

Recreational aviation risk survey

Foreword

After the disastrous crash at Jämsijärvi that claimed eight lives, the Minister of Transport and Local Government, Ms Henna Virkkunen, commissioned Trafi on 24 April 2014 to conduct an extensive survey of the risks of recreational aviation by 30 September 2014. Preparation for this survey involved a broad-based consultation with aviation operators, sport aviators and authorities.

A project team led by Trafi was assembled, with experts from Trafi, the Finnish Aeronautical Association and AOPA Finland. Further experts from Trafi and the aviation community were invited to join the project and the risk workshops at various times. All participants had a background in aviation.

The group was highly motivated to undertake the commission. The work of the working group and the large number of expert responses to the interest group survey revealed a genuine interest and desire to contribute to improving the safety of recreational aviation. Effective channels and procedures must be found to leverage the profound expertise and motivation in recreational aviation found in the aviation community.

Aviation is a demanding and time-consuming hobby. It is also rewarding and at its best has unique experiences and a true community spirit to offer. It is the desire of the working group that the risk survey material will give the recreational aviation community plenty of background information **for their own safety efforts.**

I would like to thank the working group for their efforts. I would also like to thank the steering group for their support. Above all, I would like to thank the aviation community, which contributed enormously to the success of the survey.

Wishing you a pleasant autumn in the skies,

Helsinki, 30 September 2014

Working group leader, on behalf of the working group

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ABSTRACT

Background, goals, delimitation and implementation of the survey

During the present year and the two previous years, the number of fatalities in recreational aviation has been alarmingly high.

The state of safety in recreational aviation has been viewed with concern at the Finnish Transport Safety Agency (Trafi) for some time. The present situation has been analysed by the Safety Investigation Authority, Trafi and aviation interest groups. This work has already led to tangible measures to improve the safety of recreational aviation.

As an immediate consequence of the disastrous crash at Jämijärvi that claimed eight lives, the Minister of Transport and Local Government, Ms Henna Virkkunen, commissioned Trafi on 24 April 2014 to conduct an extensive survey (LVM/869/00/2014) on the risks of recreational aviation by 30 September 2014. Preparation for this survey involved a broad-based consultation with aviation operators, sport aviators and authorities. The survey was also required to include comparable information from key reference countries.

The risk survey indicated that **it is necessary to conduct an open debate on the acceptable level of risk, to determine the roles and responsibilities of the authorities and recreational aviation actors and to decide on short-term and medium-term measures** for improving safety in recreational aviation.

For the purposes of the survey, recreational aviation was considered to include all forms of flying engaged in privately and for leisure, including parachuting, hang gliding and paragliding. Many risks, causes of accidents and means for improving safety apply equally to general and recreational aviation. **Aerial work and commercial pilot training classified as general aviation, as well as hot-air balloons and helicopters were excluded from the risk survey,** as these are principally commercial operations in Finland.

The survey was conducted by analysing existing data, through an extensive interest group questionnaire and on the basis of findings from the risk workshops. The working group was led by Trafi and included representatives from the Finnish Aeronautical Association and AOPA Finland. The recreational aviation community was consulted extensively in the course of the work. It is the desire of the working group that the risk survey material will give the recreational aviation community plenty of background information **for their own safety efforts.**

International changes and challenges in the operating environment

From the perspective of risk assessment and risk management, recreational aviation is a challenging field. Whereas commercial air transport operates on a zero-tolerance basis as far as safety is concerned and accidents are seen as unacceptable, risk levels in recreational aviation are considerably higher. **According to the risk hierarchy adopted by the European Aviation Safety Agency (EASA),** the aim of the authorities is principally to protect uninvolved third parties and passengers on commercial air transport. This is about prioritisation. A reform of the regulation and operating structures of general aviation (in a broad sense) is going on under the guidance of the EASA. The trend is towards lighter regulation and the transfer of official duties and responsibility to recreational aviation organisations. This has already been enacted in several countries.

Some of the provisions concerning recreational aviation are in mandatory EU legislation, while part of recreational aviation is and will remain subject to national legislation. The principles of European development must be taken into account. The measures proposed in the report highlight the importance of exploring best practices and experiences of the transfer of duties in comparable countries.

Defining an acceptable level of safety requires an open and public debate between the public at large, aviation interest groups, the Ministry of Transport and Communications and Trafi. We must understand and accept that **raising the overall level of safety** would seem to involve **many very diverse factors that often are slow to take effect**, based on the findings of the recreational aviation risk survey. **Only a small percentage of the measures proposed involve stricter or additional regulations. Basically, more regulation must be regarded as the last resort.** The findings show for several types of aviation that in the absence of formal regulation, the operators themselves have employed risk management means for improving the safety of their operations. This demonstrates a commendably responsible attitude.

When a particular level of safety is set as the goal, the means to achieve it require investments: human and financial resources, and often also (and sometimes only) improvements to operating quality and practices. A fundamental issue is who should pay for safety efforts: the operators themselves or society.

The state of recreational aviation safety

Safety in recreational aviation is clearly poorer than in commercial air transport. Comparing the accidents that occurred in Finland between 2004 and 2013 to the number of hours flown, we find a disproportionate number of accidents, fatal accidents and fatalities in ultralight aviation. No statistically significant trends can be noted because the annual fluctuations are so great and the absolute number of occurrences is so small. Even a single accident with multiple fatalities causes a huge spike in the statistics. The risk level in general and recreational aviation per hours flown is also relatively high compared to other types of leisure-time movement activities. Finland performs clearly worse than the reference countries, particularly in ultralight aviation.

Over the past ten years, the number of hours flown in general and recreational aviation has decreased by an average of just over 3% per year. This trend has been the most notable in general aviation, where the decrease over ten years has been 40%. In ultralight aviation, the number of hours flown has increased slightly year on year, from 11,000 hours in 2004 to just over 13,000 hours in 2013.

Key risks in recreational aviation and how to manage them

Cost pressures and the role of the authorities: When any individual aviator flies fewer hours per year, there is less opportunity for maintaining routines and improving skills. This is one of the identified risk-increasing factors. The state of public finances, general aviation developments at the European level and prioritisation in regulatory operations call for a specification and clarification of roles in recreational aviation. Safety management in organisations is not conducted by the aviation authorities but by the operators themselves. This should be the case in recreational aviation too.

Understanding of the key risks in recreational aviation: International studies highlight the same major risks that were identified in the present survey. Apart from a handful of special features, the situation in Finland is much like other countries. Most measures available to mitigate risks are the same and have been identified as such. Adding more regulation or making it stricter is rarely the answer. Rather, unnecessary and excessive regulation should be dismantled, and provisions should be enhanced by focusing on identified major risks. Apart from a few items concerning regulation, the proposed measures address other topics. Many of the proposed measures involve improving the quality and content of functions in recreational aviation organisations.

Role of the authorities: The role of the Safety Investigation Authority is clear. Trafi and any other parties addressed by the recommendations given in safety investigations must invest in actively putting these findings into practical use.

The role of Trafi as an aviation authority comprises regulatory duties, the issuing of permits and approvals, and supervision. Trafi's operations are always prioritised. Trafi does not engage in

safety management at the level of operators; its goals are pursued at the level of the Finnish Aviation Safety Programme. Trafi supports safety efforts undertaken by the aviation community itself. It is important to clarify the roles and duties in recreational aviation and to delegate statutory duties as necessary by mutual understanding.

Role of the recreational aviation community: The aviation community must adopt a more prominent role and responsibility for the safety of recreational aviation. For this purpose, the community needs a clear mandate and sufficient operating potential (financial, human and expertise resources). The community will face a great but rewarding task of developing its operations to meet the challenges of its new role. The large number of expert responses to the interest group survey revealed a genuine interest and desire to contribute to improving the safety of recreational aviation. Effective channels and procedures must be found to leverage that expertise and motivation.

Role of an individual recreational aviator: It is the responsibility of every individual aviator to maintain and continuously improve his/her competence and to be aware of his/her limitations. Every aviator is also an ambassador for the right attitude. Therefore it is everyone's personal responsibility to promote good airmanship.

Key safety risks: In recreational aviation as in any other hobby, **the realisation of risks in 'dangerous sports' depends to a great extent on the actions of the individual.** All dangerous sports entail risks, which can be mitigated to a great extent by practitioners adopting responsible and safety-conscious procedures. **Conscious or unconscious risk-taking and unawareness of one's own limitations** are unfortunate but common contributing factors to accidents.

A lack of decision-making ability was also identified as a key risk in general and recreational aviation: the pilot fails to make the decision not to fly or to turn back in a situation where the risk level has become unacceptably high because of poor weather or some other cause. **Deficiencies in flight planning** often contribute to the situation in addition to decision-making problems.

The key risk factors identified in the studies on which European development of general aviation is based can be seen in Finland too. More than 80% of fatal accidents in general aviation in the USA and the UK are caused by loss of control in flight (LOC-I), whether VFR or IFR; low-altitude aerobatics, or more specifically conscious or ill-considered risk-taking in flying a manoeuvre without sufficient ground clearance; or an emergency landing due to pilot error such as fuel exhaustion.

The key risk in flying an **ultralight aircraft** is **loss of control in flight** (LOC-I) during takeoff, approach or landing. Contributing factors identified include **problems in recognising an imminent stall.** Aircraft loading and centre of gravity are also high-risk factors in ultralight aviation.

A collision of two sailplanes is seen as a key risk in gliding. The clearest threat identified for hang gliders and paragliders was **taking off into or flying in excessively challenging weather conditions.**

In parachuting, the major risks were **risk-taking beyond one's own limitations** for experienced skydivers and the unexpected stress of the real thing for students in a jumping situation, which may cause even the best training to be forgotten. **The survey shows that the key risks in flight operations related to parachuting have to do with aircraft loading and the shifting of the centre of gravity at takeoff and particularly during exit.**

The clearest risk factor category in aerodrome operations was **the runway and shortcomings in its condition or in information provided about its condition.**

Measures proposed by the working group: The working group proposes a large number of measures to improve the safety of recreational aviation. They are listed in chapter 14 of the present report. **Some are generic and broad, others are category-specific and limited.** Some are simply lists of things for which further information or further study is required. Only a small

portion of the proposed measures involves stricter or added regulation. The most important of the latter concerns the establishment of a national operating licence and the setting of clear minimum requirements for nationally regulated large (as defined) recreational aircraft.

Generally, the proposed measures aim to **continue the work already started**. Before prioritising and scheduling the measures, we must **first discuss and determine the role of practitioners and society in recreational aviation; the goals, division of duties, roles and responsibilities in the transfer of official duties regarding recreational aviation; and the ensuring of sufficient operating potential (financial, human and expertise resources)**. Then the measures can be assigned and timetabled. Key action groups and themes include:

- **Increased community feeling:** Community is considered an essential means for distributing tacit knowledge and safety-favouring attitudes and for ensuring the upkeep of the competence of individual recreational aviators. Community also prevents risk-taking, both conscious and unconscious. Individualist pursuit of these sports instead of traditional club activities requires new ways of promoting communality.
- **The field of training:** Training is a vital background factor in building skills and attitudes. Measures proposed regarding training aim to develop and harmonise the qualitative elements in theory instruction, flight training and teaching materials, learning results and the quality of teaching, lifelong learning and the maintenance of competence, utilising information and materials gained from comparable countries, and addressing identified risk factors in training.
- **Increased cooperation and harmonisation:** There are numerous examples in the recreational aviation community of excellent safety work and best practices by clubs, associations and individual aviators. These examples must be made more widely known and employed. This requires increased cooperation and the development of models for information dissemination.
- **Increasing efficient safety communications:** When the structures of the aviation community are reinforced, closer cooperation is pursued and operating practices are harmonised, high-quality safety communications will have a greater impact. Increasing awareness of identified risks and of factors that exacerbate or mitigate them is an efficient way of reducing risks, along with encouraging safety-conscious attitudes. Both the authorities and the aviation community must find new ways for enhancing communications.

Sisällys

Recreational aviation risk survey	1
12 Key risks in recreational aviation and how to manage them	3
12.1 General aviation	3
12.1.1 Training	3
12.1.2 Flight planning	4
12.1.3 Impacts of weather	4
12.1.4 Importance of flying experience.....	5
12.1.5 Key risks	5
12.2 Ultralight aircraft	6
12.3 Aerodromes	10
12.3.1 Runway condition and information provided	11
12.3.2 Obstacles in the vicinity of the aerodrome	11
12.3.3 Information on weather conditions and other aerodrome operations.....	12
12.3.4 Other traffic	12
12.4 Gliding.....	13
12.4.1 Collision risk.....	13
12.4.2 Take-off	15
12.4.3 Approach and landing.....	16
12.5 Aerobatics.....	16
12.5.1 Theory instruction.....	17
12.5.2 Flying instruction and practising, solo or with an instructor	17
12.5.3 Flying at competitions	17
12.5.4 Flying at air shows.....	18
12.5.5 Summary	18
12.6 Hang gliders and paragliders	18
12.6.1 Taking off into or flying in excessively challenging weather conditions.....	19
12.6.2 Technical defects, planning approach and landing, obstacles ..	19
12.6.3 Flying skills and experience	20
12.6.4 Other traffic	20
12.6.5 Towing	21
12.7 Parachuting.....	21
12.7.1 Landing	21
12.7.2 Collisions in free fall.....	22
12.7.3 Unintended parachute deployment during exit from aircraft ..	22
12.7.4 Flight operational risks in parachuting	23
13 Summary and conclusions	25
13.1 Risks: the big picture and how to address it	25
13.2 International situation, safety and risks.....	26
13.2.1 EASA general aviation strategy and roadmap	26
13.2.2 European General Aviation Safety Team (EGAST).....	28
13.2.3 Five hazardous attitudes and their consequences	28
13.3 General factors affecting the level of risk in recreational aviation	29
13.3.1 General factors increasing and decreasing risks: attitude, maintaining routine, costs and community spirit..	29

13.3.2	Increasing costs of recreational aviation	30
13.4	General aviation	31
13.4.1	Training 32	
13.4.2	Flight planning	32
13.4.3	Impacts of weather	32
13.4.4	Importance of flying experience	32
13.4.5	Key risks 33	
13.5	Ultralight aircraft	33
13.6	Large recreational aircraft	35
13.6.1	Major generic risks.....	36
13.6.2	Conclusions of the working group	37
13.7	Aerodromes	37
13.8	Gliding.....	38
13.9	Aerobatics.....	39
13.10	Hang gliders and paragliders	39
13.11	Parachuting.....	40
14	Working group recommendations for further action	42
14.1	Measures proposed by the working group:	42
14.2	Defining an acceptable level of safety: roles and responsibilities	42
14.3	General measures.....	43
14.4	General aviation	44
14.5	Ultralight aircraft	44
14.6	Large recreational aircraft	44
14.7	Uncontrolled aerodromes	45
14.8	Hang gliders and paragliders	45
14.9	Parachuting.....	45

1 Appendix 1, Proposed measures

- 1.1 Table of measures 1
- 1.2 Table of measures 2, measures requiring further study

2 Appendix 2, Regulation of recreational aviation

- 2.1 Aeroplanes
- 2.2 Ultralight aircraft
- 2.3 Sailplanes
- 2.4 Autogyros
- 2.5 Hang gliders and paragliders
- 2.6 Parachuting
- 2.7 Summary

3 Appendix 3, Background information and sources for calculating levels of risk for various sports

- 3.1 Cycling
- 3.2 General and recreational aviation
- 3.3 Motorbiking
- 3.4 Boating (motor boats, sailboats and jetskis)

4 Appendix 4, Summary of the interest group survey by question group

5 Appendix 5, Scenario evaluation

- 5.2 Risk workshop: Parachuting
- 5.3 Risk workshop: Large recreational aircraft

12 Key risks in recreational aviation and how to manage them

This chapter contains a **summary of the working group's views by category of aviation and for aerodromes**. These views were derived from an analysis of all the background information described above and of the results of the interest group survey and the risk workshops. Background information was discussed extensively in earlier chapters. Principally, the data from various sources that were analysed were consistent and supported the views of the working group. However, some differences of opinion remain, and these are shown in the summaries included in the appendices to the report (for instance regarding the interest group survey and the risk workshops). Chapters 12, 13 and 14 contain the overall view of the working group, and **chapter 13** discusses risks and risk management from a **broader perspective** than that of individual categories.

12.1 General aviation

Flight safety in recreational general aviation was **relatively good** in the period under review (2004–2013). The figures for general aviation are somewhat higher than those for sailplaning but clearly lower than for ultralight aviation.

Relative to hours flown, the accident figures for recreational general aviation are slightly higher than for sailplaning but clearly lower than for ultralight aviation. However, because incidents are rare and their annual number fluctuates greatly year on year, it is difficult to draw any conclusions on long-term trends.

During the period under review, there were five fatal accidents in recreational general aviation, causing eight fatalities. **There are no common underlying technical causes for the general aviation accidents that occurred between 2004 and 2013**. By contrast, in almost every accident the root cause was a decision made by the pilot-in-command to take a risk and/or to violate flight regulations.

Of the total of eight fatal accidents, five (eight fatalities) occurred in recreational general aviation and three (six fatalities) in professional pilot training or aerial work.

General aviation and recreational aviation differ substantially in terms of the regulatory basis applied. Only recreational aviation is subject to national regulation; everything else in aviation is regulated at the European level. This must be taken into account when considering proposals for action.

Regarding the regulations, it must be noted that better results can be attained even with the current rules. Compliance with regulations is the key to improvement for quite a way into the future.

12.1.1 Training

To achieve the learning goals under current requirements, training plays a crucial role especially in its initial stages. Therefore attention must be paid to the quality of training materials, pedagogical elements and standardisation. These elements will help ensure learning.

As a practical example, we may consider a flight training situation. An instruction flight, as a learning situation, is a package where the flying itself is only one compo-

ment. Careful advance preparation by the student, reviewing the flight programme and its key elements with the instructor before the flight, and particularly debriefing after the flight are also crucial learning events. On the flight itself, the student's focus is usually simply on performing the flight. It is in the debriefing after the flight, where events are reviewed and linked to the topics being taught and to good airmanship, that the actual learning takes place.

Everything that has been learned must be at the very least maintained in order to keep up with the requirements for safe operations. Even better, skills and knowledge must be continuously improved. In improving the safety culture, the important thing is to focus on safeguarding learning results and the continuity of instruction and learning.

Regarding training we must remember, though, that training programmes and their areas of focus are beyond national regulation, meaning that they can only be addressed through qualitative means. Naturally, training organisations are free to provide more than the minimum training in terms of its quantity.

12.1.2 Flight planning

There are clear indications that the origins of many accidents can be found in events on the ground, before the actual flight even takes off. Conscientious preparation helps minimise surprises in flight.

The importance of experience and routine in aviation is often cited, but attention tends to be unduly focused on the number of hours that the pilot has flown. The flight planning routine is a vital element in the process, and diligence in this respect is not dependent on time, place, weather, availability of aircraft or money. Why, then, is upholding this routine considered somehow an extra chore?

12.1.3 Impacts of weather

When we broaden the period under review by ten years, back to 1994, we find that all fatal accidents (four accidents, seven fatalities) were caused by **loss of spatial orientation in challenging circumstances**. Some of the cases did not necessarily involve conscious risk-taking but rather derived for instance from **shortcomings in earlier training or qualification risks that resulted from then current regulations**. Finland is a particularly high-risk environment as regards loss of spatial orientation, for several reasons.

Long dark periods in winter: Night flights are an inescapable part of a general aviation pilot's activities in Finland, because not flying in the dark means not flying at all outside normal office hours in the winter, even in southern Finland. The risk of unintentionally flying into clouds is remarkably higher at night than in the day, because at night it is difficult to discern a cloud before flying into it.

Variable weather: Finland's climate produces the majority of all known weather phenomena, sometimes within a single day.

These factors, combined with the revision of minimum weather requirements for special-VFR at night pursuant to the introduction of the Standardised European Rules of the Air (SERA), elevate the risk.

Risk assessment in general aviation is complicated by the **nature of aviation meteorological services, which are geared towards commercial air transport** and

therefore do not update their weather reports when circumstances change because those changes have no bearing on the significant weather.

For example: If the weather changes in the middle of a forecast period so that a new bank of cloud forms under the significant cloud ceiling but does not cover more than half of the sky, the forecast will not be updated. Combined with the increasing use of automatic weather stations, this means that in the worst case the observations and forecasts are inconsistent with the actual weather.

12.1.4 Importance of flying experience

Flying experience is a vast subject that needs to be broken down into components for the purposes of the present discussion.

- **Total flying experience**

This is an indicator of how well established the pilot's procedures and habits are. Flying experience helps comprehend and monitor the airspace around the aircraft, handle radio traffic, and so on.

- **Experience on the current type of aircraft**

Experience in a specific aircraft typically indicates how well developed the pilot's cockpit routines are, i.e. how automated the pilot's moves are.

- **Recent experience**

This is typically an indicator of automated actions. (Routine)

- **Recent experience on the current type of aircraft**

Type-specific routines are usually the area of flying experience where safe operating margins are generally at their best.

All types of experience are important as contributors to safe operations, but generally the more recent the experience is, the more relevant it is. We should also note that not all experience is positive experience. If a pilot has learned a procedure that is sub-standard in some way, it is not desirable to develop it to the level of an automated action.

12.1.5 Key risks

The decision to fly is often made too frivolously. The purpose of flight planning is to review all available material to ensure that the intended flight can be completed safely. It is important to examine and correctly interpret the current and forecast weather along the route. Airspace availability and airspace classes must also be investigated for the entire flight.

Even with the best of preparation, an unexpected situation may emerge that requires a deviation from the original plan in mid-flight. For this reason, it is important also to investigate the availability and suitability of aerodromes and airspace adjacent to and in the vicinity of the planned flight route.

Unawareness of the mechanics of flow separation. It is vital to be able to recognise an imminent stall. This depends on both theoretical and practical knowledge. The pilot must know the theoretical basis of conditions and flight modes in which the aircraft typically may approach stall, and must also have a practical knowledge of the indications and behaviour of the specific aircraft in such a situation.

Incorrect procedure in case of flow separation. Correct control movements are the only thing that will allow recovery from an actual stall. Stall often occurs at low altitudes and low speeds, and the corrective action must be precise and immediate. Sometimes the margins are so small that even a highly skilled pilot would be unable to recover.

12.2 Ultralight aircraft

Recent accidents involving ultralight aircraft have been caused without exception by loss of control in flight, almost always during take-off or landing. These accidents have involved both land planes and seaplanes, but the statistics look particularly grim for the safety of seaplane operations.

Take-off and landing are challenging phases of flight for any aircraft of whatever class. Ultralight aircraft fly at an average speed of 100 km/h during the initial climb after take-off and on final approach. The margin above stall speed is about 25 km/h at take-off and about 35 km/h on final approach, taking the flap position into account. These margins are roughly the same for general aviation aeroplanes.

The fact that the ratio of engine power to aircraft weight is high in ultralight aircraft makes the initial climb after take-off challenging, as the angle of attitude may be remarkably high. **Determining the aircraft attitude without an attitude indicator may be difficult for an inexperienced pilot**, the actual horizon being hidden behind the nose of the aircraft. In that situation, the angle of attitude must be gauged on the basis of lateral references.

Although in visual flight the attitude of an aircraft is always determined on the basis of external references, an attitude indicator is a considerable aid in establishing a safe angle of attitude during the initial climb. An attitude indicator is not a compulsory instrument on ultralight aircraft. However, as modern ultralight aircraft evolve towards including electronic displays instead of traditional gauges, attitude indicators are becoming more common. As the flight instruments on ultralight aircraft improve, it may become necessary to update the training requirements to include the basics of flying by instruments. At the moment, training for ultralight aircraft pilots does not include any requirements regarding attitude instrument flight.

Good take-off performance enables a high angle of climb and a short take-off run. The take-off distance to a height of 15 m on ultralight aircraft is a few hundred metres, depending on the conditions.

Seaplanes have a significantly larger drag than land planes because of their floats, not only when taking off from water but also in the air. Therefore seaplanes have longer take-off distances, and their angle of attitude during initial climb is not as great as for land planes. Inexperience in operating a seaplane may lead to a pilot pulling up too sharply after a low-speed take-off on water. This increases the risk of stalling. **How a seaplane behaves in a stall may come as a complete surprise to the pilot, since the fitting of floats can crucially change how an aircraft handles.** It is not necessarily even possible to establish the exact stalling properties of a seaplane in any other way than by actually flying it, because the impact of floats on flying properties is not satisfactorily explained in the flight manuals of some ultralight aircraft.

12.2.1.1 *Recognising an imminent stall*

High power combined with a high angle of attitude may make it difficult to recognise an imminent stall. Ultralight aircraft do not have a compulsory stall warning

system, so the pilot must recognise an imminent stall by other means. A high angle of attitude is one of these indicators. However, in flight training stall exercises are performed with the engine on idle, in which case the angle of attitude when approaching stall is not comparable to the angle of attitude that may lead to a stall at take-off power.

During take-off and during approach and landing, the pilot may have to concentrate for instance on other traffic to the extent that there is no capacity left for monitoring airspeed. This may be a considerable challenge for inexperienced pilots in particular. The purpose of the stall warning is to draw the pilot's attention to the airspeed of the aircraft. Stall warning systems are calibrated so that they give a stall alert well before the aircraft reaches a critically low speed.

Retrofitting an ultralight aircraft with a stall warning system is not so expensive that cost would act as a deterrent. The most difficult issue with a stall warning system if not installed at the factory is calibration. In a retrofitted stall warning system, it should be possible to test that the system activates at the appropriate time on a test flight, for instance in connection with an airworthiness review. An incorrectly calibrated stall warning system may instil a false sense of security in the pilot.

12.2.1.2 Importance of flying experience

The inexperience of recreational pilots brings a challenge to aviation. **An inexperienced pilot is not necessarily able to recognise situations where the risk of loss of control is elevated.** Current regulations concerning ultralight pilot licence holders allow exercising the rights under that licence with a very low level of recent experience. A licence holder is allowed to pilot an ultralight aircraft if he/she has, during the past 12 months, flown a refresher flight with an instructor or two flights on an ultralight aircraft, motor glider or powered aircraft. The relevant aviation regulation does not specify any minimum lengths for these flights.

12.2.1.3 New aviation regulations

Aviation regulation PEL M2-70 concerning ultralight pilots' licences is being updated. The update is behind its original schedule because of the large number of comments received when the draft was circulated. The update will introduce requirements for ultralight pilots that may serve to reduce the risks caused by lack of recent experience. Under the new regulation, an ultralight pilot must have had 12 hours of flying experience during the previous 24 months. Depending on whether the required 12 hours of flying experience was acquired during the past 12 months or not, a check flight or training flight is also required. The requirement for recent experience in the new regulation matches the flying hours requirement for the single-engine piston class rating under a private pilot's licence.

12.2.1.4 Weight and loading

The maximum permitted take-off weight of an ultralight aircraft may be 472.5 kg for land planes and 495 kg for seaplanes. The basic weight of a modern ultralight aircraft is just under 300 kg on average. This poses a problem for loading, because the maximum take-off weight specified in the aviation regulation must not be exceeded. **As the remaining total load capacity is often less than 200 kg, an occupancy of two persons leaves little room for fuel and baggage.** This may pose serious problems for cross-country flights in basic training, as the fuel requirement is greater than for a local flight and there are always two people on board: the student and the in-

structor. As an added challenge, the fuel distribution network has shrunk to a minimum, and refuelling is no longer possible at sufficiently many aerodromes.

Because of the problems with loading limits, ultralight aircraft are often flown with excess weight. This is apparent not only from **accident investigations** but also from the **interest group survey conducted in connection with the risk assessment**. Some respondents to the survey noted that flying with excess weight is common. This may even be an accepted practice among recreational aviators. Because no mass and balance documentation is required for ultralight aircraft, loading may be based on nothing more than the pilot's experience of how much weight a particular type of aircraft can carry. On the other hand, written mass documentation is not required for general aviation aircraft either, but since they are less forgiving regarding excess weight, the matter is taken more seriously.

Actually, ultralight aircraft are designed to carry more weight than their structural take-off weight. For this reason, **it is possible to register the same type of aircraft either as an ultralight or as an LSA**. A Light Sport Aircraft (LSA) is defined by the EASA as an aircraft with no more than two seats and weighing a **maximum of 600 kg**. However, an aircraft registered as an LSA may not be flown with an ultralight pilot licence; it requires at least a valid single-engine piston class rating (SEP) or an EASA-LAPL licence.

Aviation regulation OPS M1-9 on aircraft loading allows the use of **standard masses** in weight calculations for aircraft weighing up to 5,700 kg. This means that the provision also applies to ultralight aircraft, even though such an aircraft category did not even exist when the regulation was issued. The regulation allows the use of a standard mass of 75 kg for persons over the age of 12 and of 35 kg for persons under the age of 12 unless this would lead to a substantial deviation from the actual weight at the discretion of the pilot-in-command.

If the possibility of using standard masses is abused, the actual take-off weight may be considerably more than the mass and balance calculation indicates. Although an ultralight aircraft may still be structurally airworthy despite considerable excess weight, the pilot needs to be extremely well aware of how such excess weight affects the performance and flying properties of the aircraft. The same is true of ordinary powered aircraft, of course. A C152 general aviation aircraft with a maximum take-off weight of 757 kg has a maximum load capacity of about 200 kg. When the two occupants have a combined weight of 160 kg, this leaves 40 kg for fuel, or 55 litres. While this sounds better than the loading capacity available on an ultralight aircraft, the fuel consumption is also higher. The operating time is limited to 2 hours and 20 minutes. Using standard masses would push the operating time up to 3 hours.

Using standard masses for calculations also causes problems with insurance. Insurance companies may refuse to pay compensation in case of an accident or incident if the actual weight of the aircraft was greater than its maximum permitted take-off weight. This is only natural, because the aircraft had not then been used in accordance with its flight instructions manual or the aircraft flight manual. However, if the aircraft was loaded fully in compliance with aviation regulations, the pilot had not actually done anything wrong.

Centre of gravity

Shortcomings in weight discipline are also common in flying instruction for ultralight aircraft, and instructors may pass on incorrect loading procedures to students. **Exam-**

ination of mass and centre of gravity should be taught so thoroughly during training that the safety-ensuring calculations forming part of flight planning do not seem too challenging for pilots. A factor increasing the difficulty of load calculations is that some ultralight aircraft have inadequate flight instruction manuals in some respects.

However, the problem with excess weight is not that an ultralight aircraft would be incapable of operating with excess weight. **The principal safety risk in flying an overweight aircraft is that excess weight changes the flying properties of the aircraft, above all increasing the stall speed.** As the weight of the aircraft increases, the critical angle of attack at which flow separation occurs and the aircraft goes into a stall is attained at a speed higher than the stall speed of a lighter aircraft. The safety margin to the stall speed decreases when taking off, approaching or landing with excess weight. Flight instruction manuals should have more detailed descriptions of how changes in weight and centre of gravity affect stalling and other flight properties in that particular type of aircraft. At the moment, recreational aviators are not necessarily well enough informed about how excess weight changes the flight properties. This lack of knowledge may be due to inadequate theory instruction.

12.2.1.5 Training

The purpose of theory instruction for ultralight pilots is to provide them with sufficient knowledge for recreational flying activities. However, the minimum requirement for theory instruction is rather modest in view of instructors having enough time not only to teach the subject matter but to ensure that the students have learned the essentials. Also, training organisations do not necessarily understand the official minimum hours requirement correctly. The official minimum does not mean that the instruction should be provided within that time. If instructors consider the number of hours to be insufficient, there is nothing to prevent them from giving additional theory instruction or flying lessons.

Students are tested in knowledge examinations, and they must score at least 75% on every one of them. If a student fails to reach this score, he/she must retake the test. There are several theoretical knowledge examinations, at least one per subject taught. The subjects include aircraft structures, aerodynamics and aircraft control. There are some differences in subject titles compared with powered flight training.

Once the student has passed the theoretical knowledge examination, the training organisation will issue a certificate. In powered flight training, students must also undergo official tests after receiving a certificate of theoretical knowledge instruction, and they must score at least 75% on these tests as well. The training instructions for ultralight aviation and motor gliding, drawn up by the Finnish Aeronautical Association, determine the topics that must be included in the examinations. However, the current method cannot guarantee sufficient competence in all essential matters. For instance, training instructions for ultralight aviation and motor gliding specify that the aerodynamics examination must include four questions on stalling. Depending on the total number of questions on the test, a student may score over 75% even if the answers to all four questions about stalling are wrong.

It is also noteworthy that the four questions about stalling on the aerodynamics examination do not need to include questions on any of the following: aircraft properties during a stall; stall in level flight; stall while climbing, descending or banking; indications of an imminent stall; or recovery from a stall. Although these items must be in-

cluded on the aircraft control examination, recent accidents indicate that more attention should be paid to ensuring that the students acquire sufficient knowledge.

To attain the learning goal under the current requirements, instruction must be of extremely high quality. Instead of increasing the number of training hours required, it would be more important to focus on the quality of instruction to improve the safety culture.

Teaching should be standardised in both theoretical instruction and flight training, and the duties of responsible persons in training organisations should be specified in more detail. One possibility for standardising training would be a normative training programme prepared by the authorities. The British Microlight Aircraft Association (BMAA) has drawn up comprehensive instructions for the training of ultralight pilots. Its *Instructor and Examiner Guide* is comparable in scope and detail to the training manuals or syllabuses used by commercial flying training organisations operating in Finland. A syllabus makes it easier for both student and instructor to prepare for an instruction flight. The syllabus also explains in detail how the subjects to be taught during instruction flights should be taught and performed. Serious consideration should be given for drawing up a similar guide for organisations training ultralight pilots in Finland, since by international comparison the UK has a far more advanced safety culture in recreational aviation than Finland. At the moment, the only guideline available in Finland is the instructions for ultralight aviation and motor gliding, issued by the Finnish Aeronautical Association.

As aviation regulation PEL M2-71 concerning ultralight flying instructors is revised together with aviation regulation PEL M2-70 on ultralight pilots' licences, it will be easier to monitor the competence of flight instructors, as instructors will be required to fly a check flight regularly to keep their qualifications valid. Under the current provisions, a flight instructor's competence is only evaluated in the skill test following flight instructor training. The qualification can be upheld through giving training and attending a refresher seminar.

12.2.1.6 Key risks

The key risk in flying an ultralight aircraft is loss of control during take-off, approach or landing. The highest likelihood of a fatal loss-of-control accident occurs when an aircraft stalls at an altitude at which it is not possible to recover, leading to the aircraft crashing into the ground or water.

A stall may be caused by any of the following, or a combination of several factors:

- too steep initial climb due to incorrectly estimated angle of attitude;
- ignoring the extra drag caused by floats in take-off when switching from a land plane to a seaplane;
- ignoring the change in stall speed caused by excess weight;
- ignoring the combined effect of excess weight, flap setting and banking on the stall speed during approach and landing;
- inability to notice that a stall is imminent.

12.3 Aerodromes

The survey was also intended to explore risks related to uncontrolled aerodromes and activities there. In addition to risk factors identified at the risk workshops with a di-

rect link to activities at uncontrolled aerodromes, experts were separately asked about operating risks at uncontrolled aerodromes at various workshops.

In the interest group survey, 42% of the respondents reported that they mainly operate at uncontrolled aerodromes. The data collected from the responses provided an excellent overview of the operating risks at uncontrolled aerodromes.

The clearest risk factor category in aerodrome operations was **the runway and shortcomings in its condition or in information provided about its condition**. Other risk factor categories identified included **obstacles in the vicinity of the aerodrome, information about weather conditions or the condition of the airfield, and the variety of traffic and operations** that may be going on simultaneously at an uncontrolled aerodrome.

12.3.1 Runway condition and information provided

The runways at uncontrolled aerodromes are very different: some are paved, while others may have a sand or grass surface. A runway may thus be very soft at some times of the year, it may sustain frost damage, or there may be tall grass growing along it. Uncontrolled aerodromes are often not fenced, which means that there may be persons, vehicles, animals or other dangerous obstacles on the runway and in the movement area.

In winter, a runway may be inadequately cleared, leaving accretions of snow. A runway may also be cleared unevenly on one side only, or the ploughed heaps may be too high or placed differently from what the pilot assumes.

There may be unevenness between the runway and other parts of the movement area that may surprise the pilot when taxiing off the runway.

It is the responsibility of the aerodrome operator, under aviation regulations, to maintain the runway and runway strip in good condition and to inform pilots of any damage and, if necessary, of runway closure. However, the regulations do not specify how often runway condition should be inspected. Therefore **a runway may be in poor condition for a long time without pilots receiving advance information of it**.

Aerodrome operators are not required to have any particular qualifications for or knowledge about general aviation. Therefore the aerodrome operator may not be aware of the potential consequences of insufficient information.

12.3.2 Obstacles in the vicinity of the aerodrome

Protected surfaces are defined for the approach sectors of runways at aerodromes; these may not be penetrated by obstacles such as trees. An approach cannot be performed safely if the obstacles are too high.

Tree growth near the aerodrome must be continuously monitored and trees cleared as necessary. In some cases clearing trees may pose a problem if the trees are located on land owned by someone else than the aerodrome operator. If clearing is not possible, the runway threshold must be moved so that there are no obstacles in the redefined approach sector.

Obstacles located further from the aerodrome may also be a threat if not appropriately marked and lit. In some cases, temporary obstacles such as cranes may remain unmarked, because crane operators do not necessarily know that such obstacles

should be marked in the vicinity of uncontrolled aerodromes just as in the vicinity of airports.

Trees and other major obstacles in the vicinity of the aerodrome may also cause vortices, which locally operating pilots may be aware of but occasionally visiting pilots are not.

It is also common at uncontrolled aerodromes that approaches and landings may be performed on areas other than the runway proper. Pilots should bear in mind that obstacle requirements are only considered for the actual runway(s).

12.3.3 Information on weather conditions and other aerodrome operations

Uncontrolled aerodromes normally do not have the kind of weather observation equipment that controlled aerodromes do. Therefore it may be **difficult to obtain precise information on weather conditions at uncontrolled aerodromes**, and pilots may have to rely on general weather observations and forecasts instead of those specifically designed for aviation purposes.

Often the only weather observation equipment available at an uncontrolled aerodrome is a wind sock, and even that may be located so that it does not give an accurate picture of actual wind conditions at the aerodrome. A wind sock may also be broken or incorrectly installed.

If the aerodrome is used for activities other than aviation, **the aerodrome operator is obliged to issue a NOTAM informing pilots of it and to lay out the necessary markings** in the movement area to alert pilots. If no such information is provided or if the markings are inadequate or the signal area at the aerodrome is in a poor condition, **there is a risk of a pilot landing in the middle of the other activities**.

Operations may be conducted at uncontrolled aerodromes at night as well. In such cases, the pilot and aerodrome operator must agree on the use of lights. The lights may be incorrect or broken, however. At night, it is also very difficult to notice any other activities at the airfield, or the presence of vehicles or persons on the runway.

12.3.4 Other traffic

An uncontrolled aerodrome may host **a variety of very different activities simultaneously**, from model plane flying and hang gliding to sailplanes and ordinary powered flight.

An aerodrome may have local operating instructions, but these are not binding. Safety seminars and discussions among recreational pilots at aerodromes are good ways of increasing awareness of safety matters. However, it should be noted that locally agreed procedures must not be such as to pose a risk for an occasionally visiting pilot who is unaware of those procedures. Ultimately, the only document which must be mandatorily complied with at an aerodrome is aviation regulation OPS M1-1, Rules of the Air, which includes provisions for instance on the right-of-way. A paraglider, an ultralight aircraft and a sailplane may, for instance, be approaching the same runway at the same time, operating at very different speeds. There may also be model plane flying in progress at the aerodrome.

On the ground, there may be **towing activities using a variety of devices, and the tow ropes may extend to a high altitude and be difficult to discern**. Some aerodromes have multiple, crossing runways with simultaneous take-offs and landings.

Also, as noted above, **uncontrolled aerodromes are not fenced, and there is nothing to prevent someone completely unaware of aviation regulations from accessing the runway, for instance.**

Pilots are not required to listen to radio communications or to announce their intentions by radio at an uncontrolled aerodrome. **However, good airmanship requires that pilots in an aircraft with radio equipment listen to communications and announce their presence at all times.** It is not uncommon, though, for pilots to taxi on to a runway at an uncontrolled aerodrome without announcing that they are doing so, surprising a pilot in an approaching aircraft.

Because of all of the above, a pilot not accustomed to operating at an uncontrolled aerodrome may find it challenging to figure out who has the right of way to land or take off. The confusion may lead to **evasive action and, in the worst case, to loss of control or a collision.**

12.4 Gliding

Aviation safety in gliding has been relatively good in recent years. The accident rate has been slightly over two accidents per year on average over the past 10 years. The average number of fatalities is 0.6 per year. The figures for gliding are somewhat lower than for general aviation or ultralight aviation.

Relative to the number of hours flown, the statistics for gliding are on a par with general aviation. Per 10,000 hours flown, the accident rate is about 1, the fatal accident rate is 0.24 and the fatality rate is 0.3. No significant trends can be found.

Over the past five years, there have been five sailplane accidents, with three fatalities. In addition, one accident happened to a tug/gliders combination, where the sailplane approached and landed without damage after aborted towing but the tug aircraft was destroyed.

12.4.1 Collision risk

Based on the findings of the interest group survey that was open until the end of July 2014, **sailplane pilots feel that the key risk in gliding is the risk of collision.** The collision risk has risen especially at competitive sailplane meets, even if the pilots are aware that other competitors are flying via the same turnpoints. The only gliding accident that occurred in 2011 was a collision between two sailplanes on a competition flight.

Gliding is substantially different from aviation in all other aircraft categories. An unpowered aircraft depends on rising air, or lifts, to stay airborne. What this means in practice is that **a sailplane must remain in a lift until it has gained sufficient altitude** to begin gliding in search of the next lift.

There are several ways in which a lift may be created. The most common type is a thermal, caused by uneven warming of the earth's surface. As warm earth warms the air above it, the warmer air begins to rise. Flying in a lift often requires flying in circles, as lifts may be very small in diameter. However, advantageous terrain such as a ridge or esker may create several lifts next to one another. A series of lifts can be identified by the cumulus clouds that form over it. Flying under a bank of clouds enables good progress while making continuous use of lifts. In mountainous terrain, the wind may create a standing wave or wave lift, which allows a sailplane to climb along the wave.

Having attained a sufficient altitude, the sailplane pilot must choose a direction in which to glide. This direction may be determined by the next turnpoint in the mission, but basically gliders are oriented towards the next available lift. As a result, gliders do not generally fly in a straight line from one turnpoint to the next but instead meander according to the lifts available.

On competition flights where several gliders fly via the same turnpoints, many gliders may share the same lift at the same time, especially at the start of the course. This makes airspace observation crucially important, because separation between aircraft may be very small. Responses to the interest group survey highlighted the importance of risk awareness when flying in a lift. **Small separation between aircraft and a large number of aircraft in the same lift are 'par for the course' in gliding.** Sailplane pilots know the standard procedures for flying in a lift; for instance, it is not allowed to circle in opposite directions. **However, the rules of gliding are only based on good airmanship,** as there is no national aviation regulation concerning sailplane operations. On the other hand, even good basic rules cannot prevent occasional contact between aircraft. **Fortunately airspeed is relatively low when flying in a lift.** The glider collision in 2011 occurred when one of the parties involved was making the transition from gliding to turning in a lift. The pilot began to reduce speed after entering the lift, after which the glider collided with the bottom of the glider above, with serious consequences.

There have been no collisions in gliding flight in recent history, but the risk of such a collision should not be ignored. The frontal area of a glider is very small because of the aerodynamic shaping of the aircraft. Also, gliders are generally white. These two properties make **a glider very difficult to notice when approaching head-on.** In competitions, turnpoints are generally circled in the same order, so there should be no need to fly in opposite directions. However, in certain situations the competition mission may cause participants to occasionally fly in opposite directions.

Further attention must be paid to the flying of the landing circuit at an uncontrolled aerodrome. The runway in use may be agreed jointly if necessary, but the rules of the air dictate that the first aircraft to enter the landing circuit will determine the runway to be used. Therefore situations where simultaneous approaches to a runway from opposite directions cause an elevated collision risk should never emerge. By contrast, a situation where **a glider on the downwind leg of the landing circuit and a glider aiming for the downwind leg collide with each other is more likely (e.g. the Hyvinkää crash in 1987).** Gliders usually begin the landing circuit at an altitude of 250 to 300 m from ground level. After a collision, considering the time needed to exit the aircraft, the altitude is not necessarily sufficient for opening an emergency parachute. Wearing an emergency parachute is compulsory when flying a glider, but it does not have to be hooked up to an automatic activation device as in some other countries where gliding is more widespread. In the interest group survey, not using the automatic activation device was not seen as a safety risk by sailplane pilots. When hooked up to the automatic activation device, the emergency parachute deploys automatically when the pilot exits the aircraft, which may be advantageous in a jump made from a low altitude.

In gliding, the objective principally is to end up at the same aerodrome where the flight began. Exceptions to this rule are cross-country flights and flights that end in a landing in terrain. If, however, a flight ends at another aerodrome contrary to plan, the pilot must plan the approach using not only the information on the navigation chart but also information gained from other traffic on the aerodrome radio frequency. The

runway to be used is determined mainly by wind conditions, and observing the wind sock at the aerodrome may be the only way to gauge the surface wind. The landing circuit may also be unusual at some aerodromes. This is usually made apparent by an arrow painted on the runway or the signal area, indicating the direction of turn after take-off. These are things that the pilot will not know until he/she sees the wind sock and the movement area at the aerodrome. **The interest group survey revealed that it is considered a clear safety risk that charts (even unofficial ones) with essential aviation details are no longer available for uncontrolled aerodromes. This applies not only to gliding but also to other general and recreational aviation.**

In recent years, a collision alert system known as FLARM has become increasingly common in gliders. The system alerts the pilot if there is another aircraft with a similar device on a collision course. FLARM is compulsory equipment in gliding competitions nowadays.

12.4.2 Take-off

Gliders take off by aerotow, winch launch or car tow. Aerotow and winch launch are the most common take-off methods. **In aerotowing, changes in the position of the glider relative to the tug aircraft represent a key safety risk.** For instance, if the glider rises up too far behind the tug, the control forces of the tug are not necessarily sufficient to compensate for the torque caused by the glider. This may result in the tug colliding with terrain or an obstacle. Similarly, a glider descending too low may cause the nose of the tug to pitch up and the aircraft to stall.

Aircraft fitted out as glider tugs are equipped with quick-release devices. Generally this is a link similar to the one on gliders for releasing the tow rope. The tug may also have a mechanical guillotine for severing the tow rope if required.

In both the Räyskälä crash in 2009 and the Jämijärvi crash in 2005, the accident was caused by the glider rising up too high behind the tug, to the extent that the tug pilot lost control of the aircraft. In both cases, the tug was destroyed but the glider was undamaged. At Jämijärvi, flying into worsening weather was a contributing factor.

In a glider accident in summer 2014, the pilot of the glider lost control during an aerotow. The glider collided with terrain, and the pilot died.

The key risks in a winch launch appear during the ground run and initial climb. The ground run is often very short due to high acceleration. The initial climb can easily become too steep. High acceleration and weak aileron control during the ground run may cause an accident risk if a wingtip hits the ground. The pilot will not necessarily have time to abort the take-off before the glider becomes airborne. The wingtip that hit the ground may cause the glider to turn because of increased drag on that side or otherwise create unfavourable conditions for the initial climb.

A hazard may also be caused by the tow rope snapping during initial climb in a winch launch if the climb angle is too steep. The pilot will then not necessarily be able to level the glider off to a normal glide in time, and the glider will stall and collide with terrain. The tow rope used for winch launches is usually steel wire or a braided tow rope. In the Rautavaara crash of 2012, the principal cause was that a wingtip hit vegetation at the edge of the runway and subsequently hit the ground. As a consequence, the glider took off at a very steep angle, and the pilot lost control. The glider was destroyed, and the pilot was seriously injured.

12.4.3 Approach and landing

Approach and landing in a glider differ substantially from powered aircraft, because it is not possible to abort the approach or landing. When landing a glider, the pilot must estimate the gliding ability of the aircraft and use airbrakes to achieve the desired glide profile. Deploying the airbrakes too much and reducing air speed excessively during levelling and flare in landing may lead to an excessively heavy ground contact. On the other hand, reducing the deployment of airbrakes in the final stages of landing may cause the aircraft to bounce on ground contact. A hard landing and a bounce may both lead to damage to or destruction of the aircraft, even the death of the pilot. **Airbrake use should continue to be given a lot of attention in basic training for sailplane pilots.**

An elevated risk may be caused by **landing in terrain instead of a normal landing.** If a glider runs out of favourable weather during the flying day and no more lifts are found, the pilot may have to decide to land at a location outside an aerodrome. Landing in terrain is a wholly normal action for a glider. However, we must remember that the risk of an accident is always greater in a terrain landing than in a landing at an aerodrome. This risk may be mitigated by choosing the landing site appropriately. The best place for landing in terrain is an open field with as low a growth as possible. The main thing is that the landing site should be level, there should be no power lines running across it, and there should be no ditches, well covers, animals or other obstacles.

High grass may cause the glider to spin on landing. This is generally not dangerous, as damage is usually limited to structural damage to the aircraft. **Colliding with a power line during approach is a much more serious safety risk.** At Jämijärvi in 2009, a glider pilot died when the glider collided with a power line running across a waterway when making an approach for a landing on ice. A runway had been cleared on the ice, and the landing was a planned one. However, the pilot failed to notice the power line because of the lighting conditions. A contributing factor was that the glider had ended up lower than usual on the final leg of the landing circuit.

The decision to land in terrain may be delayed, as the pilot is strongly motivated to get back to the point of departure. A landing in terrain means extra work, because the transport trailer must be brought to the landing site to retrieve the glider. A late decision of landing in terrain may lead to a poor choice of landing site. The pilot will not necessarily have time to consider all essential factors when planning the landing. Therefore **the importance of making the decision to land in terrain as early as possible must be emphasised. This must be done during theory instruction,** since landing in terrain is not covered in the flight training of sailplane pilots.

12.5 Aerobatics

Aerobatics is a category of recreational aviation that may be divided into four areas:

- 1 – training: a) theory and b) practice
- 2 – practising: solo or with an instructor
- 3 – flying at competitions
- 4 – flying at air shows

Aerobatics may be flown on powered aircraft, sailplanes, helicopters or hang gliders. Every aircraft used for aerobatics must naturally be specifically designed and manufactured for that purpose.

12.5.1 Theory instruction

It is **fundamentally important that students are given theory instruction that helps them acquire a thorough understanding of aerodynamics**. Students must understand all the forces that affect an aircraft, from gyroscopic forces to propeller torque, etc. **Aerodynamics theory must also be put into practice**.

A thorough understanding of aerodynamics and the forces affecting an aircraft facilitates manoeuvring at low airspeeds. In that situation, aerodynamic forces are low but all other forces are high. The aircraft can be manoeuvred along all three axes in ways considerably different from conventional aerobatics.

12.5.2 Flying instruction and practising, solo or with an instructor

Once theory instruction has been completed adequately and commensurate with the student's current aims, the student may be introduced to an aircraft in practice. Initially, all movements must be executed with a qualified instructor. The instructor must ensure that the student truly understands what is happening in the training. An example is the basic wingover, where the aircraft is pulled up and then a flat 180-degree turn is made. Engine power must be at the maximum to maintain sufficient air flow across the tail for the turn. Maximum power and the resulting gyroscopic force from the propeller have the effect of rolling the aircraft. If this is not countered, the aircraft may enter a flat spin, and if the centre of gravity is far aft, it is difficult to recover from the spin.

After this instruction, the student may begin practising solo, with occasional input from an instructor. A student must always prepare a plan for flying practice.

12.5.3 Flying at competitions

Competitive flying can create a thorough and safe foundation for aerobatics, assuming that the pilot has a safety-conscious attitude. Even some of the most successful and experienced competition pilots have had accidents through unnecessary risk-taking, although not in competitions, because competition rules are very strict. Unnecessary risks are sometimes taken during practice flights or at an air show through over-confidence. If a pilot develops a sense of being 'all-powerful' through mastery of routine, this may be fatal. Flying involves hundreds of variables, and aerobatics is even more complicated. Indeed, flying always entails risk factors, and that risk should not be compounded through poor risk management.

There are five classes in competition aerobatics: Basic, Sportsman, Intermediate, Advanced and Unlimited. In the Basic class, competitors execute individual basic manoeuvres graded by the judges. The Unlimited class involves highly complex combinations of manoeuvres with a minimum altitude of 100 m. This requires a top-quality aerobatics aircraft and a highly skilled pilot. The other classes are between these two in terms of their level of difficulty.

The Aerobic Club of Finland, an aerobatics organisation under the Finnish Aeronautical Association, provides theory and flying instruction. Pilots joining the club are given comprehensive guidance and support. They are also monitored, ensuring that they do not transfer to a more demanding class or aircraft before they have the skills required. The system is highly evolved, following common worldwide practice.

In competition aerobatics, programmes (combinations of manoeuvres) must be planned in accordance with the manual and rules prepared by the aerobatics committee (CIVA) of the Federation Aeronautique Internationale (FAI), known as ARESTI.

This is an established practice whereby competitors are not allowed to ‘wing it’ but must practice manoeuvres with prior approval for competition use.

12.5.4 Flying at air shows

Flying at air shows is different from flying in competitions. At an air show, the pilot alone determines which manoeuvres or combinations to execute. As a result, many pilots perform manoeuvres at air shows that are not found in the ARESTI catalogue published by the CIVA of the FAI. **If the pilot is not qualified, the risks may be huge.**

In air show flying, the national competent authority sets the minimum manoeuvring altitude for each show pilot, for both normal and inverted flight. The maximum allowance in an air show approval from a national authority may be ‘Unlimited’. This is a reference to the Unlimited class in competition aerobatics. However, it is a crucial issue whether the pilot actually meets the knowledge and skill requirements for Unlimited class pilots. **Assessing this is a demanding task that requires thorough familiarity with aerobatics and the individual pilot’s skills.**

It should be noted that air show flying is much more demanding than competition flying, because there is no supporting infrastructure. In competition flying, there are judges and strict rules governing manoeuvres and combinations. No one ever improvises in a competition, and this makes competition flying a very safe environment.

In air show flying, no one can interrupt a performance except the Air-Boss, who must be sufficiently qualified to be able to estimate when flying becomes unsafe. Consequently, event organisers must ensure that anyone in this role has sufficient competence. So far, there have fortunately been no serious accidents at air shows in Finland, although worldwide such incidents are not unknown.

An aerobatics qualification requirement will enter into force next year as an EASA reform. This is a welcome development that will hopefully introduce adequate rules for the management of key risks.

12.5.5 Summary

Aerobatics is fundamentally a very safe mode of flying, and it enhances flying safety through increasing pilot skills. When properly practised with the right aircraft in the right place, it involves minimal risk.

Safe aerobatics, whether in a competition or at an air show, requires a humble attitude, severe self-criticism, recognition of one’s limitations, good training (especially when learning the basics) and suitable aircraft.

Lack of comprehensive regulations must not be an excuse for ignoring or failing to observe good practice, instructions and basic rules for safe operations in practising aerobatics, at competitions or at air shows.

12.6 Hang gliders and paragliders

Pilot requirements for hang gliders and paragliders have been published in aviation regulation PEL M2-9. There is no licence requirement for gliders, only a training certificate is required. The training requirements are based on the instructions and recommendations of the Fédération Aéronautique Internationale (FAI), e.g. SafePro and ParaPro. There is no ICAO standard governing the training, and there are no medical requirements.

Regarding hang gliders and paragliders, the survey was mainly based on threats identified at the risk workshop. Fewer than 10 of those who responded to the interest group survey were involved in hang gliding or paragliding.

At the risk workshop, glider flying was divided into powered and unpowered hang gliding and paragliding. **The clearest threat identified for gliders was taking off into or flying in excessively challenging weather conditions.** Other threats identified included shortcomings in flight preparation, approach and landing planning, taking obstacles into account, flying skills, experience, other traffic and towing.

12.6.1 Taking off into or flying in excessively challenging weather conditions

Hang gliders and paragliders are generally very light aircraft, and as such are particularly vulnerable to changes in wind conditions. Shifting wind direction causes problems for take-off and landing. High winds make approach and landing difficult.

Hang gliders and paragliders are more susceptible than other aircraft to loss of control due to adverse weather conditions such as turbulence and unsafe thermal conditions. In winter, if frost accumulates on a glider wing, it becomes more prone to stalling just like other aircraft. A paraglider will not necessarily take off at all if there is too much frost or moisture on it. Because gliders are lightweight, flying into a cloud is also a very real risk if there is a substantial updraft under the cloud.

Hang gliders and paragliders often operate from uncontrolled aerodromes, but unlike in other types of aviation, powered gliders also operate from fields or any other open spaces. Pilots are thus completely reliant on general weather forecasts and observations for their weather information. Monitoring the weather may be ignored by beginner pilots whose focus is on flying. **The danger here is that the pilot may not notice in time that the weather is becoming worse.** On the other hand, a glider requires very little space for landing, so it is relatively easy to abort a flight if unsafe weather is unexpectedly encountered.

Training for hang gliding and paragliding mainly follows the SafePro and ParaPro training programmes. These are based on a five-step structure. The pilot's level of training indicates the level of knowledge, skill and experience attained and the type of flying allowed. In basic training, the pilot completes the training programme to level 2, after which an assessment of skill is conducted and a training certificate issued. Completing the next levels is an independent pursuit, and whether the pilot actually has the skills required for any particular level is not tested. A pilot may thus believe that he/she is competent to level 5 without anyone having checked whether this is actually the case. **Levels 3 to 5 require flying in a variety of thermals and cross-country flying; understanding weather conditions is an essential component of the knowledge and skills required.** In paragliding, a test on the rules of the air is required for level 4 (cross-country flying).

12.6.2 Technical defects, planning approach and landing, obstacles

The glider and other equipment must be checked before the flight. If the check is performed carelessly because the pilot is in a hurry or for other reasons, an undetected fault in the equipment may affect control during flight. In paragliding, there is so much material involved (fabric and lines) that faults may occur despite a careful pre-flight check.

With powered gliders, an engine malfunction does not necessarily compromise flight safety, as it is usually relatively easy to find a landing site within reach of unpowered gliding. Even an engine failure on take-off is generally not dangerous, although in some circumstances taking off with an underpowered engine may lead to the aircraft colliding with lateral obstacles or, if the pilot circles back too abruptly, to a stall.

As powered gliders are often operated from fields and other open spaces, **taking obstacles into account emerges as a risk factor.** In particular, it may be difficult to discern power lines even when flying at low speeds. **Extra care should be given to the choice of landing site and checking it in advance.** Insufficient planning of the approach and landing may lead to choosing a landing site that is too small or too short or to the pilot beginning the approach at the wrong altitude or at the wrong time.

Landing in a field or similar area means dealing with terrain that may vary greatly in its surface material and condition. There may be holes, rocks or high grass that complicate landing.

12.6.3 Flying skills and experience

A gliding hobby should be started with an airfoil that is sufficiently easy to handle and matches the pilot's skills. **In hang gliding in particular, flying with an airfoil that is unduly challenging may lead to loss of control.** It is also more common in hang gliding to move directly from the beginner's airfoil to a competition airfoil, which is considerably more difficult to control. This is not specifically addressed in training programmes; it is assumed that pilots will themselves acquire the required experience before progressing to more difficult airfoils. There is a standard for paragliding, EN-926-2, that links the aerodynamic properties of the airfoil and the skills required of the pilot. In hang gliding, the German DHV classification and the classification system maintained by hang glider manufacturers in the USA are used.

Gaining flying experience takes time and requires patience, because weather conditions are not always suitable for gliding.

Glider operations are also not subject to requirements for regular check flights, which means that **a hang glider or paraglider may be piloted by a person whose skills are questionable and not clear even for the pilot himself/herself.**

12.6.4 Other traffic

Hang gliders and paragliders usually **fly at speeds very different from those of other aircraft.** Therefore gliders normally have a much shorter landing circuit, which in turn may make it difficult to estimate the landing order. **Under the rules of the air, powered aircraft must yield to gliders, including powered gliders.** To comply with this rule, powered aircraft may sometimes have to abort an approach or take evasive action, as the difference in speed between the aircraft and a glider is great. On the other hand, gliders do not necessarily need a runway to land and can leave the runway for the use of other aircraft.

Sailplanes, hang gliders and paragliders may use the same thermal. Here, too, speed differences may be substantial, but this also serves to stack the aircraft automatically, with gliders flying in a tighter circle in the middle and sailplanes flying in a larger circle.

12.6.5 Towing

Unpowered gliders generally have to be towed to take off, unless take-off is performed for instance by running down the side of a mountain. For successful towing, both the tug and the glider must act appropriately.

A sudden loss of towing power because of a severed tow rope requires the pilot to react quickly, especially if this happens at a low altitude. Excess towing power may complicate take-off, particularly in paragliding. It is important for the glider pilot to communicate with the tug concerning the towing power required. In some cases, the tug may have a PMR radio and the person assisting the glider may have an aviation radio, or vice versa, meaning that communication during towing is not possible.

12.7 Parachuting

Serious parachuting accidents in recent years have principally been injuries or fatalities in landing or collisions in free fall. In both 2013 and 2014, there was one parachuting fatality in Finland. An earlier fatal accident occurred in 2004. The accident at Jämijärvi that claimed the lives of eight skydivers in the current year was classified as an aircraft accident. Nevertheless, the accident occurred in a parachuting operation. The investigation into this accident is ongoing at the time of writing. The Safety Investigation Authority is responsible for the investigation and for publishing its findings. In the risk workshops under the present survey, parachuting was discussed from the perspective of parachute jumping on one hand and from the perspective of parachuting-related flight operations on the other.

Parachuting is an extreme sport where part of the attraction is in the thrills and accepted risks involved. **Several accidents and incidents have occurred as skydivers have exceeded their competence in performing challenging manoeuvres.** In practice, there is risk involved at every stage of a parachute jump, but most of these risks can be efficiently minimised through training and equipment. However, on the whole the sport involves fewer risk-mitigating measures than recreational aviation. The following is a discussion of the key risks in parachuting and related flight operations.

12.7.1 Landing

One of the key risks in parachuting is in **landing**. A correct landing under normal circumstances presents no particular risk. **Landing risk may be divided into two categories: high-speed landings by experienced skydivers and initial landings by learners.**

12.7.1.1 Risk-taking by experienced skydivers

Modern parachutes are high-performance and high-speed devices that enable landings at great speeds. Some experienced skydivers aim at performing ‘swoop landings’ by deliberately increasing their airspeed with a low-altitude turn and converting their kinetic energy into lift close to the ground, enabling them to glide along the ground at high speed for a considerable distance. **The small margins of error and high risks involved in such landings are well known**, and there is a multitude of information and handling training available for such manoeuvres, beginning in basic training. Nevertheless, a major reason for injuries and fatalities sustained by experienced skydivers on landing is an error in judgment when increasing speed too low, leading to the skydiver being unable to level off and colliding with the ground. **The fatal accidents in 2013 and 2014 were both due to judgment errors made by experienced skydivers on landing.** ‘Swoop landings’ have been addressed in training and educa-

tion for years. It has been acknowledged that such high-risk actions prone to errors, undertaken by individual experienced skydivers, cannot be wholly eliminated and this represents a **permanent risk characteristic of the sport**.

12.7.1.2 Initial landings by students

Statistically speaking, students most frequently sustain injuries in their first three jumps, but the injuries are usually only mild sprains and fractures. In 2013, 62% of student injuries occurred in the first three jumps. **Despite thorough training, practice and radio guidance, the actual fact of landing and the related tension and stress may overwhelm the student** and lead to errors in timing the final pull-up, in assuming the landing position or in following radio instructions. The parachutes used by students are large and easy to handle, reducing the risk of injury. It is generally agreed in the sport that all possible measures have been undertaken to mitigate injuries to students on landing and that the **residual risk is acceptable, considering the nature of the sport**.

12.7.2 Collisions in free fall

Skydivers colliding with each other in free fall has emerged as a **key risk** in modern skydiving. Skydivers move **in three dimensions at high speeds and with great speed differences**, increasing the risk of miscalculation and colliding with another skydiver. At high speeds and with great differences in speed, a collision may lead to serious injury, loss of consciousness, incapacity or even death. **Automatic activation devices (AAD)** have saved many skydivers worldwide, Finland not excepted, in cases where a skydiver has lost consciousness due to a mid-air collision and their parachute nevertheless deployed thanks to the AAD. An AAD is highly recommended, but only mandatory for students and licensed skydivers in classes A and B (fewer than 200 jumps).

Skydivers are aware of the elevated risk of collision in free fall. Demanding jumps involving free fall manoeuvres are principally undertaken by experienced skydivers; inexperienced skydivers are taken along to practice. Risks are minimised through planning, practice and contingency plans for exceptional circumstances such as loss of visual contact. Having said that, we should note that the training of a licensed skydiver for new, demanding performances depends mainly on the skydiver's own initiative and is not mandatory (except for wingsuits). Not every club has an instructor competent in every type of skydiving.

12.7.3 Unintended parachute deployment during exit from aircraft

Unintended parachute deployment during exit from aircraft is a risk particularly in small aircraft typically used by skydiving clubs, which are exited through a door under the wing, commonly using the wing strut for support. The confined space elevates the risk of the parachute rubbing against the aircraft, possibly causing unintended parachute deployment. A parachute deploying during exit may make contact with the aircraft, damaging the tail or other structures and in the worst case causing loss of the aircraft and multiple casualties.

Preventive measures include thorough exit training and careful maintenance and inspection of the parachute rig. Exit training aims to create circumstances as close to the real thing as possible in an exit simulator and train the student to perform the appropriate moves inside and outside the aircraft. Skydiver training also includes, as an essential component, the inspection of parachute gear before the jump and protecting the release handles while moving inside the aircraft and during exit. Neverthe-

less, students (particularly those making their first exit) may be **overwhelmed and stressed by the actual situation, stress being a contributing factor** in taking incorrect actions.

12.7.4 Flight operational risks in parachuting

Several types of aircraft are used for parachuting in Finland. There are several small Cessna aircraft (accommodating 4–6 jumpers) and some larger aircraft: two Pilatus Porters (10 jumpers) and two Cessna Caravans (15–18 jumpers). Aircraft operated by both non-commercial clubs and commercial operators are used for parachuting in Finland. Aircraft used for parachuting do not need to have seat belts for all passengers – with the agreement and responsibility of the pilot-in-command and the jumpers – if there are fewer than 10 jumpers. Everyone on board without a seat belt must have a parachute and must have undergone parachute training.

The Finnish Aeronautical Association requires the skydiving instructions of parachuting clubs to include general rules for aircraft loading and for moving about on board. Because aircraft types are different, the Association has not issued general instructions on flight operations related to parachuting or associated risks for skydivers or pilots.

12.7.4.1 Aircraft loading and take-off

The principal risk factor during take-off is the aircraft having an incorrect or shifting centre of gravity that may cause loss of control. Preventive measures include correct loading of the aircraft, clearly defined weight limits and markings to indicate where the jumpers should be located on board or how movement on board is allowed during take-off. In many of the small aircraft used for parachuting, the only relevant factor is observing the weight limit, because the aircraft size precludes passengers from moving around inside it. Some larger aircraft have clear markings indicating that passengers should remain forward of that marking during take-off. In some aircraft, passenger placement is dictated by seats and seat belts.

12.7.4.2 Exit

When the aircraft is flying at exit altitude, there is **a risk of incorrect or excessive movement by jumpers in the aircraft, especially towards the rear**, causing a shift in the aircraft's centre of gravity at a critical moment and resulting in a stall. Such a stall may at worst lead to loss of control and multiple casualties. Operators have different instructions as to how to perform an exit and how to maintain the aircraft centre of gravity within permissible limits. Some operators specify how many jumpers may at most be stationed at the aircraft doors waiting to exit, so as to maintain the centre of gravity within permissible limits. No general instructions regarding the risks of parachuting-related flight operations have been issued for skydivers.

12.7.4.3 Skydivers' awareness of flight operational risks

Skydivers generally perceive parachuting risks to concern the jump itself. **Knowledge of flight operations related to parachuting and the risks involved is low.** While the threats may be acknowledged, their seriousness or causes are not known well enough, and skydivers may not be familiar with the instructions or follow them readily. Skydivers should be informed about the risks of aircraft loading and the shifting of the centre of gravity when moving around in the aircraft, and how serious these risks are.

12.7.4.4 Pilot training for parachuting operations

Pilot training for parachuting operations is the responsibility of the club in the case of non-commercial operations and of the company operating the aircraft in the case of commercial operations. **Because aircraft are different, pilot training varies, and there is no nationally coordinated exchange of information.** The Finnish Aeronautical Association has issued no general instructions for pilot training for parachuting operations. The risk survey revealed an occasional lack of coordination between skydivers and pilots.

13 Summary and conclusions

13.1 Risks: the big picture and how to address it

Cost pressures and the role of the authorities: As the overall costs of recreational aviation grow and recreational aviation sites retreat further away from cities, it is becoming more difficult to maintain routines. This is one of the identified risk-increasing factors. On the other hand, the resources available to the authorities are scarce due to the poor economic situation in Finland as elsewhere in Europe. Priority focus areas for the authorities are being sought in the ongoing reform at the EU level. This action must be undertaken in Finland too, taking EU-level reforms into account. The division of duties, roles and responsibilities in recreational aviation must be clearly defined and sufficient operating potential (financial, human and expertise resources) must be ensured.

Understanding of the key risks in recreational aviation: International studies highlight the same major risks that were identified in the present survey. Apart from a handful of special features, the situation in Finland is much like in other countries. Most measures available to mitigate risks are the same and have been identified as such. Adding more regulation or making it stricter is rarely the answer. Rather, unnecessary and excessive regulation should be dismantled, and regulations should be enhanced by focusing on identified major risks. Apart from a number of items concerning regulation, the proposed measures address other topics. Many of the measures involve improving the quality and content of operations.

Role of the authorities: The role of the Safety Investigation Authority is clear. Trafi and any other parties addressed by the recommendations given in safety investigations must invest in actively putting these findings into practical use.

The role of Trafi as a national aviation authority involves actively influencing EU legislation and participating in international safety cooperation. Trafi also manages national regulatory duties in recreational aviation and serves as a coordinating and supportive body for the aviation community, seeking for efficient and modern ways of contributing to the upkeep of an acceptable level of safety.

Role of the recreational aviation community: The aviation community must adopt a more prominent role and responsibility for the safety of recreational aviation. For this purpose, the community needs a clear mandate and sufficient operating potential (financial, human and expertise resources). The community will face a great but rewarding task of developing its operations to meet the challenges of its new role. The large number of expert responses to the interest group survey revealed a genuine interest and desire to contribute to improving the safety of recreational aviation. Effective channels and procedures must be found to leverage that expertise and motivation.

Role of an individual recreational aviator: It is the responsibility of every individual aviator to maintain and continuously improve his/her competence and to be aware of his/her limitations. Every aviator is also an ambassador for the right attitude. Therefore it is everyone's personal responsibility to promote good airmanship.

13.2 International situation, safety and risks

13.2.1 EASA general aviation strategy and roadmap

The safety of general aviation is a topic of international interest. The European Aviation Safety Agency (EASA), the European Commission, recreational aviation communities and aviators are concerned about the increased and increasingly complicated regulation of general aviation, rising prices, and the effects of those factors on safety. The EASA has initiated a broad-based project to improve the safety of general aviation and to revise its safety structures. A European General Aviation Safety Strategy and roadmap were drawn up in August 2012 as a starting point. The concept of ‘general aviation’ (GA) is understood broadly in this context and covers several areas of recreational aviation too. Initially, European GA efforts will focus on the ‘lighter end’ of general aviation.

The EASA has drawn up a two-stage plan for simplifying and clarifying regulations concerning general aviation. The first stage of the process was written up in Opinion 10/2013 submitted by the EASA to the European Commission, prepared in accordance with the standard Regulation amendment procedure. The Commission has not yet adopted any amendments to the Regulations concerned.

13.2.1.1 Underlying principles of the roadmap

The discussion leading to the roadmap concentrated on the need to prioritise measures so as to focus resources, regulation and measures in areas where the risk of serious accidents is greatest, based on risk assessment. This represents a change to the traditional approach, where regulation covers all areas equally. Now all regulation is measured against identified risks and requires assessment.

The International Civil Aviation Organization (ICAO) also highlights the responsibility of general aviation pilots and aircraft owners for their own actions, in Annex 6 to the ICAO Convention. Under Annex 6, governments do not have an equivalent duty of care towards general aviation as towards commercial operations: “...*due to the inherent self-responsibility of the owner and pilot-in-command. The State does not have an equivalent “duty of care” to protect the occupants as it does for fare-paying customers in commercial operations...*”.

This approach is also apparent in the risk hierarchy determined by the EASA, intended for evaluating the acceptable risk level in various areas. The principle is that the higher a party is in the risk hierarchy, the more effectively they will be protected through regulation. Parties lower in the hierarchy may be considered to be more aware and accepting of the risks involved. Risk hierarchy:

1. Uninvolved third parties
2. Fare-paying passengers in commercial air transport
3. Involved third parties (e.g. air show spectators, airport ground workers)
4. Aerial work participants / Air crew members involved in aviation as workers
- 5. Passengers (‘participants’) on non-commercial flights**
- 6. Private pilots on non-commercial flights**

All regulation must be considered in relation to the above risk hierarchy and the need for protection derived from it. On the one hand, the ongoing safety effort is also about finding new ways of improving safety, including ways of leveraging existing infor-

mation better and getting the general and recreational aviation community to assume more responsibility for safety. On the other hand, new means for the authorities to support the aviation community are also needed. **What must be resolved, both on the European level and in Finland, is how the roles of the general and recreational aviation community and the aviation authorities are divided in the future and what modern forms of active cooperation may be established between them.**

13.2.1.2 Baseline information for the road map

A working paper of the EASA Management Board dated December 2012 notes that **the top 5 causes of fatal general aviation accidents analysed in the USA and the UK, which between them caused more than 80% of those accidents, may be found in the list below, irrespective of the year or country.** The findings of the present survey are consistent with the aforementioned study: the principal causes of the most serious (i.e. fatal) accidents form a relatively short list, and the principal means for improving safety are not to be found in increasing regulation. The factors listed here have **also been identified in accidents in Finland:**

1. Loss of control in flight in visual meteorological conditions (LOC-I in VMC), typically problems in aircraft control, recognition of stall and recovery from a stall;
2. Controlled flight into terrain (CFIT). A typical CFIT accident in general aviation is one where a pilot not qualified for IFR flight encounters bad weather, loses situational awareness and collides with terrain or an obstacle;
3. Low-altitude aerobatics, specifically conscious or ill-considered risk-taking in performing a manoeuvre without sufficient ground clearance;
4. Loss of control in flight in instrument meteorological conditions (LOC-I in IMC). Similar to CFIT accidents caused by poor weather, but here the pilot makes a conscious decision to enter a cloud, thereby losing spatial orientation and control of the aircraft;
5. Emergency landing due to pilot error. The most typical cause for this is fuel exhaustion.

The working paper also notes that **the principal cause of an accident is almost always pilot error, very rarely technical issues with the aircraft.** It is further noted that **all of the contributing factors listed are already protected against through regulation. Clearly additional regulation is futile; instead, new means are needed** for improving the safety of general aviation. The same is noted in the conclusions to the present survey.

13.2.1.3 Progress of roadmap amendments

The purpose of the amendments is to shift responsibility from the aviation authorities to operators. At the first stage, the approval process for maintenance programmes will be simplified to allow for operators' own maintenance programmes based on a minimum inspection template and to allow repair shops to approve maintenance programmes and to carry out airworthiness reviews (ARC).

The impact of this change on aviation safety is difficult to estimate, but it shifts responsibility from the authorities to operators.

Every year, the EASA holds an extensive safety conference with a variable theme. The safety of general aviation is the theme for this year, showing how urgent and important the topic is considered. The conference, to be held on 15 October, will focus

particularly on ongoing legislative work aiming at simpler, lighter and better regulation of general aviation in Europe. As this is work in progress, there is no accurate information as yet of the changes it will involve. On the other hand, Trafi is actively involved in this process.

The status of the GA regulation work undertaken by the EASA can be viewed on the EASA website:

<https://www.easa.europa.eu/easa-and-you/aviation-domain/general-aviation>

13.2.2 European General Aviation Safety Team (EGAST)

The EASA hosts the European General Aviation Safety Team (EGAST), a voluntary consortium of the EASA, other European aviation authorities and general aviation organisations. The EGAST, the European Commercial Aviation Safety Team (ECAST) and the European Helicopter Safety Team (EHEST) are all subordinate to the European Strategic Safety Initiative (ESSI). ESSI is a 10-year programme set up by the EASA, other European aviation authorities and the aviation industry in 2006; EGAST, EHEST and ECAST are its three central pillars.

The purpose of EGAST is to promote safety in general aviation for instance by improving availability of safety information and by sharing best practices. More information on EGAST operations is available here: <http://easa.europa.eu/essi/egast/>.

13.2.3 Five hazardous attitudes and their consequences

In 2006, the US Federal Aviation Administration (FAA) published a study entitled 'The Effects of Hazardous Attitudes on Crew Resource Management Skills' in the *International Journal of Applied Aviation Studies*, examining the connection between aeronautical decision making (ADM) and crew resource management (CRM) in the light of fatal accidents in general aviation.¹

The study identified five hazardous attitudes or behavioural patterns that were found to have a clear, measurable negative impact on ADM and CRM skills. They are:

1. Anti-authority
2. Impulsivity
3. Invulnerability
4. Macho
5. Resignation

The study showed that pilots with the aforementioned attitudes are readier to take big risks (including the decision to embark on a flight involving elevated risks), more prone to make bad decisions, more likely to make errors if a dangerous situation evolves in flight, and less likely to use all available resources in a critical situation to prevent an accident from happening.

The authors propose that attention should be paid and better training given in ADM and CRM skills at all levels of aviation.

This is an area that has been addressed in commercial air transport for a long time through the selection process for pilot training and in training programmes. By contrast, **more attention needs to be paid to this in recreational aviation, in Finland too, both in training and in the day-to-day operations of the aviation community,**

¹ The Effects of Hazardous Attitudes on Crew Resource Management Skills, 2006 (Michael Wetmore and Chien-tung Lu)

because problems in decision-making and ill-advised risk-taking can, unfortunately, be identified as contributing factors in some accidents.

13.3 General factors affecting the level of risk in recreational aviation

13.3.1 General factors increasing and decreasing risks: attitude, maintaining routine, costs and community spirit

Recreational aviation is said to be a suitable pastime for anyone with an interest in aviation. While this is essentially true, we must remember that **aviation is a demanding and time-consuming hobby, although also an inspiring and rewarding one.** Professional pilots (including commercial air transport pilots) often have a background in recreational aviation or were inspired to take up aviation as a hobby when flying small planes in their basic pilot training. Surprisingly often, however, professional pilots abandon recreational aviation once they have established a career. Yet this should not be surprising, as it reflects how demanding recreational aviation is: not even flying commercial aircraft for a living can provide a sufficient routine for recreational aviation.

Aviation professionals are generally highly safety-oriented. They understand that in order to have aviation as an active hobby, one must be prepared to spend a lot of time and maintain one's competence and routines to keep the risk level low. In other words, they are aware that even if their licence and qualifications were still valid, one should not take to the air in an unfamiliar aircraft without sufficient revision and careful preparation. This takes time and requires a high degree of motivation.

Traditionally, recreational aviation is a **highly communal activity.** Many of its categories, such as gliding or parachuting, rely on volunteer organisations or clubs. This communality is the source of the practice known in Finnish aviation circles as 'café chatter time', meaning 'hanging out at the club' and exchanging experiences. Sometimes disparaged, this tradition is crucial in **transferring 'tacit information', i.e. experiences and how to learn from them, from experienced recreational aviators to younger ones.** Occurrence reporting, a central source of information in the safety management systems of commercial air transport, may be seen as nothing more than a process-standardised development of 'café chatter' – a vehicle for conveying information about the experience of one individual to benefit the entire community. In airline companies, information is analysed systematically; in 'café chatter', a community processes information through informal conversation. The major difference is in documentation and accumulation: **the challenge in the transfer of tacit information is maintaining the communal nature of club activities.** If the information chain is broken or if some recreational aviators remain outside the community, as is the trend these days, important lessons remain untransmitted. **As individualist pursuits increase, new forms of and replacements for communality must be found.** The interest group survey revealed that seminars were found to be a useful channel for distributing safety information. Participants liked them and would like to see more of them. The survey also revealed that **there is no single principal communication channel; safety information must be communicated in many different ways** so that all recreational aviation participants can be reached. Online chats and the websites of associations and clubs are places where new kinds of communality could be established.

The learning curve in recreational aviation is long and shallow. Gaining a licence says nothing more than that the pilot is allowed to embark on the journey. Ensuring true learning, adding to one's competence and attaining a high level of knowledge and skills personally and maintaining that level are important for safety. If there is no community to rely on, other means must be employed to ensure that recreational aviators are sufficiently 'forced' to learn and revise what they have learned.

Of course, the flip side of communality is the learning of bad habits and attitudes. **The recreational aviation community, especially flight instructors and jumpmasters, are role models for beginners.** Bad and risky attitudes are learned quite as easily as good attitudes. Once learned, bad attitudes are difficult to learn away from. Every recreational aviator should consider what attitudes he/she is conveying to newcomers.

Statistics and the interest group survey clearly indicate that the costs of recreational aviation are increasing and numbers of practitioners are falling. An added risk referred to in the survey was the closure of Malmi Airport. This will cause a variety of problems, including the complicating of fuel distribution throughout Finland, increasing traffic at nearby uncontrolled aerodromes (which are already subject to noise restrictions), reducing hangar capacity and thereby relegating aircraft to outdoor storage, reducing activity in recreational aviation as distances increase, and consequently complicating or terminating the business of many training and maintenance enterprises. These will probably also be reflected in the operating potential of recreational aviation.

As costs increase and the sites available for recreational aviation retreat further away, there are fewer opportunities to uphold routines. This is one of the identified risk-increasing factors. Emphasis falls then on **careful flight preparation, upkeep of competence by other means, awareness of one's limitations and safety-oriented decision-making.** General weather minima are not the same as personal, often more restrictive weather minima subject to individual discretion. Those minima must be based on the pilot's actual competence, routine and functional capability on the day. **Safe pilots do not seek to 'push the envelope'.** A wise flight instructor once put this attitude concisely into words: "If you find that you are lost on a VFR flight, go home." In other words: you should never be so lost that you could not find your way home.

13.3.2 Increasing costs of recreational aviation

The high and increasing costs of recreational aviation were identified as a risk-elevating factor both in the interest group survey and in the working group. Increasing costs represent a challenge particularly if the sites available for recreational aviation are further and further away; both factors erode the potential for maintaining routines. An expensive hobby is also less attractive and prevents some of those interested from taking it up. This may have an indirect effect in increasing safety risks for instance by reducing the number of club members who take an active part in operations or choose to become instructors.

General aviation engages in a lot of volunteer work that is of general utility and value for society at large, particularly in aerial work (e.g. fire patrol and search-and-rescue flights). Increasing costs also impact the number of volunteers available.

A fundamental issue is who should pay for safety efforts: the operators themselves or society. Whatever the answer may be, it is important to identify those costs that can be reduced without detracting from the overall benefits.

The costs of recreational aviation consist of numerous elements:

- Purchase price of an aircraft, glider, parachute or similar equipment
 - In earlier years, recreational aviation aircraft were wholly exempt from VAT. As a result, many new aircraft in good condition were imported to Finland. It was still possible to import aircraft exempt of VAT through Denmark up until a few years ago. This loophole was recently plugged up.
- Storage costs:
 - In Finland's climate, aircraft must be stored so that harsh winter weather cannot damage or weaken the condition of the aircraft so as to indirectly cause a flight safety risk. Outdoor storage involves exposing electrical equipment and instruments to humidity. Snow may place undue stress on aircraft structures in outdoor storage. Sufficient hangar space and heated maintenance facilities are needed for recreational aviators.
- Maintenance costs:
 - Aircraft owners are increasingly being prevented from maintaining their aircraft themselves. The problem in Finland is that there are only a few aircraft maintenance enterprises. Maintenance costs are often very high. The EASA will be alleviating regulation in this area in the near future.
- Insurance costs:
 - Insurance premiums may account to 8% to 10% of an aircraft's purchase price.
- Finavia season ticket and parking fees:
 - Season ticket and parking fees for aircraft, and landing fees, are a significant cost element.
- Fuel costs:
 - How comprehensive the distribution network is also affects costs crucially.
- The EASA occasionally issues further regulations concerning recreational aviation aircraft. New regulations often mean more costs. In addition to the above, costs are incurred in acquiring and maintaining training, licence and medical certificate.

13.4 General aviation

Flight safety in recreational general aviation was **relatively good** in the period under review (2004–2013). There were five fatal accidents in recreational general aviation, causing eight fatalities. There are no common underlying technical causes for the general aviation accidents that occurred between 2004 and 2013. By contrast, in almost every accident the root cause was a decision made by the pilot-in-command to take a risk and/or to violate flight regulations.

General aviation and recreational aviation differ substantially in terms of the regulatory basis applied. Only recreational aviation is subject to national provisions; everything else in aviation is regulated at the European level. This must be taken into account when considering proposals for action.

Regarding the regulations, it must be noted that better results can be attained even with the current rules. Compliance with regulations is the key to improvement for quite a way into the future.

13.4.1 Training

To achieve the learning goals under current requirements, training plays a crucial role especially in its initial stages. Therefore attention must be paid to the quality of training materials, pedagogical elements and standardisation. These elements will help ensure learning.

Everything that has been learned must be at the very least maintained in order to keep up with the requirements for safe operations. Even better, skills and knowledge must be continuously improved. In improving the safety culture, the important thing is to focus on safeguarding learning results and the continuity of instruction and learning.

13.4.2 Flight planning

There are clear indications that **the causes of many accidents are found in events on the ground, before the actual flight even takes off.** The flight planning routine is a vital element in the process, and diligence in this respect is not dependent on time, place, weather, availability of aircraft or money. Why, then, is upholding this routine considered somehow an extra chore?

13.4.3 Impacts of weather

When we broaden the period under review by ten years, back to 1994, we find that all fatal accidents (four accidents, seven fatalities) were caused by **loss of spatial orientation in challenging circumstances.** Finland is a particularly high-risk environment as regards loss of spatial orientation, for several reasons.

Long dark periods in winter: Night flights are an inescapable part of a general aviation pilot's activities in Finland, because not flying in the dark means not flying at all outside normal office hours in the winter, even in southern Finland.

Variable weather: Finland's climate produces the majority of all known weather phenomena, sometimes within a single day.

Risk assessment in general aviation is complicated by the nature of aviation meteorological services, which are geared towards commercial aviation and therefore do not update their weather reports when circumstances change because those changes have no bearing on the significant weather.

13.4.4 Importance of flying experience

Flying experience is a vast subject that needs to be broken down into components for the purposes of the present discussion.

- **Total flying experience**
- **Experience on the current type of aircraft**
- **Recent experience**
- **Recent experience on the current type of aircraft**

Type-specific routines are usually the area of flying experience where safe operating margins are generally at their best.

All types of experience are important as contributors to safe operations, but generally the more recent the experience is, the more relevant it is. We should also note that not all experience is positive experience. If a pilot has learned a procedure that is sub-standard in some way, it is not desirable to develop it to the level of an automated action.

13.4.5 Key risks

The decision to fly is often made too frivolously. The purpose of flight planning is to review all available material to ensure that the intended flight can be completed safely. It is important to examine and **correctly interpret** the current and forecast weather along the route. Airspace availability and airspace classes must also be investigated for the entire flight.

Even with the best of preparation, an unexpected situation may emerge that requires a deviation from the original plan in mid-flight.

Unawareness of the mechanics of flow separation. It is vital to be able to recognise an imminent stall. This depends on both theoretical and practical knowledge. The pilot must know the theoretical basis of conditions and flight modes in which the aircraft typically may approach stall, and must also have a practical knowledge of the indications and behaviour of the specific aircraft in such a situation.

Incorrect procedure in case of flow separation. Correct control movements are the only thing that will allow recovery from an actual stall. Stall often occurs at low altitudes and low speeds, and the corrective action must be precise and immediate. Sometimes the margins are so small that even a highly skilled pilot would be unable to recover.

13.5 Ultralight aircraft

Recent accidents involving ultralight aircraft have been caused without exception by loss of control in flight, almost always during take-off or landing. These accidents have involved both land planes and seaplanes, but the statistics look particularly grim for the safety of seaplane operations.

Although in visual flight the position of an aircraft must always be determined using external references, the fact that the ratio of engine power to aircraft weight in ultralight aircraft is high makes the initial climb after take-off challenging, as the angle of attitude may be remarkably high. **Determining the attitude of the aircraft without an attitude indicator may be difficult for an inexperienced pilot.** At the moment, training for ultralight aircraft pilots does not include any requirements regarding attitude instrument flying.

Seaplanes have a significantly larger drag than land planes because of their floats, not only when taking off from water but also in the air. Inexperience in operating a seaplane may lead to a pilot pulling up too sharply after a low-speed take-off on water. This increases the risk of stalling. **How a seaplane behaves in a stall may come as a complete surprise to the pilot, since the fitting of floats can crucially change how an aircraft handles.** How the floats affect the flying properties of an aircraft is inadequately described in the flight manuals of some ultralight aircraft.

13.5.1.1 Recognising an imminent stall

High power combined with a high angle of attitude may make it difficult to recognise an imminent stall. Ultralight aircraft do not have a compulsory stall warning

system, so the pilot must recognise an imminent stall by other means. A high angle of attitude is one of these indicators.

During take-off and during approach and landing, the pilot may have to concentrate for instance on other traffic to the extent that there is no capacity left for monitoring airspeed. The purpose of the stall warning is to draw the pilot's attention to the airspeed of the aircraft.

The most difficult issue with a stall warning system if not installed at the factory is calibration. An incorrectly calibrated stall warning system may instil a false sense of security in the pilot.

13.5.1.2 Importance of flying experience

The inexperience of recreational pilots brings a challenge to aviation. **An inexperienced pilot is not necessarily able to recognise situations where the risk of loss of control is elevated.**

Aviation regulation PEL M2-70 concerning ultralight pilots' licences is currently being updated. The update will introduce requirements for ultralight pilots that may serve to reduce the risks caused by lack of recent experience. The new requirements match the requirements for the single-engine piston class rating under a private pilot's licence.

13.5.1.3 Weight and loading

As the total load capacity of an ultralight aircraft often remains under 200 kg, an occupancy of two persons leaves little room for fuel and baggage. This may pose serious problems for cross-country flights in basic training, as the fuel requirement is greater than for a local flight. As an added challenge, the fuel distribution network has shrunk to a minimum, and refuelling is no longer possible at sufficiently many aerodromes.

Because of the problems with loading limits, ultralight aircraft are often flown with excess weight. This is apparent not only from accident investigations but also from the interest group survey conducted in connection with the risk assessment. Some respondents to the survey noted that flying with excess weight is common. This may even be an accepted practice among recreational aviators.

Aviation regulation OPS M1-9 on aircraft loading allows the use of standard weights in weight calculations for aircraft weighing up to 5,700 kg. This means that the provision also applies to ultralight aircraft, even though such an aircraft class did not even exist when the regulation was issued. The regulation allows the use of a standard weight of 75 kg for persons over the age of 12 and of 35 kg for persons under the age of 12 unless this would lead to a substantial deviation from the actual weight at the discretion of the pilot-in-command. **If the possibility of using standard weights is abused, the actual take-off weight may be considerably more than the weight calculation indicates.**

Shortcomings in weight discipline are common in flying instruction for ultralight aircraft, and instructors pass on incorrect loading procedures to students.

A factor increasing the difficulty of load calculations is that some ultralight aircraft have inadequate flight instruction manuals in some respects.

A factor increasing the difficulty of load calculations is that some ultralight aircraft have inadequate flight instruction manuals in some respects. Flight instruction manuals should have more detailed descriptions of how changes in weight and centre of gravity affect stalling and other flight properties in that particular type of aircraft.

13.5.1.4 Training

The purpose of theory instruction for ultralight pilots is to provide them with sufficient knowledge for recreational flying activities. However, the minimum requirement for theory instruction is rather modest in view of instructors having enough time not only to teach the subject matter but to ensure that the students have learned the essentials. We should note that if instructors consider the number of hours to be insufficient, there is nothing to prevent them from giving additional theory instruction or flying lessons.

To attain the learning goal under the current requirements, instruction must be of extremely high quality. Instead of increasing the number of training hours required, it would be more important to focus on the quality of instruction to improve the safety culture.

Teaching should be standardised in both theoretical instruction and flight training, and the duties of responsible persons in training organisations should be specified in more detail. One possibility for standardising training would be a normative training programme prepared by the authorities.

As aviation regulation PEL M2-71 concerning ultralight flying instructors is revised together with aviation regulation PEL M2-70 on ultralight pilots' licences, it will be easier to monitor the competence of flight instructors, as instructors will be required to fly a check flight regularly to keep their qualifications valid.

13.5.1.5 Key risks

The key risk in flying an ultralight aircraft is loss of control during take-off, approach or landing. The highest likelihood of a fatal loss-of-control accident occurs when an aircraft stalls at an altitude at which it is not possible to recover, leading to the aircraft crashing into the ground or water.

A stall may be caused by any of the following, or a combination of several factors:

- too steep initial climb due to incorrectly estimated angle of attitude;
- ignoring the extra drag caused by floats in take-off when switching from a land plane to a seaplane;
- ignoring the change in stall speed caused by excess weight;
- ignoring the combined effect of excess weight, flap setting and banking on the stall speed during approach and landing;
- inability to notice that a stall is imminent.

13.6 Large recreational aircraft

The survey risk workshop included a discussion of large aircraft referred to in Annex II of the EASA Regulation (Regulation (EC) No 216/2008 of the European Parliament and of the Council) or other aircraft accommodating a large number of passengers or with high collision energy, used in recreational aviation. The category of 'large recreational aircraft' includes aircraft of very different kinds, used in widely

varying activities. What they have in common is that Annex II aircraft are not covered by EU legislation; their use in recreational aviation is **subject to national legislation and considerably less strictly regulated** than in commercial operations. **The challenge** at the large recreational aircraft workshop was firstly **to identify generic risks in this category** and secondly **to come up with proposed improvements** to reduce risks. Risk issues were always first examined from the perspective of a Douglas DC-3 aircraft and then generalised.

13.6.1 Major generic risks

13.6.1.1 Maintenance and airworthiness (the risk is given first and the risk-mitigating feature under it):

- **Identified generic risk:** In some vintage aircraft, worn-out parts have to be replaced with custom-made parts that are no longer factory-made.
 - Risk-mitigating factor: Every modification must be approved by Trafi (modification approval).
- **Identified generic risk:** Historical aircraft were designed according to the standards of their day and do not even come close to complying with current airworthiness requirements for commercial aircraft.
 - Risk-mitigating factor: The weaknesses and risks for the aircraft type in the specific operations must be identified, and it must be described and shown that risk-mitigating measures have been identified and carried out.
- **Identified generic risk:** Untrained volunteer fitters (on the other hand: activities would be impossible without them).
 - Risk-mitigating factor: Trained employees oversee the work and issue clear instructions as to what jobs the volunteers may do. Maintenance is done in the winter, so there are no major timetable pressures.

13.6.1.2 Flight operations

- **Identified generic risk:** Pilots with little flying experience and/or experience supportive of flying the specific type of aircraft are assigned to fly (example: the AN2, which weighs less than 5,670 kg and is a single-engine aircraft, for which reason no type rating course is required for flying it; the Baltic states require a type rating nevertheless).
 - Proposed measure: A national operating approval must be required for aircraft exceeding a certain passenger number (cf. the EASA maximum for private flying: 6), and requirements for pilot competence must be defined.

13.6.1.3 Carrying passengers in recreational aviation

- **Identified generic risk:** Any situation where passengers in any category of recreational aviation are not sufficiently aware of the special features of that type of aviation may be regarded as a risk. The group discussed the level of safety in flight operations. It was noted that safety may be good, bad or something in between in both recreational and commercial aviation, depending on the operator; legislation does not guarantee a high level of safety in itself. Passengers must understand that commercial air transport is considerably better regulated and supervised than recreational aviation and that legislation on the former takes advanced risk management measures into account. Leveraging the above benefits in recreational aviation depends on the initiative and will of the operator.
 - Risk-mitigating factor: Every member must be familiar with the association's by-laws (and sign off on them); every member must register and pay the membership fee before the flight. This will prevent e.g. audience at public events from joining and boarding a flight on a whim. Flights must be booked in advance, and the purser must check the names of passengers on embarking. A mass and balance calculation must be made for each flight and a copy of the document left on the ground.

13.6.2 Conclusions of the working group

The working group decided to propose the establishment of national regulations to determine to a sufficient extent the minimum requirements for airworthiness, training and flight operations governing large recreational aircraft subject to national legislation. These include aircraft used in recreational aviation with a capacity of more than 6 passengers or with a high collision energy, jet aircraft and aircraft requiring a multi-pilot crew to operate.

In these requirements, former military aircraft must be distinguished from the rest and differences between the aircraft and their original purpose of use must be taken into account. The general requirements should be brief, but separate requirements by aircraft type and/or type of operation must also be prepared. In terms of flight operations, a national operating approval should be established, in which particularly the purpose for which the aircraft will be used would be taken into account.

There are several bodies in Finland operating vintage aircraft (such as the DC-3 association) that, even in the absence of comprehensive regulation, maintain their operations to tried and tested commercial-aviation safety standards and have set their own strict requirements for pilot experience and competence. The operations of these associations and the minimum standards required in other countries might be considered when drawing up national requirements.

13.7 Aerodromes

The survey was also intended to explore risks related to uncontrolled aerodromes and activities there. In the interest group survey, 42% of the respondents reported that they mainly operate at uncontrolled aerodromes.

The clearest risk factor category in aerodrome operations was **the runway and shortcomings in its condition or in information provided about its condition**. Other risk factor categories identified included **obstacles in the vicinity of the aerodrome, information about weather conditions or the condition of the airfield, and the variety of traffic and operations** that may be going on simultaneously at an uncontrolled aerodrome.

It is the responsibility of the aerodrome operator to maintain the runway and runway strip in good condition and to inform pilots of any damage and, if necessary, of runway closure. However, regulations do not specify how often runway condition should be inspected. Therefore a runway may be in poor condition for a long time without pilots receiving advance information of it.

Aerodrome operators are not required to have any particular qualifications for or knowledge about general aviation. Therefore the aerodrome operator may not be aware of the potential consequences of insufficient information.

Tree growth near the aerodrome must be continuously monitored and trees cleared as necessary. If needed, the runway threshold must be moved so that there are no obstacles in the redefined approach sector. Obstacles located further from the aerodrome may also be a threat if not appropriately marked and lit. In some cases, temporary obstacles such as cranes may remain unmarked, because crane operators do not necessarily know that such obstacles should be marked in the vicinity of uncontrolled aerodromes just as in the vicinity of airports.

It may be difficult to obtain accurate information on weather conditions at uncontrolled aerodromes. Uncontrolled aerodromes often host activities in multiple and very different categories of aviation and have locally agreed practices; there may also be activities other than aviation from time to time. If the airfield is used for activities other than aviation, the aerodrome operator is obliged to issue a NOTAM informing pilots of it and to lay out the necessary markings in the movement area to alert pilots.

Using an uncontrolled aerodrome involves several risks that can be mitigated by careful flight planning and advance study. Appropriate monitoring of the aerodrome condition, maintaining it and informing pilots about the condition and activities at the aerodrome are important risk-mitigating measures.

Good airmanship includes careful flight planning and, when using an uncontrolled aerodrome, monitoring radio communications and announcing the pilot's intentions if the aircraft is equipped with radio.

13.8 Gliding

Gliding is a traditional category of recreational aviation. Flying a sailplane is markedly different from other aircraft operations, as an unpowered aircraft depends on rising air, or lifts, to stay airborne. Many of the elements that elevate risks in this type of aviation are part of its 'attraction'. While risks cannot be fully eliminated, they can be mitigated through awareness and effective training.

The safety situation in gliding is stable, and no significant trends have been observed apart from a slow decline in the number of participants and the number of flying hours. Relative to the number of hours flown, the statistics for gliding are on a par with general aviation. Over the past five years, there have been five sailplane accidents, with three fatalities.

Gliding is traditionally a highly communal activity. There is no national aviation regulation governing gliding; the basic rules are based on the rules of the air (and on the Standardised European Rules of the Air (SERA) in the future) and good airmanship.

A collision of two sailplanes is seen as a key risk in gliding. This risk is elevated by the fact that, because of the nature of the sport, distances between aircraft are sometimes small. The same thermal may be occupied by a large number of aircraft, and a sailplane is difficult to see if it is approaching head-on. Risk-mitigating factors include a thorough knowledge of the rules acquired through high-quality instruction and regulations, and the fact that airspeeds are rather low.

A collision risk was also identified in aerodrome traffic circuits at uncontrolled aerodromes, where flying practices must continue to be vigilantly addressed. The interest group survey revealed that it is considered a clear safety risk that charts (even unofficial ones) with essential aviation details are no longer available for uncontrolled aerodromes. This applies not only to gliding but also to other general and recreational aviation.

Other risks in gliding were considered to involve take-off and landing in particular. In aerotowing, changes in the position of the sailplane relative to the tug represent a key safety risk. The key risks in a winch launch occur during the ground run and initial climb. Approach and landing in a sailplane differ substantially from powered aircraft, because it is not possible to abort the approach or landing. An elevated risk may be caused by landing in terrain instead of a normal landing. Therefore the importance of

making the decision to land in terrain as early as possible must be emphasised. This must be done during theory instruction, since landing in terrain is not covered in the flight training of sailplane pilots.

13.9 Aerobatics

Aerobatics is fundamentally a very safe mode of flying, and it enhances flying safety through increasing pilot skills. When properly practised with the right aircraft in the right place, it involves minimal risk.

Safe aerobatics, whether in a competition or at an air show, requires a humble attitude, severe self-criticism, recognition of one's limitations, good training (especially when learning the basics) and suitable aircraft. Because of its demanding nature, aerobatics involves risks. These risks may be actualised especially when the above points have not been taken into account. Air shows in particular challenge the professionalism and skills of both the event organisers and the pilots.

Lack of comprehensive regulations must not be an excuse for ignoring or failing to observe good practice, instructions and basic rules for safe operations in practicing aerobatics, at competitions or at air shows.

Lack of comprehensive regulations must not be an excuse for ignoring or failing to observe good practice, instructions and basic rules for safe operations in practising aerobatics, at competitions or at air shows.

13.10 Hang gliders and paragliders

Pilot requirements for hang gliders and paragliders have been published in aviation regulation PEL M2-9. There is no licence requirement for gliders, only a training certificate is required. The training requirements are based on the instructions and recommendations of the Fédération Aéronautique Internationale (FAI), e.g. SafePro and ParaPro. There is no ICAO standard governing the training, and there are no medical requirements.

Regarding hang gliders and paragliders, the survey was mainly based on threats identified at the risk workshop. Fewer than 10 of those who responded to the interest group survey were involved in hang gliding or paragliding.

At the risk workshop, glider flying was divided into powered and unpowered hang gliding and paragliding. **The clearest threat identified for gliders was taking off into or flying in excessively challenging weather conditions.** Other threats identified included shortcomings in flight preparation, approach and landing planning, taking obstacles into account, flying skills, experience, other traffic and towing.

To mitigate risks, the pilot's skills should be tested at levels 3 to 5 as well as at levels 1 and 2. **Levels 3 to 5 require flying through a variety of thermals and cross-country flying; understanding weather conditions is an essential component of the knowledge and skills required.** In paragliding, a test on the rules of the air is required for level 4 (cross-country flying). Other risk-mitigating measures include encouraging pilots to use a checklist for pre-flight checks and/or issuing recommendations specific to skill level and/or experience regarding the type of airfoil to use, informing pilots about existing recommendations, stressing the importance of radio communications, and increasing the number of radio transmitters on paragliders.

Hang gliders and paragliders usually fly **at speeds very different from those of other aircraft**. Therefore gliders commonly have a much shorter landing circuit than other aircraft, which in turn may make it difficult to estimate the landing order. **Under the rules of the air, powered aircraft must yield to gliders, including powered gliders.**

13.11 Parachuting

Every stage of parachuting involves a risk, but training and equipment help minimise them. Nevertheless, parachuting is an extreme sport where part of the attraction is in the thrills and accepted risks involved. **Several accidents and incidents have occurred as skydivers have exceeded their competence in performing challenging manoeuvres.**

The Parachuting Committee of the Finnish Aeronautical Association is the highest national expert body on parachuting, working on a volunteer basis towards improving the safety of parachuting. Voluntary occurrence reporting and using these reports to identify safety deficiencies and rectify them has been a common practice in parachuting for a long time. Information is also distributed at an annual parachutist event. Parachuting instruction and training materials are of high quality and up to date. The gear used is advanced and reliable; gear-related incidents hardly ever occur. **The sport is characterised by a strong sense of community, which is a good foundation for training and for the production and distribution of new safety information.**

Training and gear are designed to **minimise hazards for students**. Nevertheless, **when faced with the real thing on their first jump, students may panic and misjudge**. Training and information notwithstanding, the serious accidents that have occurred to experienced skydivers in recent years have mainly involved demanding manoeuvres on landing. In both of the above categories, a standard of safety has been attained that cannot feasibly be improved by addressing the gear, regulations or training; the remaining risk is a residual risk that may be actualised because of the individual decisions and misjudgements of the skydiver.

With the **increase in popularity of new sub-genres among licensed skydivers, the risk of mid-air collision in free fall has increased**. This risk has been acknowledged and addressed in training. However, to train for new genres is up to the initiative of the licensed skydiver himself/herself. Instructors for every sub-genre are not available everywhere.

The survey shows that the key risks in flight operations related to parachuting have to do with aircraft loading and the shifting of the centre of gravity at take-off and particularly during exit. The risks of parachuting-related flight operations are known to skydivers, but the seriousness of those risks and the factors contributing to them are not always fully understood. Therefore skydivers may not be sufficiently familiar with the instructions or ignore them.

There are no standardised instructions for skydivers or pilots concerning the risks of flight operations related to parachuting. Pilots are trained separately at each club or by each operator. There are no harmonised national training instructions for flight operations related to parachuting either. The survey revealed a need to **increase awareness among skydivers and parachuting pilots of each other's actions**, especially as regards key risks and how to mitigate them.

On 24 September, the Safety Investigation Authority issued a press release on the initial findings of the ongoing investigation into the accident that occurred at Jämijärvi in April (L2014-02). Because the investigation is active, this accident was not discussed in the present survey. Once the final findings are available, Trafi will evaluate them and decide on further action. Trafi has continued its normal cooperation with the Safety Investigation Authority during the investigation and the survey.

In the press release, the Safety Investigation Authority stated: “...*the right wing strut of the aircraft carrying skydivers failed in mid-air due to an uncontrolled aircraft movement. A separate study of the aluminium wing strut from the Comp Air aircraft revealed a fracture due to metal fatigue. The study indicated that the wing strut had been fractured for some time before the accident flight. This, however, was a technical fault that could not be observed in normal maintenance or inspections... The failure of the wing strut was only one of the factors leading to the accident. The significance of the fracture to the accident as a whole cannot be evaluated until the investigation has been completed. There were other contributing factors whose analysis continues... Pursuant to the Safety Investigation Act, the Safety Investigation Authority has notified the Finnish Transport Safety Agency (Trafi) of the wing strut fracture.*”

14 Working group recommendations for further action

14.1 Measures proposed by the working group:

The working group proposes a large number of measures to improve the safety of recreational aviation. Some are generic and broad, others are category-specific and limited. Some are simply lists of things for which further information or further study is required. **Only a small portion of the proposed measures involves stricter or added regulation.** The most important regulatory needs concern the establishment of a national operating approval and the setting of clear minimum requirements for large (as defined) recreational aircraft.

Generally, the proposed measures aim to continue the work begun here. Before prioritising and scheduling the measures, we must discuss and determine the goals, division of duties, roles and responsibilities for the delegation of supervisory duties in recreational aviation, and also ensure sufficient resources (financial, human and expertise resources). Then the measures can be assigned and timetabled. Key action groups and themes include:

- **Increased community feeling:** Communality is considered an essential means for distributing tacit knowledge and safety-favouring attitudes and for ensuring the upkeep of the competence of individual recreational aviators. Communality also prevents risk-taking, both conscious and unconscious. Individualist pursuit of these sports instead of traditional club activities requires new ways of promoting communality.
- **The field of training:** Training is a vital background factor in building skills and attitudes. Measures proposed regarding training aim to develop and harmonise the qualitative elements in theory instruction, flight training and teaching materials, learning results and the quality of teaching, lifelong learning and the maintenance of competence, utilising information and materials gained from comparable countries, and addressing identified risk factors in training.
- **Increased cooperation and harmonisation:** There are numerous examples in the recreational aviation community of excellent safety work being done and best practices by clubs, associations and individual aviators. These examples must be made more widely known and employed. This requires increased cooperation and the development of models for information dissemination.
- **Increasing efficient safety communications:** When the structures of the aviation community are reinforced, closer cooperation is pursued and operating practices are harmonised, high-quality safety communications will have a greater impact. Increasing awareness of identified risks and of factors that exacerbate or mitigate them is an efficient way of reducing risks, along with encouraging safety-conscious attitudes. Both the authorities and the aviation community must find new ways for enhancing communications.

14.2 Defining an acceptable level of safety: roles and responsibilities

- A debate must be launched on the acceptable level of safety and the responsible parties and roles in recreational aviation. The aim is to create **guidelines for a division of duties, roles and responsibilities among the authorities and the aviation community as well as for the operating potential (financial, human and expertise resources) in recreational aviation.** The findings of the present survey, the EASA General Aviation Strategy, the road map, the current reform of safety structures and the forthcoming air transport strategy must be taken into account.

- A seminar will be held on the themes of the present debate in late 2014 or early 2015.
- After the measures listed above are carried out, the final list of actions will be determined and prioritised.

14.3 General measures

- Completing the risk workshops: assessment and prioritisation of identified threats and risks, leading to a prioritisation of measures. Responsible party: Trafi, the work to be concluded by summer 2015.
- Analysed information from flight safety reports with safety-improving potential must be more broadly and more systematically disseminated to recreational aviators, using new means and new channels.
- A separate project will be set up for reviewing theory instruction materials and guidelines from selected comparable countries, and versions suitable for flying instruction in Finland will be selected, edited and translated for the Finnish aviation community. In connection with the present survey, the working group has already received written permission from the British Microlight Aircraft Association (BMAA) to make free use of all teaching material they have published.
- In the reference countries, some duties of the authorities in recreational aviation have already been delegated to recreational aviation organisations. A separate project will be set up to find out how well and how effectively these arrangements work. This investigation will also concern measures through which the comparable countries have attained a better level of recreational aviation safety than Finland, particularly in ultralight aviation.
- In flight training programmes, refresher courses, safety bulletins and the operations of flying clubs and communities, attention will be drawn to the key risks identified in the present survey and the measures available to mitigate them. The importance of safety-promoting attitudes, decision-making capabilities and awareness of one's limitations will be addressed.
- In-house communications in flying clubs have a significant impact on the operating culture. Best practices should be disseminated from one club to another. The aviation community, headed by the Finnish Aeronautical Association, is seeking ways for using seminars and events in disseminating safety information, aiming to eliminate duplicate work.
- The information content of the *VFR – Suomi* publication should be made available to recreational aviators. This will be explored. Means for making it easier to acquire updated aeronautical charts and for simplifying things seen as difficult in flight planning will also be explored.
- In commercial air transport, recreational aviation and other modes of transport, there are numerous examples of systems successfully adopted in the insurance sector to improve safety. The potential of linking the terms and conditions of insurance policies and their premiums to safety-improving features will be explored.
- Training organisations and aviators must be notified of the night-VFR minima that will enter into force with SERA and what their impact will be.
- Attitude instrument flying will be adopted as a theme on inspection flights in 2015.
- Cooperation between the Finnish Meteorological Institute and recreational aviation organisations will be improved for the purpose of developing general aviation weather services.
- Training organisations and aviators must be informed of the criteria for preparing weather reports and forecasts and their limitations; existing good-quality instructions will be utilised.

14.4 General aviation

- Improving and modernising the theory instruction material.
- Improving the flight training programme so that students are better equipped to recognise an imminent stall. Stalling exercises should be carried out at various engine power settings so that the student will understand the impact of power settings on aircraft behaviour both when approaching stall and in an aerodynamic stall.
- Harmonisation of operating procedures for flight instructors. Existing material in other Member States may be used for this.
- Informing training organisations and aviators of changes to night flying minima and their effects.
- Attitude instrument flying will be adopted as a theme on inspection flights in 2015.
- Cooperation between the Finnish Meteorological Institute and recreational aviation organisations to improve general aviation weather services.

14.5 Ultralight aircraft

- Improving theory instruction to the extent feasible.
- Improving the examination system so that the students' knowledge and learning results in various subjects can be better assessed during the course.
- Stressing the importance of mass and balance calculations.
- Improving ultralight aircraft flight manuals so that they give a better basis for mass review and better descriptions of how the aircraft behaves in a stall. Particular attention must be paid to how floats affect the aircraft stalling properties in the test flight programme after fitting floats.
- Improving flight training so that students are better equipped to recognise an imminent stall. Stalling exercises should be carried out at various engine power settings so that the student will understand the impact of power settings on aircraft behaviour both when approaching stall and in an aerodynamic stall.
- Improving aircraft handling training in seaplane flying instruction.
- Exploring the potential for installing stall warning systems on ultralight aircraft (installation, calibration, costs).
- As ultralight aircraft become increasingly sophisticated, attitude instrument flying should be included in the training programme to the extent relevant for recreational pilots. This could be done with an additional 1–3 hours of theory instruction and a 45-minute instruction flight.
- Harmonisation of operating procedures for flight instructors. Existing material in other Member States may be used for this.

14.6 Large recreational aircraft

- National regulations must be established to adequately determine the minimum airworthiness, training and flight operations requirements for large recreational aircraft subject to national provisions. These include aircraft used in recreational aviation with a capacity of more than 6 passengers or with a high collision energy, jet aircraft and aircraft that require a multi-pilot crew.

In these requirements, former military aircraft must be distinguished from the rest and the differences between the aircraft and their original purpose of use must be taken into account. The general requirements should be brief, but separate requirements by aircraft type and/or type of operation must also be prepared. In terms of flight operations, a national operating approval should be established, in

which particularly the purpose for which the aircraft will be used would be taken into account.

There are several bodies in Finland operating vintage aircraft (such as the DC-3 association) that, even in the absence of comprehensive regulation, maintain their operations to tried and tested commercial-aviation standards and have set their own strict requirements for pilot experience and competence. The operations of these organisations and the minima required in other countries might be considered when drawing up national requirements.

14.7 Uncontrolled aerodromes

- The interval for scheduled inspections of uncontrolled aerodromes in recreational use should be determined according to usage and local needs. The aerodrome operator must be able to provide up-to-date information on the availability of the aerodrome to anyone preparing a flight plan.
- A training package must be outlined for aerodrome operators, the completing of which would be a requirement for holding that position.
- A mandatory visit to an uncontrolled aerodrome must be added to flight training.
- Local rules at aerodromes must be harmonised at the national level so that the same principles apply for instance concerning the use of intersecting runways.

14.8 Hang gliders and paragliders

Regarding hang gliders and paragliders, the recommendations are aimed at the recreational aviation community: the Finnish Aeronautical Association, glider associations and recreational aviators.

- The pilot's skills should be assessed also at levels 3 to 5.
- Encouraging the use of a checklist in the pre-flight check.
- Recommendations specific to skill level and/or experience concerning the airfoil to be used, or informing recreational aviators of existing recommendations.
- Emphasising the importance of notifications by radio, and increasing the use of radio equipment on paragliders.

14.9 Parachuting

- The Finnish Aeronautical Association will conduct an investigation as to whether an automatic activation device should be required of all skydivers.
- Increasing awareness: the Finnish Aeronautical Association is contemplating ways in which information and training could be efficiently disseminated to all beginning licensed skydivers and experienced skydivers beginning or experimenting with a new sub-genre with an elevated risk of collision in free fall.
- The Finnish Aeronautical Association will issue general training instructions to pilots flying parachuting planes. The instructions will be generic and not specific to any aircraft type. The instructions will focus flying training on matters that are specific to parachuting-related flight operations (e.g. shifting centre of gravity, slow flight, stalling). This may be based on suitable paragraphs from the Federal Aviation Administration's guideline AC 105-2E (8. Pilot responsibilities, Jump pilot training, paragraphs 8 b – 8 f).
- The Finnish Aeronautical Association will issue instructions for skydivers concerning risks in parachuting-related flight operations. The instructions will stress the seriousness of risks involved in aircraft loading and moving around on board, and the importance of coordination between the jumpers and the pilot.

- Clear markings and instructions on loading and movement on board will be introduced in all aircraft used for parachuting.

All instructions should be drawn up under the Finnish Aeronautical Association, jointly by pilots and skydivers.