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SPIN: Survey of Practices in Safety Nets Summary Report

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Abstract

This report provides an overview of the SPIN: Survey of Practices in Safety Nets activities and the most relevant areas of concern identified.
The report includes 5 parts:

- **Survey 1**: investigation of current practices related to STCA, MSAW and APW in the ECAC area.
- **Survey 2**: selection of studies and R&D actions concerning ground based Safety Nets.
- **Survey 3**: analysis of relevant aspects of Safety Nets in the airborne domain.
- **Survey 4**: investigation on commercial products and services currently available in the Safety Net domain.
- **Areas of Concern**: list of issues that has been identified and selected as the more relevant during the investigation, linking together the results of the four surveys.

Keywords

Safety Nets	STCA	TCAS
SNET	MSAW	GPWS
ECAC States	APW	
Implementation policies		

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CONTENTS

EXECUTIVE SUMMARY

This summary report has been produced by Deep Blue and Sofréavia under contract to EUROCONTROL (Contract Number C/1.185/00/NB/TRS/018/04). Access to the complete data repository of the survey -including the *SPIN Final Report* and the *SPIN Annexes*- can be requested from the contact person at the following address: ben.bakker@eurocontrol.int .

The SPIN -Survey of Practices in safety Nets- consisted of four surveys concerning four different aspects of Safety Nets (SNET):

- **Survey 1** - **Ground based safety net implementations.** Full-scale investigation of current practices related to STCA (Short Term Conflict Alert), MSAW (Minimum Safe Altitude Warning) and APW (Area Proximity Warning) in the States of the ECAC Area. This survey highlighted, amongst others, that there are no harmonised or uniform optimisation procedures and validation criteria. In most cases, there is no explicit, overall policy and little or no involvement of Regulatory Authorities.

- **Survey 2** - **Studies and R&D Actions.** Search, selection and analysis of relevant studies and R&D actions concerning ground based SNET. This survey highlighted that there is limited publicly available material to contribute to short-term SNET enhancement actions.

- **Survey 3** - **Existing practices in the airborne domain**. Analysis of relevant aspects of airborne SNET, aimed at considering potentially useful practices for the ground domain. This survey highlighted contrasting practices for airborne SNET.

- **Survey 4** - **Current industrial capabilities and practices**. Investigation of commercial products and services currently available in the domain of ground based SNET. Many products and services are available, but detailed information is not publicly available.

After the presentation of the four surveys, the final section of the report lists 14 **Areas of Concern**. The list summarises and links together the results of the four surveys, providing pointers to the *SPIN Final Report* and to the *SPIN Annexes* (available on request), under the following headings:

- Group A – Areas of concern that are relatively well understood and for which best practices exist that can be used as model for guidance material, standards and regulations, including:
    - Nuisance reduction and need for a trade off between nuisance alerts and anticipated warning time;
    - Local instructions and information for controllers;
    - Consideration of cleared flight levels in STCA algorithms.
- Group B – areas of concern that are less well understood and where further studies or R&D actions are needed, including:
    - Analysis and management of STCA alerts, including use of alert records as safety indicator;

  - HMI of the STCA (multilevel alarms, aural alarms, information about STCA status, easiness of use by controllers, overload of information for controllers);
  - Validation criteria and validation process;
  - Understanding and management of possible interactions between STCA and TCAS.

- Group C – Areas of concern for which adequate best practices have not been identified, or that are linked to problems in other domains, to be advanced before the resolution for ground-based SNET can take place, including:
  - Definition of STCA purpose and coherent setting of parameters and of procedures;
  - Organisational roles and responsibilities within ANSP with regard to the adoption and use of SNET;
  - Harmonisation within and between countries (including uniform implementation policy, similar concepts for HMI, similar definitions and related procedures and policies);
  - Discrepancies between regulations and standards and role of regulators in the deployment of SNET;
  - Understanding and management of the differences between different safety nets;
  - Adoption of more user friendly guidelines about SNET and better dissemination of these guidelines;
  - Provision of technical information about SNET to controllers.

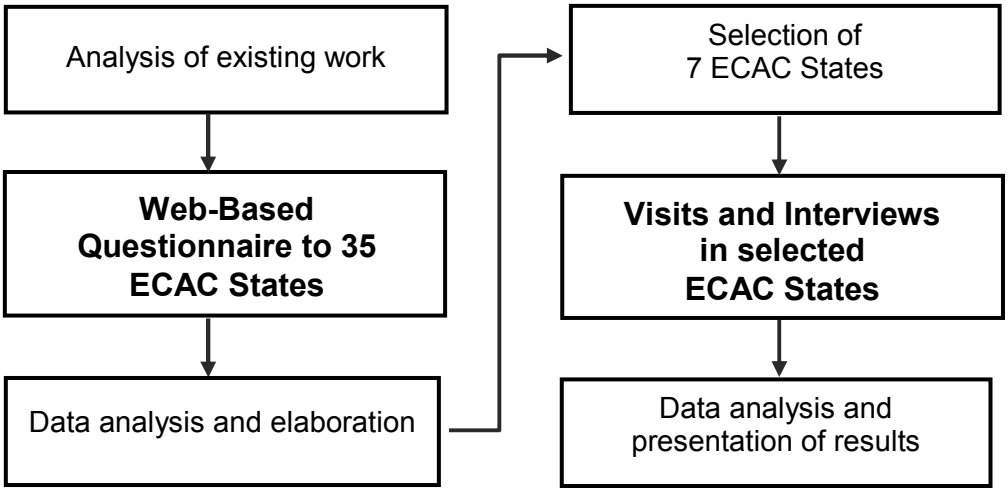
1. SURVEY 1: GROUND BASED SAFETY NET IMPLEMENTATIONS

1.1 Introduction

The first survey is the core of the SPIN initiative and comprises a full-scale investigation of current practices regarding existing implementations of ground based SNET in the ECAC Area. The survey was specifically focused on STCA, MSAW and APW and was conducted in two main steps: the administration of a web-based questionnaire to different stakeholders in 35 ECAC States, followed by face-to-face interviews in the ANSP headquarters of 7 selected States.

The web-based questionnaire aimed at collecting a large amount of data, giving to the SPIN consortium the opportunity to build up a general picture of the situation in all the ECAC Area. Whereas the 7 interviews aimed at investigating more in depth some of the more relevant issues that emerged from questionnaire responses.

The questionnaire responses provided basic information about the implementation practices adopted in several States. While interview responses represented a limited, but representative sample of the ECAC Area, these responses provided a better understanding of the rationale behind the practices described by the respondents.



The flowchart above is a representation of the path followed, starting from the analysis of the existing documentation available to EUROCONTROL and finishing with the analysis of both questionnaire and interviews' results.

The work performed for this survey served also as a mean to identify the **14 areas of concern** described at the end of this document, summarising the most relevant findings of the project. The other three surveys provided further insights and suggestions to address the identified areas of concern.

1.2 Questionnaire administration and data overview

An invitation to answer the questionnaire on a secure web server was sent to **87 persons** belonging to different categories of stakeholders: ANSP safety managers, SRC commissioners and representatives of other organisations (EUROCONTROL, IFATCA, ATCEUC, CMIC, NATO and FAA). The heterogeneity of the targets aimed at exploring a wide range of opinions concerning SNET implementation policies. Nevertheless the main focus was on ANSP Safety Managers, which were considered as the main role with responsibilities in the implementation policies.

The questionnaire structure was designed with the aim of including all the targets, with a special attention to the Safety Managers. The structure included three main sections:

1. **General SNET implementation policies** (12 questions);
2. **Safety Manager section** (21 questions);
3. **Local implementation of SNET** (60 questions)

The first part addressed all the targets, while the second and the third part were reserved for Safety Managers, with the possibility to delegate the last part to managers at local ATC Units (the complete set of questions can be found in *SPIN-Annex 1.1*).

At the end of the questionnaire administration, the response rate was 51% considering all the targets, with a total number of 44 responses. More specifically the responses from Safety Managers were 20, corresponding to the 57% of the targets in this category and to about the **80%** of the States having at least the STCA implemented[1].

Stakeholder	Received Responses	Expected Responses	Response Rate
ANSP Safety Managers	20	35	**57%***
SRC commissioners	11	30	36%
Representatives of other organisations	13	22	59%
GENERAL RESPONSE RATE	**44**	**87**	**51%**

***80% of ECAC States with STCA implemented** (data available to EUROCONTROL in 2003)

The table above provide the specific figures showing the contribution of each category to the general response rate. The column “Expected Responses” indicates the number of persons actually invited to answer the questionnaire.

Note that for some categories only a few people were involved, whereas the ANSP Safety Managers covered all the 35 ECAC States (see *SPIN-Annex 1.1* for a summary of Questionnaire responses by Safety Managers).

[1] The ECAC States not equipped with SNET didn’t answer to the questionnaire, except for one.

1.3 Interviews in selected ECAC States

After the questionnaire administration and a first analysis of collected data, a sample of 7 ECAC States was selected for visits by the SPIN Consortium to conduct face-to-face interviews.

States were selected according to the following criteria:

- Presence of different types of SNET in the State.
- Completeness of the responses to the questionnaire.
- Coverage of different regional areas.
- Presence of potential best practices (such as use of performance analysis tools, performing of optimization processes, etc.)

The interviews were conducted using a 10 points checklist summarising the main issues already addressed by the questionnaire. Main targets of the interviews –as for the web-based questionnaire– were the ANSP Safety Managers and/or the persons responsible for SNET in the ANSP (if different from the Safety Managers). Nevertheless other stakeholders were involved, according to their availability in the course of each visit. These were mainly Safety Managers of local ATC units, technical staff with experience in SNET implementation and ATCOs (see *SPIN-Annex 1.2* for a complete reporting of the 7 interviews).

1.4 Selected findings

Nuisance alerts in relation to both STCA and MSAW are managed in different ways. Some States have specific optimisation procedures in order to minimise nuisance alerts while ensuring appropriate warning times. However only in a few States the procedure uses a specific analysis tool. Other States don't have specified policies to address this subject and -in some cases- the SNET parameters are kept at the default values set by the manufacturer. Regardless of the different factors that can affect the ANSP policies (e.g. high or low traffic density; large or small geographic area; long or short experience with SNET; etc.) there are no uniform or harmonised approaches for optimisation procedures.

Cleared Flight Levels are used by some States to reduce the number of nuisance alerts. Nevertheless the advantages and the obtained performances are still unclear at these sites and should be further investigated. Several other States expressed their interest in this option.

Sometimes a tight setting of STCA parameters -to minimise the number of nuisance alerts- leads to very short warning times. Some States reported cases -especially in TMA- in which the TCAS TA can be activated before the STCA, thus drastically limiting the possibility for appropriate remedial actions by the ATCO. This suggests the need for a better consideration of the possible **interactions between STCA and TCAS** in the setting of STCA parameters.

The **HMI adopted for the STCA** varies considerably among the States. In the majority of cases only visual alerts are used, while in a few cases both visual and aural alerts are used. Furthermore, in most of the cases, there is only one alert level, while in a some cases there are two alert levels, generally corresponding to a situation of proximity to the infringement (level 1) and to a current infringement (level 2). The adoption of both visual and aural alerts is only considered a reasonable solution if the number of nuisance alerts is limited. The actual advantages of the multiple level alerts are still to be verified, even in the States where this solution has already been adopted.

The survey indicates a general lack of defined **criteria for SNET validation**. In particular with respect to STCA, some States only perform initial acceptance tests with ATCOs. While in many other cases, the performed optimisation processes are considered also to be validation processes. In general, no objective goals are established.

In most of the States there is little awareness of the obligations coming from ICAO Doc 4444 §15.6.2 and §15.6.4 for specific written **Local Instructions** related to respectively STCA and MSAW. In most States the instructions are lacking, while in some States the need has been identified but not yet fulfilled. In other cases specific written instructions are not considered necessary because the SNET is perceived as having no significant impact on the ATCO's way of working.

The analysis of SNET implementation policies revealed general **organisational issues** in some States (such as unclear definition of specific responsibilities, or imprecise agreements with industrial partners). The survey revealed that Safety Managers are not always the persons with overall responsibility for SNET, as expected when preparing the survey. Decisions concerning SNET are often considered as mere technical choices, with a limited role played by the management and without the need for a deliberate agreed policy.

Concerning the **use of guidance material**, half of the States didn't use the EUROCONTROL "Operational Requirement Document for EATCHIP Phase III" when implementing SNET. In most cases the document was not known, while in some cases –States with longer experience in SNET implementation– the document was not available at the time of SNET implementation. The survey revealed a limited awareness of the document by ANSP Safety Managers. This could be explained by the technically-oriented issues presented in it and by the perceived uncertainty of its intended audience and use. One State claimed that the document is useful for the implementation and optimisation of STCA, but providing too little support with respect to MSAW.

Generally, national **Regulatory Authorities** play a very limited role in defining SNET policies. With very few exceptions, ANSPs didn't receive directions or recommendations from the Regulatory Authorities. In some cases a regulatory framework is still under preparation. In none of the cases performance targets for SNET have been established.

2. SURVEY 2: STUDIES AND R&D ACTIONS

2.1 Introduction

Survey 2 offers identified and selected relevant studies and R&D actions concerning ground based SNET.

The investigation strategy relied mainly on searching information through on-line databases and on establishing contacts with projects representatives. The contacts aimed at obtaining relevant documentation pertaining to the most important R&D initiatives, including both terminated and ongoing projects.

Collected documentation was analysed, in order to understand the potential benefits for the improvement of SNET implementations and practices.

While all the projects concerning MSAW and APW were selected, some exclusion criteria were applied to STCA related projects, in order to avoid the analysis of too old contributions, with limited interest for R&D purposes. In particular projects having the following characteristics were excluded:

- STCA development projects with completion date before 1999;
- STCA performance improvement projects with completion date before 1996.

Relevant information was summarised in a standard template and a preliminary evaluation was performed using the following criteria:

- Focus on specific SNET
  (*Does the project provide solution for a specific SNET?*)
- Efficacy
  (*What kind of problem could the project solve?)*
- Level of feasibility
  (*Is the proposed solution actually feasible?*)
- Expected time for the actual use of the results
  (*What is a reasonable time for concretely adopting the proposed solution?*)
- Generalisability of the approach to other contexts
  (*Is the methodological approach transferable to other research contexts?*).
- Transferability of the application to other contexts
  (*Is the technological solution transferable to other application contexts?).*
- Availability of information and accessibility to documentation
  (*How can relevant information concerning this project be accessed?).*

The final selection process resulted in a list of 13 projects, presented below. The list is divided in three main groups, aimed at identifying different characteristics and purposes:

1. Research and development projects of European consortia

   - **NUP Phase 2**
   - **FARADS – RADE 1**

- **TELSACS**
- **SMART Safety Nets**

2. National research and development projects

- **Development of System Functions in the Amsterdam Advanced ATC System** (by NLR)
- Safety Nets (by NATS)
- Short Term Conflict Alert (by NATS)
- Short Term Conflict Alert (by CENA/STNA/THALES)
- Radar and Tracker Evaluations -ELISA, DACOTA, ARTAS- (by STNA/CENA)
- Minimum Safe Altitude Warning (by STNA/CENA)
- MSAW/GCAS Comparison (by STNA/THALES)

3. Research projects by NASA and Boeing Company

- **Required Total System Performance and Result of a Short Term Conflict Alert Simulation Study** (by FAA-Boeing)
- **Conflict Probe Concept Analysis in Support of Free Flight** (by NASA-Boeing)

The 7 projects listed in bold have been analysed using a standard template that can be found in section 2 of the *SPIN Final Report*.

Detailed analysis of the other 6 projects was not possible, as public accessible documents were not available. Note that these projects are all part of the "National R&D projects" group. The limited information available is due to the confidentiality issues related to their industrial and commercial implications. The project representatives accepted to provide specific information only in relation to the first project of the group, although also in this case no public documentation was available. Nevertheless it should be considered that most of these projects appear to be oriented to pure development, with limited research aspects. The projects that are part of this group are documented providing only their reference number in the EUROCONTROL ARDEP database and a short description of their contents.

2.2 Selected findings

Recently completed and ongoing general **research activities** are few, and typically focussed on improving SNET performance by exploiting air/ground data link. There is little to be obtained from these activities for short-term SNET enhancement actions.

The results of specific **development activities** could be more beneficial for short-term SNET enhancement actions, but are not publicly available.

3. SURVEY 3: EXISTING PRACTICES IN THE AIRBORNE DOMAIN

3.1 Introduction

Survey 3 investigates practices related to airborne SNET: ACAS-TCAS (Airborne Collision Avoidance System – Traffic Alert and Collision Avoidance System) and on GPWS-TAWS (Ground Proximity Warning System - Terrain Awareness and Warning System).

The main purpose of the survey was to investigate best practices available in the airborne domain, potentially useful for the definition of ground based SNET best practices.

Two main source of information were adopted.

- The first source was a collection of technical documents on TCAS and GPWS, offering examples of the principles of functioning, of their technical description and standards and of their use in operational conditions (see *SPIN Annex 3.1* and *3.2*).
- The second source consisted of three face-to-face interviews involving 2 pilots and the member of a Flight Safety Department (responsible for Flight Data Analysis) in two major European Airlines (see *SPIN Annex 3.3* and *3.4*).

The practices related to ACAS/TCAS were compared with the STCA practices on the following aspects:

- Planning and Feasibility (cost benefit analysis / safety case)
- Design / Development
- Training
- Implementation / Certification
- Procedures
- Evolution / Optimisation
- Experience Feedback / Monitoring
- Compatibility between ACAS and ATC
- Monitoring Programmes
- Communication

The practices related to TAWS/GPWS were compared with the MSAW practices on relation the following aspects:

- Planning and Feasibility (cost benefit analysis / safety case)
- Development (and associated validation / certification)
- Implementation (and associated validation / certification)
- Procedures
- Maintenance
- Evolution / Optimisation
- Training.

Both comparisons were summarised in tabular synopses (see Sections 3.3.3 and 3.4.3 in the *SPIN Final Report*).

3.2 Selected findings

All aspects of airborne SNET are covered by **exhaustive regulations, standards and guidance material**. As a result, there is little or no ambiguity left for those at the sharp edge of the system: the flight crew.

The performance of ACAS is quantified using a specific **encounter model**. This encounter model played an important role in the decision making process to mandate ACAS in the ECAC area.

Airborne SNET are important elements in **closed-loop incident reporting and safety improvement procedures**. Major airlines have implemented several complementary procedures, in order to maximise the opportunities for learning lessons. Communication is always an important aspect and there is an increasing awareness of the advantages of sharing the lessons over organisational boundaries.

4. SURVEY 4: CURRENT INDUSTRY CAPABILITIES AND PRACTICES

4.1 Introduction

Survey 4 is an analysis of commercial products and services currently available in the domain of ground based SNET.

Also in this case two main source of information were used.

- The first source was the search and review of existing material obtained through conventional commercial channels, including commercial booklets and websites.

- The second source consisted of establishing links with commercial contacts of the manufacturers, in order to obtain more detailed information.

Survey 1 identified at least three different strategies for the implementation of SNET by ANSPs, with important implications for the provision of product and services by manufacturers:

1. To design, develop and implement the SNET without seeking the help of a SNET manufacturer.
2. To buy an "on-the-shelf" or industrially product and then to adapt it to the specific needs.
3. To buy a turn-key installation of SNET.

Taking into account these distinctions, the detailed analysis considered the following list of manufacturers, with their respective products and the associated services.

Manufacturer	Product name	STCA	MSAW	APW
Thales ATM / French STNA	New generation STCA	X		
French STNA	MSAW		X	
Barco Orthogon	OPScenter	X	X	X
Lockheed Martin	STCA system	X		
QinetiQ	STCA	X		
Raytheon	Guardian	X	X	
Raytheon	Auto Trac	X		X
Saab	i-acs	X		
Si ATM	Si ATMsys	X	X	X
Comsoft	C-STCA	X		

It is to be noted that this survey encountered many difficulties in obtaining relevant detailed material, due to the confidentiality issues related to the commercial products and to their associated services. The latter, in particular, are considered strategic by the manufacturers from both commercial and industrial point of views. Thus in most of the cases direct contacts with them were fruitless and didn't provide any additional information about the services.

4.2 Selected findings

Many larger and smaller manufacturers are offering SNET products and related services. However, detailed information is considered **commercial-in-confidence** and therefore not publicly available.

5. AREAS OF CONCERN

This section lists **14 areas of concern**, which have been identified during the investigation. The list summarises and links together the results of the four surveys, providing pointers to the *SPIN Final Report* and to the *SPIN Annexes*

(available on request). The 14 areas of concern have been organised in the three following groups.

A) Areas of concern that are relatively well understood *and for which best practices exist that can be used as model for guidance material, standards and regulations. These areas are:*

A1. Nuisance reduction and need for a trade off between nuisance alerts and anticipated warning time

A2. Local instructions and information for controllers

A3. Consideration of cleared flight levels in STCA algorithms

B) Areas of concern that are less well understood *and where further studies or R&D actions are needed. These areas are:*

B1. Analysis and management of STCA alerts, including use of alert records as safety indicator

B2. HMI of the STCA (multilevel alarms, aural alarms, information about STCA status, easiness of use by controllers, overload of information for controllers)

B3. Validation criteria and validation process

B4. Understanding and management of possible interactions between STCA and TCAS

C) Areas of concern for which adequate best practices have not been identified*, or that are linked to problems in other domains, to be advanced before the resolution for ground-based safety nets can take place. These areas are:*

C1. Definition of STCA purpose and coherent setting of parameters and of procedures

C2. Organisational roles and responsibilities within ANSP with regard to the adoption and use of SNET

C3. Harmonisation within and between countries (including uniform implementation policy, similar concepts for HMI, similar definitions and related procedures and policies)

C4. Discrepancies between regulations and standards and role of regulator in the deployment of SNET

C5. Understanding and management of the differences between different Safety Nets

C6. Adoption of more user friendly guidelines about SNET and better dissemination of these guidelines

C7. Provision of technical information about SNET to controllers

The areas of concern are illustrated in a tabular format, including:

- A description of the specific area of concern;
- A set of pointers to the sources of evidence used for the identification and description of the areas of concern. These sources of evidence are responses given to the questionnaire or the interviews within survey 1;
- A short description and a set of pointers to information obtained in the different surveys (surveys 1-2-3-4) that could offer possible solutions and/or potential best practices to address the areas of concern.

The following generally available EUROCONTROL documents are referenced:

[1: ORD] Operational Requirements Document for EUTCHIP Phase III ATM Added Functions: Volume 2 – Safety Nets (OPR.ET1.ST04.DEL01.2, Edition 2.0 dated 25.01.1999)

[2: STCA] Technical Input for Guidance Material, Standards and Regulations for Short Term Conflict Alert (Edition 1.0 dated 25 Nov. 2004)

[3: MSAW] Technical Input for Guidance Material, Standards and Regulations for Minimum Safe Altitude Warning (Edition 1.0 dated 24 Jan. 2005)

Group A

Areas of concern that are relatively well understood and for which best practices exist that can be used as model for guidance material, standards and regulations

AREA OF CONCERN - A1	
Nuisance reduction and need for a trade off between nuisance alerts and anticipated warning time	
Safety Net interested	STCA (also applies to MSAW)
Details about the area of concern	Nuisance alerts are considered as one of the main problems for an effective use of the STCA. The controller acceptance of STCA is highly dependent on the frequency of nuisance alerts. Setting of parameters should have the aim of reaching a trade off between nuisance alerts and anticipated warning time and this is not always clear to Stakeholders.
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Sec. 1.5.2 of the SPIN Final Report - Reply to questions Q8, Q10, Q11, and Q12 in Annex 1.1 → **From Interviews** (all contained in Annex 1.2): - Interview 1, Issue 9 - Interview 2, Issues 8b and11 - Interview 7, Issues 2c and 10c
Potential Best Practices emerged from Survey 1	Optimisation practices adopted by two of the ANSP (See Interview 3, Issue 4; Interview 5, Issue 4 in Annex 1.2) or planned by another ANSP (See Interview 7, issue 3d in Annex 1.2). Differentiation in setting of parameters adopted by 3 of the ANSP (See Interview 3, Issue 3; Interview 4, Issue 3 and Interview 5, Issue 3 in Annex 1.2).
What is available to investigate the Potential Best Practice	- Guidelines offered in [1: ORD] - Practices suggested in Sections 4, 6 and 7 of [2: STCA] and [3: MSAW]
How to have additional information about the potential best practice	Collect documentation describing the process adopted by the ANSP. Comparison between process of the ANSP and process suggested in [2: STCA] and [3: MSAW].
What could come from R&D according to the results of Survey 2	None in the short time. In the long term a reduction of nuisance alerts could come from the adoption of ADS-B and the related derivation of intent information. This is under study **in NUP II** (Section 2.1.1 of the SPIN Final Report). The advantages due to the exchange of information between ACAS systems and STCA - including the reduction of nuisance alerts - have been studied in **TELSACS** (Section 2.1.3 of the SPIN Final Report).
Possible solution adopted in Aeronautics according to the results of Survey 3	A reduction of nuisance alerts has been obtained for TCAS thanks to the experience feedback from the airlines and to specific programs of monitoring. These programs (as the one still performed by EUROCONTROL) permit the evolution of ACAS/TCAS definition and implementation, with the objective of reducing nuisance alerts (see question Q9, Sect 4.1, Annex 3.4 and Sect 4.2.3 of Annex 3.3) Nuisance alerts can also be reduced by the modification of procedures. For example, airlines can propose to their crews, through procedure modification, to limit to a maximum the vertical speed when levelling off. (see Sect 4.1.4 in Annex 3.3)
What could come from the industry according to the results of Survey 4	Not applicable
Comments	Nuisance alerts in some cases are considered useful by ANSP; this depends on the adopted SNET policy. If STCA function is considered as a means to help in ensuring separation, ATCO may use this kind of information to reduce the risk of separation infringements.

AREA OF CONCERN - A2	
Local instructions and information for controllers	
Safety Net interested	STCA and MSAW
Details about the area of concern	Local instructions for controllers about the use of SNET are usually lacking, or not well known. The sequence of actions to react to an alarm is considered by ANSP as standard practice for controllers, and then not needing specific procedures or training. However, there are specific operative conditions that must be specified in written instructions - in compliance with ICAO Doc 4444 §15.6.2 (for STCA) and §15.6.4 (for MSAW). These are for example: the type of flight eligible for the generation of STCA, the sectors or areas in which the STCA is implemented, the parameters for generating alerts, the conditions under which the STCA may be inhibited, etc. In some cases the issue of preparing local instructions has been raised but not resolved yet (e.g. because of the difficulty of defining instructions for different STCA alert situations).
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Reply to questions Q55, Q57, Q58, Q59, Q70, Q71 in Annex 1.1 → **From Interviews** (all contained in Annex 1.2): - Interview 1, Issues 6a and 6b; Interview 2, Issues 6a and 6b; Interview 3, Issues 6a and 6b, Interview 6; Interview 7.
Potential Best Practices emerged from Survey 1	Instructions available at some ANSP (see Int. 4, Issue 6 in Annex 1.2).
What is available to investigate the Potential Best Practice	Recommendations offered by ICAO Doc 4444 §15.6.2 and §15.6.4.
How to have additional information about the potential best practice	Collect procedures adopted by the ANSP.
What could come from R&D according to the results of Survey 2	Not applicable
Possible solution adopted in Aeronautics according to the results of Survey 3	Not applicable
What could come from the industry according to the results of Survey 4	Not applicable
Comments	The content of ICAO Doc 4444 §15.6.2 and §15.6.4 seems not very well known by Stakeholders.

AREA OF CONCERN - A3	
Consideration of cleared flight levels in STCA algorithms	
Safety Net interested	STCA (also applies to MSAW)
Details about the area of concern	Several ANSP suggested to increase the use of cleared flight levels (manually entered by the controller) to reduce nuisance alerts. However, the related advantages and disadvantages are still unclear. A theoretical analysis of these is reported in [2: STCA] and [3: MSAW]. A few service providers (2 between those replying to the questionnaire) are currently using the cleared flight level entered by the controller; however the effectiveness of this use was not investigated during the survey.
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Section 1.5.3 of the SPIN Final Report - Reply to questions Q10 and Q11 in Annex 1.1
Potential Best Practices emerged from Survey 1	The cleared flight level is normally entered by the controller in modern control systems, then the problem is mainly a technical one (modify the STCA (or MSAW) algorithms to consider this parameter), some suggestions are reported in [2: STCA] (and [3: MSAW]). Care should be put to potential human factors problems (see comment below). One ANSP suggested that the use of a Selected Flight Level (directly obtained from the aircraft and automatically entered in the ATC system) was more suitable than the use of the Cleared Flight Level (manually entered by the controller) (See Int.7, Issue 3d in Annex 1.2).
What is available to investigate the Potential Best Practice	Not applicable
How to have additional information about the potential best practice	The effectiveness of using the cleared flight levels could be investigated by visiting the service providers who are currently using it (2 between those replying to the questionnaire).
What could come from R&D according to the results of Survey 2	The project “Development of System Functions in Amsterdam Advanced ATC System” (See Sect. 2.2 of the SPIN Final Report) evaluated -through Real Time Simulations- the use of Executive Flight Levels, corresponding to the clearance given by the controller, by the STCA algorithm, to filter nuisance alerts. The project closed in 1998 and the team in charge does not exist anymore. The study was funded by LVNL and project documentation should be asked officially to them.
Possible solution adopted in Aeronautics according to the results of Survey 3	Not applicable
What could come from the industry according to the results of Survey 4	Not applicable
Comments	Some controllers (no references are reported for confidentiality reasons) reported that in heavy traffic conditions the cleared flight level is not up-dated regularly. This practice could severely affect the performance of STCA (or MSAW) should cleared flight level be used for filtering nuisance alerts. The reliability of this claim should be verified and the possible diffusion of the reported practice should be investigated.

Group B

Areas of concern that are less well understood and where further studies or R&D actions are needed

AREA OF CONCERN - B1	
Analysis and management of STCA alerts, including use of alert records as safety indicator	
Safety Net interested	STCA
Details about the area of concern	The way STCA alerts are analysed and managed is non homogeneous. Some ANSP do not or cannot record STCA alerts, some others have too many nuisance alerts to be able to distinguish between true and false alerts. Some declared to be constrained by Trade Union agreements that do not allow investigating STCA records. Very few ANSP seem to be able to derive information and learn lessons from STCA alerts. However, several ANSP evidenced the importance of this and identified the potential benefits of learning from experience. In addition, several ANSP evidenced how STCA alerts could be used as safety indicator, for example helping in identifying "hot spots", and monitoring the influence of changes in equipments and in airspace design.
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Sec. 1.5.3 of the SPIN Final Report - Reply to questions Q52 and Q53 in Annex 1.1 → **From Interviews** (all contained in Annex 1.2): - Interview 1, Issue 4; Int.2, Issue 4; Int.3, Issue 4c; Int. 4, Issue 4c; Int. 6, Issue 4a and Int. 7, Issue 4.
Potential Best Practices emerged from Survey 1	Some practices adopted by two of the ANSP (See Annex 1.2; Interview 3, Issue 4c; and Interview 4, Issues 4a and issues 4c).
What is available to investigate the Potential Best Practice	Not applicable
How to have additional information about the potential best practice	Investigate more in depth the potential best practices listed above and those of some others ANSP who claimed in the questionnaire to use information coming from STCA recording (see Annex 1.1, Q53). Investigate practices used with the ASMT (Automatic Safety Monitoring Tools), to check if elements of this approach can be applied to STCA alerts monitoring.
What could come from R&D according to the results of Survey 2	Not applicable
Possible solution adopted in Aeronautics according to the results of Survey 3	In an airline, experience feedback is based on several processes that treat different kind of data (see Sect 4.1.3 of Annex 3.3; Sect 4.1 of Annex 3.4 and Section 3.3.4 of the SPIN Final Report).
What could come from the industry according to the results of Survey 4	Not applicable
Comments	The analysis and management of STCA alerts, and even more the use of alert records as safety indicator are strongly affected by the practices and procedures of the ANSP. Therefore, best practices should be used only as a generic reference to be customised.

AREA OF CONCERN - B2	
HMI of the STCA (multilevel alarms, aural alarms, information about STCA status, easiness of use by controllers, overload of information for controllers)	
Safety Net interested	STCA
Details about the area of concern	Information presentation is mainly a technical issue but sometimes it is also linked to local conditions (e.g. aural alarms are not recommended where there is a high number of nuisance alerts). There are several ways of information presentation and alarm signalling adopted by ANSP (no uniform solution). Some of the ANSP expressed interest in knowing what the others are doing in this field and the effectiveness and usefulness of the adopted solutions .
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Sec. 1.6.1.6 of the SPIN Final Report - Reply to questions Q48, Q49 and Q59 in Annex 1.1 → **From Interviews** (all contained in Annex 1.2): - Interview 1, Issue 8a; Int. 3, Issue 8a; Int. 4, Issue 8a
Potential Best Practices emerged from Survey 1	Some solutions are apparently more effective than others, such as an information bar to indicate the status of the STCA (see Q59; Annex 1.1); the presence of both aural and visual alarms and the presence of multilevel alarms (see the interviews 3 and 4 referenced above). However, the effectiveness and usefulness of these solutions has not been investigated in depth and in some cases may be affected by local conditions.
What is available to investigate the Potential Best Practice	Solutions that are apparently effective and useful (like the one in Interview 4 referenced above) but without an evaluation of their transferability to other operative contexts.
How to have additional information about the potential best practice	Investigate for more evidence and examples about the best solutions implemented. Analysis of the possibility to transfer those solutions to other ANSP. Identify reference system and reference specifications implementing the best solutions.
What could come from R&D according to the results of Survey 2	The issue of information presentation was addressed in FARADS – RADE 1 experiment (see Sect. 2.1.2 of the SPIN Final Report). Nevertheless the main concern was on assessing the best way for distinguishing on the radar screen STCA alerts from down-linked TCAS RA –when this will be available- rather than on investigating the best way of representing the STCA information in itself.
Possible solution adopted in Aeronautics according to the results of Survey 3	Concerning information presentation to the crew, EUROCONTROL is leading a study concerning the TCAS HMI. Standards specify the TCAS equipment, specifically traffic display symbol, but differences exist between the different types of display according to the different manufacturers. Manufacturers add functionalities to TCAS that permit the crew to use the TCAS as a surveillance tool that could cause a risk of misinterpretation; the information is basic and only shows an approximate relative position of surrounding aircraft (see Sect. 5.6.2 in Annex 3.1). An action is on-going in EUROCONTROL in order to define what can be done (communication, training, HMI change, etc.) to avoid misinterpretation.
What could come from the industry according to the results of Survey 4	Not applicable
Comments	None

AREA OF CONCERN - B3	
Validation criteria and validation process	
Safety Net interested	STCA
Details about the area of concern	Some ANSP consider Validation to be coincident with the Optimisation process: a continuous activity to improve system performances. Then, there are no objective goals to be achieved for STCA performances. In several cases there are acceptance tests, but these are more aimed at verifying the presence of all the required functionalities. Sometimes these tests include an initial phase of tuning done by the producer and this is often considered as the Validation.
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Sec. 1.6.2 of the SPIN Final Report - Reply to questions Q20 in Annex 1.1 → **From Interviews** (all contained in Annex 1.2): - Interview 1, Issue 5 - Interview 2, Issue 5 - Interview 6, Issue 5 - Interview 7, Issue 5
Potential Best Practices emerged from Survey 1	None (perhaps due also to the lack of Encounter Models).
What is available to investigate the Potential Best Practice	Some practices suggested in Sections 4, 6 and 7 of [2: STCA].
How to have additional information about the potential best practice	Not applicable
What could come from R&D according to the results of Survey 2	Not applicable
Possible solution adopted in Aeronautics according to the results of Survey 3	TCAS needs to meet standards requirement so that the manufacturer could obtain the validation certificate only for the equipment. Validation conditions are defined in the MOPS (Minimum Operational Performance Standards) mainly with defined tests to be passed (in particular performance tests). If all the results to the tests defined in the MOPS are correct, then the TCAS equipment is declared compliant to the MOPS. (See Section 3.3.3 of the SPIN Final Report "Design/development" and "Validation/Certification") The TCAS integration in an aircraft has always to be validated.
What could come from the industry according to the results of Survey 4	Not applicable
Comments	Not all the ANSP are interested in this because it is typically a problem limited to new installations or to the up-grade of systems. In several cases the interviewed persons were unaware of the Validation done in their site because it happened long before they were involved with the STCA.

AREA OF CONCERN - B4	
Understanding and management of possible interactions between STCA and TCAS	
Safety Net interested	STCA (in interaction with TCAS)
Details about the area of concern	From the experience of ANSP the time separation between STCA and TCAS TA seems to be less precise than expected. Some ANSP reported occasional activations of TCAS that, especially in the approach area, precede the STCA activation. Setting of STCA parameters has a clear influence on this and should be done considering also the possible consequences of a STCA alarm that is preceded by a TCAS alarm.
Sources of evidence for this area of concern emerged from Survey 1	→ **From Interviews** (all contained in Annex 1.2): - Interview 2, Issue 3b; Int. 3, Issue 1b; Int. 7, Issue 8b
Potential Best Practices emerged from Survey 1	None
What is available to investigate the Potential Best Practice	Not applicable
How to have additional information about the potential best practice	Analysis of the results of the R&D projects SMART, FARADS and TELSACS, and interactions with the responsible of these projects to evaluate the possibility of investigating the particular case of TCAS preceding STCA (e.g. running specific scenarios during the RADE Real Time Simulations).
What could come from R&D according to the results of Survey 2	Results form the FARADS-RADE1, and also TELSACS and SMART projects (See Sect. 2.1.2, 2.1.3, 2.1.4 of the SPIN Final Report).
Possible solution adopted in Aeronautics according to the results of Survey 3	ACAS/TCAS algorithm cannot take into account STCA possibilities/performances because an aircraft can be in "interaction" with many kinds of STCA (depending on the country, the area, the separation standards, etc.).
What could come from the industry according to the results of Survey 4	Not applicable
Comments	None

Group C

Areas of concern for which adequate best practices have not been identified, or that are linked to problems in other domains, to be advanced before the resolution for ground-based SNET can take place

AREA OF CONCERN - C1	
Definition of STCA purpose and coherent setting of parameters and of procedures	
Safety Net interested	STCA
Details about the area of concern	The introduction of STCA by some ANSP appears to be more the consequence of technological improvement rather than a deliberated safety management choice. STCA comes in almost “automatically” when control systems are renewed or up-graded. Safety managers become involved in their use without a clear, pre-determined view of the role and use of STCA. Furthermore, in some cases parameters are defined at the level of local ATC units, whereas in other cases are defined at national level. Even if both the strategies can be considered valuable, they often appear more motivated by historical reasons, as by a deliberate and agreed policy.
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Sec. 1.5.1 of the SPIN Final Report - Reply to questions Q5, Q39 and Q40 in Annex 1.1 → **From Interviews** (all contained in Annex 1.2): - Interview 1, Issue 1a; Int.2, Issue 1a; Int.5, Issue 1a; Int. 6, Issues 1a, 2a, and 2b
Potential Best Practices emerged from Survey 1	The policies and the strategies for setting the parameters by three ANSP. The first one defining the parameter at local level (See Interview 3, Issues 1 and 3 in Annex 1.2), the second one defining the parameters at central level (see Interview 4, Issues 1 and 3 in Annex 1.2), the last one defining the parameters at the central level but accepting few differences at the local level to take into account local environment (see Interview 7, Issue 3a in Annex 1.2).
What is available to investigate the Potential Best Practice	The verbal description of the practices referenced above, which appear to be the result of an agreed and deliberate policy.
How to have additional information about the potential best practice	Investigate more in depth the practices referenced above
What could come from R&D according to the results of Survey 2	SMART (Section 2.1.4 of the SPIN Final Report) should explore a generalized safety architecture (as for level busts) clarifying the role and added value of the current and future safety nets, including STCA. However, these are aspects relatively well known for the STCA and the problem appears to be essentially an organizational one, where the possible support from R&D is limited
Possible solution adopted in Aeronautics according to the results of Survey 3	Setting of TCAS parameters is made in MOPS (Minimum Operational Performance Standard). The setting of parameters is centralized with MOPS and is then coherent (see Sect 3.3.3 "Design/development" and "Validation/Certification" in the SPIN Final Report)
What could come from the industry according to the results of Survey 4	Not applicable
Comments	Guidelines for the introduction of SNET within an organisation would be very useful for ANSP. These Guidelines could support the ANSP by analysing all the organisational, technical and human aspects that should be considered for a well-planned introduction of STCA, and describing what should be done for each of them.

AREA OF CONCERN - C2	
Organisational roles and responsibilities within ANSP with regard to the adoption and use of SNET	
Safety Net interested	All
Details about the area of concern	Some of the problems with the design, introduction, and management of SNET seem to be related to overall organisational difficulties of the ANSP. The specific problems of the SNET (e.g. lack of optimisation, no use of the alerts recorded, lack of dedicated roles, etc.) are more a consequence of the overall organisational problems rather then inherent in the SNET.
Sources of evidence for this area of concern emerged from Survey 1	No pointers to specific interviews or questions are provided for confidentiality reasons; evidence can be derived from the overall analysis of the questionnaire and of the interviews.
Potential Best Practices emerged from Survey 1	Potential solutions and best practices are not investigated because the problem is at an overall organisational level rather then inherent in the SNET.
What is available to investigate the Potential Best Practice	As above
How to have additional information about the potential best practice	As above
What could come from R&D according to the results of Survey 2	As above
Possible solution adopted in Aeronautics according to the results of Survey 3	As above
What could come from the industry according to the results of Survey 4	As above
Comments	None

AREA OF CONCERN - C3	
Harmonisation within and between countries (including uniform implementation policy, similar concepts for HMI, similar definitions and related procedures and policies)	
Safety Net interested	All
Details about the area of concern	There are several different concepts, technical solutions and practices at different ANSP and between different ATC units of the same ANSP. In some cases this need is due to the different practices and procedures used in the ACC of different countries. However, in other cases, this is only due to historical reasons, different providers, and lack of knowledge about the solutions adopted by other ANSP. These differences, when not due to local specificities, are inefficient and complicate the exchange of information and practices between ANSP. In this respect the need for a harmonisation process has been expressed by several ANSP.
Sources of evidence for this area of concern emerged from Survey 1	Both questionnaire and interviews show this significant difference in implementation policies, definitions, HMI and related procedures. Furthermore the need for an harmonisation process has been expressed in several points: → **From Questionnaire** - Sec. 1.5.3 of the SPIN Final Report - Reply to questions Q11, and Q12 in Annex 1.1 → **From Interviews** (all contained in Annex 1.2): - Interview 2, Issue 11; Int. 5, Issue 11
Potential Best Practices emerged from Survey 1	The SPIN initiative in itself could represent an effort in this direction, if the aim of the harmonisation is adequately expressed and supported.
What is available to investigate the Potential Best Practice	See above
How to have additional information about the potential best practice	See above
What could come from R&D according to the results of Survey 2	None
Possible solution adopted in Aeronautics according to the results of Survey 3	Concerning the TCAS, there are specific programs and working groups (RTCA Special Committee 47, EUROCONTROL ACAS program, etc.) at international level that permits to modify/adapt/update the standards. (See Sect. 3.3.3 of the SPIN Final Report "Monitoring Programmes")
What could come from the industry according to the results of Survey 4	Not applicable
Comments	None

AREA OF CONCERN - C4	
Discrepancies between regulations and standards and role of regulators in the deployment of SNET	
Safety Net interested	STCA
Details about the area of concern	The emphasis of current official definitions (from ICAO, SRC, IFATCA, and [2: STCA]) is on different aspects of STCA, and this offers the opportunity for different interpretations (e.g. prevention of separation infringement versus conflict avoidance). The problem is made worse by the limited role played by the National Regulation Authorities.
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Sec. 1.5.1 and 1.6.1 of the SPIN Final Report - Reply to questions Q5, Q14 and Q16 in Annex 1.1 → **From Interviews** (all contained in Annex 1.2): - Issues 1b, 1c, and 1d in the interviews 1, 2, 3, 4 and 5; Issues 1c and 1d in interviews 6 and 7.
Potential Best Practices emerged from Survey 1	None
What is available to investigate the Potential Best Practice	Not applicable
How to have additional information about the potential best practice	Nothing about best practices, the best possible action could be to foster a more homogeneous regulatory framework
What could come from R&D according to the results of Survey 2	Not applicable
Possible solution adopted in Aeronautics according to the results of Survey 3	The regulatory framework for TCAS is more uniform and coherent than for STCA
What could come from the industry according to the results of Survey 4	Not applicable
Comments	None

AREA OF CONCERN - C5	
Understanding and management of the differences between different safety nets	
Safety Net interested	All
Details about the area of concern	The different level of maturity of MSAW, STCA and APW requires a different approach at the regulatory level and different types of support from EUROCONTROL.
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Reply to questions Q11, and Q12 in Annex 1.1
Potential Best Practices emerged from Survey 1	None
What is available to investigate the Potential Best Practice	Nothing; a more specific action to investigate more in depth best practice for SNET other than STCA could be considered.
How to have additional information about the potential best practice	Not applicable
What could come from R&D according to the results of Survey 2	Not applicable
Possible solution adopted in Aeronautics according to the results of Survey 3	Not applicable
What could come from the industry according to the results of Survey 4	Not applicable
Comments	The preparation of supporting documentation within the SPIN initiative should consider the different level of maturity of SNET and propose differentiated guidelines

AREA OF CONCERN - C6	
Adoption of more user friendly guidelines about SNET and better dissemination of these guidelines	
Safety Net interested	All
Details about the area of concern	Several ANSP were not aware of the existence of EUROCONTROL Guidelines (or of ICAO Regulations) or have difficulties in using them. ANSP experiencing problems with them, reported a lack of understanding of who is the target of the Guidelines (safety manager, technical staff, management, system providers, etc.) and problems with the complexity of the document. Apparently (to be verified) there is room for improving the readability and user friendliness of the documentation and for providing documentation that is more target oriented.
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Reply to questions Q6 and Q12 in Annex 1.1 → **From Interviews** (all contained in Annex 1.2): - Interview 1, Issue 1c; Int. 2, Issue 1c; Int. 5, Issue 1c; Int. 6, Issue 6.
Potential Best Practices emerged from Survey 1	Not applicable
What is available to investigate the Potential Best Practice	Not applicable
How to have additional information about the potential best practice	Nothing about best practices, the best possible action could be to involve communication experts when planning future supporting documents
What could come from R&D according to the results of Survey 2	Not applicable
Possible solution adopted in Aeronautics according to the results of Survey 3	The communication is a main aspect of the experience feedback and so of the safety management in an airline. It is necessary to communicate in order to convince crews that their implication is really important in having a useful and high-performance experience feedback and safety. Several kinds of communication are possible and complementary: booklet, bulletin, journal and oral communication through specific training sessions, electronic communication. (see Sect. 3.3.3 "Communication" of the SPIN Final Report) In addition to the airlines internal communication, organization such as EUROCONTROL also communicates. For example for ACAS/TCAS subject, there is a specific bulletin that gives readers information about TCAS concerns and solutions.
What could come from the industry according to the results of Survey 4	Not applicable
Comments	None

AREA OF CONCERN - C7	
Provision of technical information about SNET to controllers	
Safety Net interested	All with main attention to STCA
Details about the area of concern	Several ANSP emphasised the usefulness of providing technical information about SNET, and STCA in particular, to let them understand the limitation of the systems and foster their optimal use
Sources of evidence for this area of concern emerged from Survey 1	→ **From Questionnaire** - Reply to questions Q12 in Annex 1.1 → **From Interviews** (all contained in Annex 1.2): - Interview 1, Issue 9d.
Potential Best Practices emerged from Survey 1	None
What is available to investigate the Potential Best Practice	No best practice available
How to have additional information about the potential best practice	Nothing about best practices, the best possible action could be to prepare a specific documentation package for controllers as requested by several ANSP
What could come from R&D according to the results of Survey 2	Not applicable
Possible solution adopted in Aeronautics according to the results of Survey 3	The same kind of concern could exist for airlines. For example, concerning the use of TAWS, it is possible during the daylight, for the pilot not to follow the E-GPWS because the procedure accepts that during daylight, in visual conditions, the procedure let the opportunity to the pilot to land according to his/her judgment (Standard Visual Pattern) (see Sect 4.2.2 of Annex 3.1 and Sect 3.4.3 of the SPIN Final Report). This means that crews have to well know and understand the limitations. In the two interviewed airlines, information about TCAS and GPWS is given to crews through: • Paper manual (or FCOM); • Computer-assisted learning; • Recurrent training (in classroom). (See Annex 3.3 and Annex 3.4. - see also Sect 3.3.3 of the SPIN Final Report)
What could come from the industry according to the results of Survey 4	Technical information can be found in commercial brochure as "user's manual" or "pilot's guide" or "technical specification" or "product description". (see Sect. 4 of the SPIN Final Report)
Comments	None

6. GLOSSARY

ACAS	Airborne Collision Avoidance System
ACC	Airspace Control Centre
ADS-B	Automatic Dependent Surveillance - Broadcast
AGAS	Action Group for ATM Safety
ANSP	Air Navigation Service Provider
APW	Area Proximity Warning
ARDEP	Analysis of R&D in EUROCONTROL's Programmes
ASMT	Automatic Safety Monitoring Tools
ATC	Air Traffic Control
ATCEUC	Air Traffic Controllers European Union Co-ordination
ATCO	Air Traffic Controller
CMIC	Civil/Military Interface Standing Committee
EATCHIP	European ATC Harmonisation and Integration Programme
ECAC	European Civil Aviation Conference
FAA	Federal Aviation Administration
FARADS	Feasibility of ACAS Resolution Advisory Downlink Study
FCOM	Flight Crew Operational Manual
FL	Flight Level
GCAS	Ground Collision Avoidance System
GPWS	Ground Proximity Warning System
HMI	Human Machine Interface
ICAO	International Civil Aviation Organisation
IFATCA	International Federation of Air Traffic Controllers' Associations
MOPS	Minimum Operational Performance Standard
MSAW	Minimum Safe Altitude Warning
MTCD	Medium Term Conflict Detection
NATO	North Atlantic Treaty Organisation
NUP	NEAN Update Programme
RA	Resolution Advisory
RADE	Resolution Advisories Downlink Experiment
SMART	Safety Management Assistance and Recording Tool
SNET	Safety Net

SPIN	Survey of Practices In safety Nets
SRC	Safety Requirements Commission
STCA	Short Term Conflict Alert
TAWS	Terrain Awareness and Warning System
TCAS	Traffic alert and Collision Avoidance System
TELSACS	Telematics for Safety Critical Systems
TCAS	Traffic alert and Collision Avoidance System
TCAS RA	TCAS Resolution Advisory
TMA	Terminal Control Area