFR flight commits an airspace violation. It should nevertheless be pointed out that the efforts of many flying schools, flying instructors, local ATC providers, EUROCONTROL, aviation associations, CAAs, etc. have been yielding fruit and making a positive contribution to the avoidance of airspace infringements.

As is made clear above, European harmonisation is still far from complete. In particular, there is room for considerable simplification of airspace design. For example in Germany the colour blue denotes Class E airspace, whereas in Switzerland it denotes Class D airspace. Italics and normal font have various different meanings. Class G airspace extends to 2,000 ft AGL in Switzerland and to 2,500 ft AGL in Germany. In France Class G airspace extends to FL115. Many more examples would be easy to find.

ANNEX 5   FULL LIST OF CAUSAL FACTORS REPORTED BY INTERVIEWEES

CATEGORY	CAUSAL FACTOR	COMMENTS
Aeronautical information	NOTAMs difficult to read/understand	The plenty of abbreviations and the large number of NOTAMs irrelevant to the VFR flights make the pilots often skip this important flight preparation activity thus ignoring important information for their flight. It is difficult and time consuming to filter out relevant information and often that is not possible due to the lack of graphical presentation. The descriptions of active danger and restricted airspaces in numerical form (Lat/Long-s) make it practically impossible for the GA pilots to understand the actual dimensions and location of such areas.
	NOTAMs difficult to obtain	Difficult access to the NOTAM briefing office of the service providers
	Use of out-of-date charts	Many pilots cancel their AI subscriptions due to financial considerations and due to the large amount of information to be replaced at each update cycle, which in most cases does not concern VFR flights. Webmasters of internet sites have to find effective means to promote changes made and "to advertise" the new updates. The lack of habits of the pilots to check for updates "every four weeks" may contribute as well.
	Cluttered maps and charts	The problem is often linked to the airspace design. Too many bits of information on a limited space make it difficult to identify important/needed information, especially in a deficit in time during a flight.
	Maps and charts not standardised	The difference in map layout can contribute to a poor flight preparation and can distract the pilot in flight or prevent him from recognising the object on the map. In addition to the difference in colours and symbols, the scale is sometimes unpractical too.
	Lack of integrated AI facility (single	There is no single source of aeronautical information that could provide

CATEGORY	CAUSAL FACTOR	COMMENTS
	portal)	the needed data for any flight. The pilot needs to spend a lot of time for searching in various sites and sources, which often is not done.
	Lack of dedicated VFR guide (maps) for GA	The maps and charts used in some counties are either old (obsolete) or military maps. Difficult to get current updated maps.
	Difficult internet access to AI at flying clubs	
	MET data not meeting GA needs	Available information is not aimed at GA operations, and consecutively of little use. The meteorological office considers the commercial aviation to be their main "client" and the service is totally customized for them
Airspace and Navigation	Complex airspace design	Complexity of airspace is a major problem that can contribute to the situation of getting lost in the air. Complex airspace can contribute to misidentification of ground features and reoccurring lack of situational awareness. Too many controlled and restricted zones/areas. Too many TRA (Temporary Restricted Areas) or RAs (Restricted Areas) which are kept "active" for too long can easily result in the pilots' decision to make shortcuts and thus infringe those airspaces.
	Unfamiliar airspace structure and classification	Refers in particular to cross-border flights due to the differences in the standards used and classifications of the airspace structures. When a pilot flies from one country into another he/she is not sure of the class of airspace that he/she is flying in. Pilots (newcomers or based in another region) do not know the local circumstances and there is no way of transferring the knowledge systematically.
	High volume of restricted, but unused airspace	Restricting, but actually very rarely using a defined volume of airspace, has a negative influence on the pilots' moral by fostering lack of respect about the restrictions.
	Airspace status information non-	Lack of information about the current changes in the airspace structure,

CATEGORY	CAUSAL FACTOR	COMMENTS
	available	e.g. activation/deactivation of segregated airspace.
	VFR routes (choke points) close to controlled / restricted airspace	Very often there is no buffer zone between controlled and uncontrolled airspace providing the opportunity for sudden unwanted penetration. The presence of many hotspots from which the pilots can decide to diverge and thus enter a controlled area without a clearance.
	Problem using GPS	For a pilot who has been trained to use ordinary paper maps the GPS system provides sometimes less information about the current airspace than an ordinary map. This is the case when the GPS does not have a graphical display of the airspace but shows only the route which the aircraft should follow. The pilots are unsure and unconfident of their position because if they rely only on the GPS system they do not know what lies between the first and the last point of their route

Failure of the power supply / batteries/ antennae of the GPS. |
	Over reliance on GPS	Young pilots' have the inclination to rely on the information from the GPS more than on their visual navigational skills.
	Outdated GPS database	Not all the changes and restrictions are entered in the GPS. Updating the GPS system could be costly and this can be another factor for not receiving recent information which contributes to navigation error and loss of orientation.
	Equipment not fitting GA aircraft needs	Use of technology (Mode S in the core of European airspace) should be encouraged, but the instruments should be appropriate to the type of aircraft. The transponder has high battery consumption and high radiation in transmission. It is a problem installing it in very light aircraft and gliders due to lack of space. Concerns were expressed about its impact on pilots' health.
	Use of dual measurement system	

CATEGORY	CAUSAL FACTOR	COMMENTS
	Cost of flying	The cost of a flight hour as an important (prohibitive) factor that makes a lot of recreational pilots reduce their flights to a bare minimum, thus not being able to maintain their piloting and navigation skills at the required level. The cost factor is also vital for getting regular aeronautical information updates in an easier way through a dedicated subscription. It was pointed out that many pilots kill their subscriptions due to associated high fee. Cost of new necessary equipment (e.g. transponders), is significant and last but not least it determines the choice where to fly and land because landing charges at big airports seem too expensive for the GA pilots.
ATC / FIS	Unfavourable attitude towards VFR flights	Lack of proper communication between controllers and GA pilots. ATCOs do not want trainees in their sector. Pilots face often ATC instructions like: "avoid all restricted airspace". In some situations the VFR flights are assigned lower priority even by FIC. Commercial flights always handled with priority. Military ATCOs are more accurate than civil ATCOs when providing FIS for GA flights.
	Insufficient scope of FIS	Lack of radar service
	Non-standardised FIS	The amount of information provided to the pilots varies depending on the FIS controller skills, workload and training. The (non) provision of traffic information was given as an example of the above. Provision of FIS is not to aligned to a common level even among the FIC controllers in the same centre.
	ATC clearance not fitting aircraft performance	Controllers do not receive dedicated training to provide ATS/FIS to GA flights and are not familiar with the characteristics/performances of light aircraft.
	Complex or unclear controller	Several instruction in one message and high speech rate are some of the

CATEGORY	CAUSAL FACTOR	COMMENTS
	instructions	factors.
	High controller workload	Sometimes when there is much traffic due to high workload the air traffic controllers can delay a call or give early ATC instructions which might lead to infringement of controlled airspace.
	Inefficient use of transponders	In certain airspaces and situations pilots are asked by ATC to switch-off the transponder to prevent unwanted TCAS alerts.
	Wrong plot's expectation of the level of ATS / FIS	There is a syndrome of expecting the same environment when flying abroad. This affects the rigor of information collection and flight preparation for flying abroad and can contribute to airspace infringement scenarios. Provision of FIS by military can be a factor as well (military controllers providing extended service compared to civil ones). Sometimes GA is confused whether and where they are separated from other VFR flights. There is pilot's wrong expectation that following establishment of communication with ATC he/she has been granted a clearance to continue on the intended flight path.
Environment	Bad weather	All pilots considered the weather problem as important especially for the rise of the stress level in the cockpit. It can cause unintentional infringement. However, the specific weather parameters and phenomena, such as "wind", "thunderstorm", "icing" or "clouds low base" were not considered separately.
Human Factors	Routine	The habit of flying the same route to the same destination for a long time can give false confidence to the pilots. This increases the likelihood that unexpected in-flight changes may lead to airspace infringement. Linked to routine flying in a well known volume of airspace is cutting corners of TMA due to the expectation (based on experience) that commercial aircraft will not be in close proximity.

CATEGORY	CAUSAL FACTOR	COMMENTS
	Use of foreign language	Besides anxiety, another factor that makes the air-ground communication difficult is the language problem. Both pilots' and FIC controllers' knowledge of English is poor in many countries. In some countries FIC controllers are reluctant to respond to pilots calls in English. On the other hand some pilots insisted on the use of the pilots' mother tongue as a premise for safety in flight and for better understanding of ATC instructions.
	Avoiding heavy traffic (area)	
	Make a short cut	
	Deliberately switching off the communications equipment	For example to listen to music
	Distraction	May be caused in flight by passengers, time pressure, complex procedures.
	Honest mistake	
	High workload (overload)	Directly linked to the level of stress
	Stress	The pilots attributed stress to "series of concurring events" that can distract them from following the route. Navigating, communicating to ATCOs, and coping with bad weather can raise the level of the "pressure in the cockpit". The inexperienced pilots are more likely to be exposed to a high stress situation. Often the stress is a result of improper flight planning.
	Fatigue	Bad weather or turbulence may contribute
	"Can do" attitude	There is sometimes an attitude problem – situation of "can do mentality"

CATEGORY	CAUSAL FACTOR	COMMENTS
		or situations of actively seeking the thrill of flying. Some pilots are *"radical"* - they are not the highly skilled and motivated commercial pilots but take more challenges in flight
Pilots' skills	Insufficient navigation skills	The potential risk of AI comes more often from inexperienced pilots, and especially from those who have been trained in small airports. Less experienced pilots can not effectively use the available tools in the pre-flight briefing phase. Moreover, inexperienced pilots usually fly at very high workload focused mainly at flying the aircraft not having time to pay attention to the correct navigation, which increases the risk of airspace infringement
	Inadequate (insufficient) communication skills and discipline	Pilots receive insufficient training for air-ground communication as well as tactics of how to communicate with ATCOs. In particular, lack of experience, anxiety and stress in flight caused by insufficient training can give the feeling of being lost and cause AI. Some pilots receive better training simply by having the chance to depart and arrive through controlled airspace during their initial training. Many GA pilot have received their flight training using only a relatively small segment of uncontrolled airspace and therefore have not developed the skills to report position and communicate with Air Traffic Controllers. Such pilots are reluctant to call ATC "Ignorance and over-confidence" were sited with respect of radio discipline.
	Insufficient (leisure) pilots' training, including refresher training	The pilots who do not fly regularly experience "skill fade" which might not be observed during the regular check flights but can suddenly cause a problem in flight. There is lack of assurance of being a "safe pilot". Once the periodical check has been passed, no one examines the pilot if he is prepared to make a long cross country flight. There is no requirement for refresher training of pilots.
	Pilots not trained (to a sufficient degree) to use GPS	Initial training syllabus does cover adequately use and maintenance of GPS

CATEGORY	CAUSAL FACTOR	COMMENTS
	Communication procedures not known	
	Loss of situational awareness	GPS is improving the knowledge of the current position, but because this information is received readily and not "*worked by the pilot*" it decreases the situational awareness – what is around, how did the pilot get here, where to go next. It only increases the (current) position awareness
	Insufficient flight planning / preparation	The lack of habits of preparing the flight. The preparation of the flight by thoroughly checking the route, the weather and the airspace structures along the route is not performed by every GA pilot. Therefore unexpected changes may not be taken into account. Poor flight planning (preparation) can result from either inexperience or neglect. Good practices about flight preparation are being gradually abandoned and the beginner pilots do not develop the habit of doing a proper flight planning.
	Inadequate knowledge of airspace use procedures	Low-hour pilots still do not have adequate knowledge of airspace structure and procedures and can easily infringe controlled airspace, especially if they feel over-confident. Another explanation is "ignorance", in other words it is pilots' responsibility to learn the airspace use procedures when flying VFR.
	Wrong interpretation of maps	Associated with workload peaks and lack of skills
	Safety inadequate attitude of Flight Instructors	JAR requirements are fairly sufficient, but sometimes instructors (safety) attitude is unfavourable. In some flight schools the instructors do not transfer the knowledge to the students if they find it impractical. They do not teach the students how to call / contact / use the FIS. The initial training is focused on teaching the basic flying skills (e.g. how to land the aircraft safely). Navigation and R/T training is secondary. There is no obligation to switch-on the transponder when equipped (except in controlled airspace), therefore some instructors teach the student not to

CATEGORY	CAUSAL FACTOR	COMMENTS
		do it.
	Insufficient experience of instructors	Part of the problem of inadequate training of young pilots is that the instructors at the aero clubs sometimes are also young and quite inexperienced. It is hard and expensive for a flying club to find and recruit experienced instructors.
Regulation	Inadequate oversight	There is perceived lack of regulatory control on the GA both in rule making and in actual oversight. Some examples were given about the ultra lights. "*after initial training people still do not know the actual capabilities of the aircraft*". The training is not really considered as an ongoing process – rather to obtain the licence only.
	Inadequate licensing regime	Licences of parachutists and paragliders are issued by the respective federation. Ultra light aircraft are licensed by the authority. The regulators do not control the schools for micro lights and paragliding.

Table 3 – Full list of causal factors reported by interviewees

ANNEX 6 FULL LIST OF RISK-REDUCTION MEASURES PROPOSED BY PILOTS

CATEGORY	MEASURE	COMMENTS
Aeronautical information	Standardisation and simplification of maps and charts in Europe	Unanimously recognised need for standardised charts. This should include a review of and agreement on more appropriate scales (e.g. 1:250 000).
	Improved NOTAM readability	Graphical presentation of NOTAMs where applicable (e.g. area/zone depiction) is considered essential. Simplification should be sought.
	Implement NOTAM selection (prioritisation) tool	The idea of grouping NOTAMs by topic enabling generation of briefing packages tailored to the need of the various user types (e.g. a glider pilot would need different information from a pilot planning a route flight). In addition, one pilot suggested creating user-based NOTAM update packages (e.g. for GA VFR flights) and adding a short descriptive document which would outline the changes in traffic schemes and airspace.
	Implement an integrated aeronautical briefing facility	The availability of a pan-European facility for the timely provision of up-to-date aeronautical and MET information is strongly recommended. The "one-stop shop" should be designed in a user-friendly manner and provide for easy and prompt access to any flight-related information which the pilot might need for his/her flight preparation.
	Install briefing stations at flying clubs	Improve the briefing facilities available at the various GA locations
	European AIS free of charge for GA	
	Improved accessibility of aeronautical and MET information	NOTAMs, maps, current weather information should be made easily accessible and visualisation improved, i.e. made user-friendly and intuitively comprehensible. The mechanisms, processes and means for the delivery of the actual status of airspace structures to GA users should

CATEGORY	MEASURE	COMMENTS
		be improved.
	Improved dissemination of map updates (and aeronautical data in general) to pilots ("alert" type of notification recommended)	It is important to maintain both the electronic and hard copy (paper) sources/versions of aeronautical information in order to provide the preferred means of flight briefing to the different generations GA pilots.
Airspace and navigation	Review airspace design and reduce complexity	This includes a review and update of airspace design criteria and priorities, taking due account of different airspace users' needs.
	Harmonisation and simplification of airspace classification	The harmonisation and simplification of airspace classification in Europe and its use procedures will contribute to better regulation and safer flight operations.
	Optimise (minimise) volume of controlled airspace	If this principle is not implemented, pilots will lose respect for the airspace use procedures and "cut corners" more often, without asking for clearance from ATC.
	Better use of airspace	Improved application of the FUA concept regarding the management of restricted areas and TSAs. Allocation of sufficient airspace for aircraft that cannot be equipped with communication means and/or transponders.
	Better use of SSR codes for GA flights	Optimised code allocation; use of transponders in uncontrolled airspace, etc.
	Use of modern technology	"Mandatory use of technology" in air navigation, given that pilots are well trained in visual navigation beforehand. Use of the following technologies and advanced equipment was recommended: Digital radio will provide a simple and universal means for reliable and

CATEGORY	MEASURE	COMMENTS
		prompt communication between controllers and pilots.
		Integrative software which can download and uplink information in flight
		Advanced GPS functions: moving map, airspace infringement warnings and further applications that can alert the pilot to deviations from the "safe flight path", for example flight alarm (FLARM).
	Use of Mode S transponders	Mode S transponders will contribute to improving FIS and will help mitigate certain risks. However, they are very costly and many pilots are not convinced that elementary Mode S will bring considerable benefits to GA, because the TIS is not supported (provision of radar information from the ground station to the cockpit). The pilots shared the observation that use of Mode S transponders should be mandatory only for those light aircraft which fly in controlled airspace.
ATC/FIS	Extend and improve LARS	LARS should be provided by the national ATS provider rather than by private companies.
	Improve FIS - extend scope and harmonise FIS provision across Europe	The improvement of FIS should follow the logic of the market – if there is a demand, there should be a supply. Since GA is asked to pay fees and taxes, it should be offered a fair FIS. This should include provision of warnings to pilots of any unfavourable factors, including airspace infringements and traffic warnings. Raise the FIS level to proactive prevention of potential conflict situations.
	Harmonised training of ATCOs to handle VFR flights	ATCOs knowledge of light aircraft and their performance characteristics should be improved to allow correct understanding and communication with GA pilots. Dedicated programmes aimed at improved GA pilot and ATC/FIC staff training and experience exchange (e.g. "flight following" training for controllers) were proposed as steps in the right direction.

CATEGORY	MEASURE	COMMENTS
	Improve communication between ATC/FIS and pilots	"A more friendly attitude and more accurate response to GA pilots" is needed. Improved understanding of GA needs and specifics. The State and controllers should pay due regard to ultralight aircraft, gliders and other types of GA, not just to commercial aviation. Regular meetings between ATC/FIS controllers and GA pilots were proposed as a means of improving the understanding of one another's problems and concerns. Pilot associations and flying clubs could play a role in improving the interface with ATC.
	Improve civil-military coordination	Better civil-military coordination will allow the provision of up-to-date, correct information to GA flights.
	Improve ATS	Improve ATS procedures and implement safety nets (automated functions) in ATC facilities in order to provide timely alerts about airspace infringements.
Pilot skills	Additional training for pilots with few flight hours	Flying clubs should encourage pilots with few flight hours to take part in rallies and cross-country tours.
	Periodic refresher training and checks for pilots	Refresher training is considered of particular importance for recreational pilots, but it is relevant to GA pilots in general.
	Enhance pilot proficiency checks beyond simple aircraft handling	The experienced instructors suggested that pilots intending to make cross-country flights should undergo extended or additional training.
	Improve pilot navigation skill training	More attention should be paid to navigation training. A pilot has to learn how to use maps/charts properly. Using the correct chart also means knowing how to mark out and note the route on it. Also, the pilot should monitor the plane's position at 3-minute intervals, in order to maintain situational awareness. To become proficient in VFR flying, pilots have to acquire sufficient knowledge of how the use the basic ("primary") navigation aids and then gradually learn the use of GPS systems and other new technology aids.

CATEGORY	MEASURE	COMMENTS
	Improved use of GPS	Introduce a special GPS training syllabus for post-graduate student pilots.
	Improve R/T skill training	Pilots' initial training in R/T communications is too limited. The practice of a separate licence for R/T communications should be reviewed (where applicable).
	Dedicated training of flight instructors	The methodological approach and quality of the training process should be improved.
	Improve flight preparation	Pilots should improve flight preparation by making best use of available means. including the Internet, aerodrome reporting offices, established communication means and points of contact with ATS to call and obtain information if needed, for example regarding areas.
	Harmonised training curriculum for GA pilots in Europe	The training should also include flights in the airspace of foreign (neighbouring) countries.
	"Tailored" training courses for pilots	This recommendation implied the improvement of certain skills and techniques in the flight training process depending on the type of aircraft and the experience of the pilot. Good practice in some flying clubs is the so-called "focused training". On the basis of a periodical analysis of everyday operations and training processes, weak points are identified and corresponding measures taken. For example, following identification of a weakness in the landing technique teaching process, the training syllabus was reorganised and training hours were increased.
Safety culture	Improve pilots' awareness of the factors impacting on flight safety	Seminars, discussions and internet fora should be used to improve pilots' awareness of the risk caused by airspace infringements. US experience and good practice might be used.
	Support the GA organisations (e.g.	Strengthening the voice and influence of GA pilot organisations and establishments could improve communication between airspace users (at

CATEGORY	MEASURE	COMMENTS
	AOPAs) in Europe	individual organisational and national level). Furthermore, it could proactively shape the pilot's safety culture by allowing for campaigning on various safety problems on national and international grounds.
	Improve pilots' safety culture	Awareness materials have limited and temporary effect, but efforts are needed to raise safety awareness of instructors at flying schools.
	Implement knowledge exchange programmes	Knowledge exchange programmes should be put in place to support controllers and GA pilots share their knowledge of airspace and aircraft. Such programmes should include pilots holding different types of licence, e.g. pilots of light aircraft, glider pilots, helicopter pilots, etc. Sharing of knowledge and experience, and dissemination of good practices among GA pilots should also be supported.
	"Open-door" days	It was suggested that use be made of the best practice widely applied in the USA of "open-door days" to improve communication between GA pilots and ATC. Such events should be held at ATC facilities, flying schools and flying clubs.
	Seminars and workshops	In addition to the initiatives run by various civil aviation organisations, pilots recommended improving the cooperation between civil and military aviation. This would enable both sides to be "familiar with one another's needs, both active and effective" in terms of following rules and regulations which ensure the safe use of national airspace
	Launch of national safety initiatives	International safety initiatives should be supported by the national authorities. Active involvement will enable GA to be in the loop and improve safety.
	Develop a dedicated "lessons learnt" website for GA	Provide pan-European means of sharing experience and disseminating lessons learnt.
	Produce awareness material for pilots	Leaflets, briefing notes, etc.

CATEGORY	MEASURE	COMMENTS
Regulation	Improve oversight of pilot training	Strengthen the regulatory oversight of training, training schools and licensing. Strengthen the regulatory control of refresher training.
	Introduce examination approach in licence validation checks	The flight check should include an assessment "satisfactory/not satisfactory"; could include some basic theory as well.
	Mandatory refresher training	Refresher courses to be made mandatory for licence renewal.
	Improve instructor licensing	Introduce strict control of instructor qualification.
	Improve oversight of airspace use	The authorities should exercise better control of the actual need for and use of controlled and restricted airspace.
	Allow use of local language for GA	Some pilots consider use of pilots' native language of paramount importance in order to ensure efficient air-ground communication and understanding, which has a direct impact on flight safety. It is vital for young pilots to understand correctly all clearances and ATS information, and it was therefore recommended that the native language be used as the primary language for the initial acquisition of rules, procedures and aviation terminology. The English language should be mandatory only for pilots who plan to fly abroad
	Mandatory carriage of transponders	Equip all aeroplanes with transponders, including all ultralight aircraft and gliders.
	Improve regulation of glider flights	Local regulation is considered inadequate for this type of GA, which could have a serious impact on the safety of all other flights. Cooperation between various flying schools should be encouraged, a practical means being cross-training (familiarisation flights) for glider pilots and light aircraft pilots.

Table 4 - Full list of risk-reduction measures proposed by pilots

ANNEX 7   ISSUES REPORTED BY PILOTS

One pilot said that the problem of non-regulated airspace, for example in Bulgaria and in neighbouring countries, should be the subject of this study. His point was that there are no rules and procedures to regulate and assist VFR flights close to airports. There are no VFR routes, VFR maps and everything is one big mess. There are no regulations and no rules to separate IFR and VFR flights except for the airspace classification and the controller. There are no special conditions for entering controlled airspace.

Another problem pointed out was that ATC disregards the FPLs of VFR flights. The pilot's point was that if a clearance is issued such as "proceed direct to point X", the GA pilot does not know the location of that point and he relies on his GPS. However, the flight is under VFR and if he is in a foreign country, the pilot does not know the landmarks and the reference points. The pilot has prepared to fly a certain route and if there is a change, everything can go wrong (potential to lose orientation). The other point is that if the GPS fails in such a situation (pilot flying on a direct route), the pilot is certain to get lost. This pilot's view was that airspace infringements occur very often in such situations.

The lack of special VFR maps/charts in many countries was pointed out as an important contributor to the airspace infringement risk. One pilot mentioned that there is no country in Eastern Europe which has published maps like those in the Western European countries. Usually, all restricted and dangerous airspace, etc. is marked on these maps/charts.

In many situations leading to airspace infringements, the client (passenger) wants to take photos of some area or another. One pilot said this problem should be looked at to find an acceptable solution.

There are a lot of airports without (published) visual landing circuits. Consequently, during the visual approach, foreign pilots often enter restricted airspace, e.g. a military airport zone located close to the civil one.

"Had I known enough about my GPS I could have had it set to warn me of the proximity of controlled airspace as it has this feature. Is this the case for all GPS versions and releases? In my opinion most GPS receivers have this, but it is hardly used for many reasons. The most important reason is that many pilots do not know how their GPS works and some of them do not even know how to enter the planned routing."

"For example, the best way to reduce the risk of airspace infringements would to be make it possible for more European GA pilots to have instrument ratings. A system which require them to undertake a formal course of study at an approved training organisation and do either the 8 written exams for just the IR ($1000 just for the exam fees) or take all 14 for the ATPL (and pick up the commercial licence too) means that pilot development is restricted and this is the major danger."

"A problem is the lack of consistency in airspace designation. One example is the widespread use of say Class E in France and none at all in the UK. So leaving French airspace you go from Class E to either Class G or Class A depending on altitude. In this case we are talking about 5,500ft before hitting Class A."

"The significant infringements, of concern to you and the CAA, probably involve EGLL and EGSS. We hear of far fewer infringements of EGKK for example. To a large extent,

those infringements are ATC-induced. I keep an aircraft 40 nm north of the EGSS CTA. If going south, I call Essex radar on leaving the circuit, but usually get told to "stand by" and frequently do not get called until west abeam their CTA. This is a policy introduced by NATS, who grade calls on their level of importance. The scheduled flight call signs are all known and responded to immediately, followed by commercial flight training using a call sign like Atlantic 401 (which would be a Diamond Star operated by Atlantic Flight Training). A call of Golf Bravo **** flags up as UK GA and goes to the bottom of the queue, below for example Foxtrot Bravo **** in a strong French accent which flags up as a visitor and therefore a potential airspace infringer. For pilots of a UK-registered aircraft therefore there is a strong urge to turn off the transponder, say nothing and cut through the edge of a CTA, adopting the "bugger them" attitude."

"A very high percentage of GA aircraft under 1,500 kg operate in the 0 to 3,500 ft. band, the majority being found around 2,000 ft. The only legal 1:500,000 CAA charts therefore contain a lot of airway clutter, insisted on by an outmoded ICAO requirement. ICAO have failed to accept the benefits of modern electronic data technology. All airworthiness authorities should be required to install software whereby, upon providing a pin code and credit card details, a pilot can download a route section of a chart at a cost not exceeding € 0.50 per A4 sheet. An A4 sheet will cover about 80 nm vertically and 50 horizontally and because it could be uploaded on the day could include NOTAM information, etc. A box could be included whereby airspace above certain levels could be excluded, in a similar manner to the NavBox flight planning aid."

"Most pilots carry a GPS, almost exclusively by Garmin. The significant problem I find is that although my Garmin knows where I am, giving messages such as "7 feet left of track" it then lies like a cheap Japanese watch regarding approaching significant Nav Aids. If I insert, for example, a user waypoint at the FIR boundary, I will get a message at the LT NDB that I am approaching the FIR boundary. If Garmin were fined every time a GPS-created infringement occurred, they would very quickly introduce software corrections free of charge to users of their products."

"NOTAMs are virtually impossible to understand. On a flight from XXXX to YYYY at the weekend, you get a string of NOTAMs saying that the military areas are closed from Friday lunchtime until 08.00 on Monday morning, whilst significant NOTAMs such as the Queen's Birthday Flypast over Buckingham Palace was defined by a string of coordinates where a picture which could be downloaded and carried would have been far easier to understand. The sensible briefing came from NNN Tower who said "They won't be north or west of the A12 trunk road". If the NOTAM is important but lost amongst a string of trivia, or so difficult to understand that it is misinterpreted, it is not only the GA pilot's fault when an infringement occurs."

"The BBMF and Red Arrows complain bitterly when their displays have to be aborted. The BBMF do not have a dedicated display area but performing a run-in at a village fete, using the Spitfire, Lancaster and Hurricane probably requires them to turn in from a point 4-5 miles from the display point, because that is two minutes at their display speed. Thus a GA pilot, flying 3 nm from the display point can fly across the run-in under conditions where the rules of the air apply and he/she has right of way. The Red Arrows actually require more airspace than the NOTAM implies because of the need to turn a 9-ship formation."

"Airspace infringements are caused to a very high degree because CAA and air traffic adopt an attitude that "It is our airspace". EU law is very specific regarding the right of free travel within the EU and the EU should seriously look at how GA can be protected

against erosion of those rights. In particular, governments should consider whether an aircraft for example taking 250 holiday makers to Miami to spend their euros in the United States should automatically have priority over an EU taxpayer making a flight within the EU, where all taxes remain within the EU."

"In my view, the reason for airspace busts is simply NAVIGATION ERROR. This is not something that can be fixed with anything simple; the navigation training (dead reckoning, mostly) within the PPL syllabus is very basic and relies on people being very careful. But pilots are not getting any cleverer, they are not getting more currency, the instructors are not getting any better, so airspace busts will continue and this is simply a problem which has no present solution."

"It will only be in years to come, when GPS has been integrated into both PPL training and normal usage, been installed in every normal aircraft, when all the "traditionally-minded" pilots have retired from flying, that there will there be a reasonable possibility of solving it comprehensively, and even then, some people will forget to look at the GPS and will fly into some piece of controlled airspace.
The new London LARS should help, by picking up lost pilots – assuming they bothered to establish contact in the first place. But a radar service is not really the best way to navigate."
There is also an assumption in some of the questions that some people don't regard busts as serious. I have never met any such person. All pilots I have ever met seem to be utterly petrified of doing a CAS bust. There was even one accident, near XXXX I believe, where the pilot took the wings off the aircraft upon realising (apparently) that he had busted the airspace. Nobody wants to have anything whatsoever to do with the CAA. The penalties are potentially much worse with the DGAC in France."

- END -

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