Network Manager
nominated by
the European Commission

EUROCONTROL

EVAIR Safety Bulletin
No 15

2010-2014

CONTENTS

EVAIR FUNCTION MANAGER'S PERSPECTIVE

The EVAIR Team draws to the attention of our readers EVAIR Safety Bulletin No 15, which covers the period 2010-2014.

As usual, our statistics and analyses are based on reports from aircraft operators and ANSPs.

Aircraft operators provide EVAIR with all types of ATM occurrences within European airspace while ANSPs also communicate ATM occurrences. In some instances air operators also provide reports of occurrences in airspace neighbouring European airspace.

ANSPs have a dual role in the data provision mechanism. In addition to occurrence reports ANSPs provide feedback on pilot reports, ACAS RAs collected automatically from Mode-S radar stations and Call Sign Similarity reports.

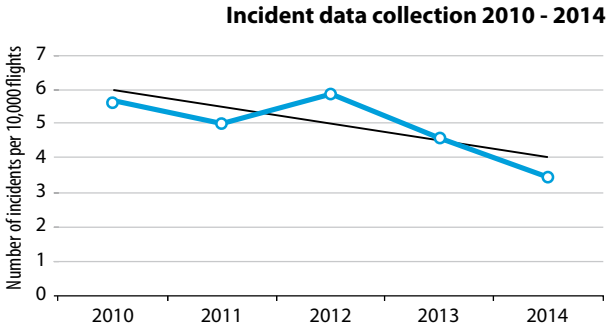


Figure 1: *Incident data collection for 2010-2014*

In the period 2010-2014, EVAIR received about 14,500 reports from more than 200 different airlines. We received during 2014 reports from 145 different airlines, including business aviation and private jets. This is fewer than in 2013 when 162 airlines provided their reports to EVAIR.

In the last two years we recorded a decrease in the number of reports. In 2014 the decrease versus 2013 was almost 20%. It is difficult to explain concisely the reasons for this considerable decrease. One way of explaining the decrease could be that European ATM safety performance is getting better and so there is less to report. However, whilst this would be pleasing it might not be the whole truth and the reduction is likely to be due to other factors as well. For instance, - we see that some airlines do not communicate all types of ATM safety reports. One of the reasons for this could be that experts dealing with data exchange with EVAIR, after leaving the position or the company, may not have given their successors full information about the cooperation with EVAIR.

That means that these specific air operators provide only selected types of ATM incidents (e.g. ACAS RA reports). In some cases we also see that certain airlines stopped providing incident data. Changes in the software used for incident reporting as well as personnel changes in airlines could be another reason for a drop in reporting. Whatever the reasons, we continue to work very actively to re-establish contacts with the airline experts dealing with reporting, explaining to them the main principles and benefits of data provision.

Besides Air Operators, European and non-European ANSPs provide huge support to EVAIR by providing their feedback on airline reports and very often also provide their own ATM reports. Without this support the overall activity would have not been successful and in a position to respond in a credible way to a number of requests for data support from our stakeholders.

Verification of EVAIR data with IATA STEADES

For more than five years EVAIR and IATA STEADES have been cooperating and contributing to a better understanding of trends and issues related to selected types of ATM safety events.

In addition to statistics, together with EUROCONTROL. IATA safety experts contribute to various local and regional ATM safety activities.

Feedback – Motivating reporting and support for quick fixes

Facilitation of the feedback process and provision of feedback on the reports submitted are two of the crucial activities and without any doubt one of the major factors which motivate pilots and air traffic controllers to file their reports.

The continuous increase in the amount of feedback is very encouraging. It is a good indicator that safety management people take very seriously the reports received in spite of the fact that it involves voluntary reporting and, in a lot of cases, occurrences with a low level of severity. At the same time, the increase in the number of reports covered by feedback makes the EVAIR data more reliable. In 2014 we recorded 24% of reports covered by feedback. This is a 3% increase on 2013. The percentage would have been much higher, however, if the Air Operators or ANSPs had sought feedback for a larger number of reports. The most frequent reason for not asking for feedback was that the main contributor to the event was very clear from the initial report provided by the pilot or air traffic controller and there was no need for additional investigation.

From time to time our data providers ask for clarification of the form in which feedback should be provided. We take this opportunity to inform them that the content of the feedback could range from a few sentences to a few pages accompanied by the voice and radar records and explanations of the root of the problem. The content of the feedback depends on the complexity of the event. Simple events can be described in a few sentences while more complex requires detailed information and support by radar and voice records to explain the root of the problem.

Another element related to feedback is the time-frame for its provision. We see from the data that it varies from a few days to a few months, depending on the complexity of the problem raised and the efficiency of the aircraft operators and ANSPs Safety Management Systems. We are working on an improved mechanism for tracking the time-frame in order to be able to provide more precise information and are sharing ideas on how improvements might be made in this area.

Main trends

Events

In 2014, as in previous EVAIR Safety Bulletins, we monitored Level Busts, Runway Incursions, Missed Approaches/Go-arounds, ACAS RAs and Call Sign Confusion.

With the exception of Call Sign Confusion all other areas recorded a decrease in the number of reports in 2014 vs 2013. One of the reasons that, in spite of the expanded use of the Call Sign Similarity De-confliction Tool, we recorded an increase in Call Sign Confusion reports is that we repeated our request to the airlines and ANSPs to report Call Sign Confusions in order to better monitor the efficiency and effectiveness of the EUROCONTROL Call Sign Similarity De-confliction tool.

Contributors to incidents – In 2014, for the first time since EVAIR has been monitoring the top seven ATM contributors, we recorded a decrease in all such contributors vs 2013. This is closely related to the overall decrease in the number of reports in 2014. We are continuing to monitor this issue to establish whether there are other reasons for this trend.

ACAS RA data collection

As usual, ACAS data comes from two different channels - manual reporting mainly from the Air Operators and automatic data collection by the ANSPs, who collect ACAS RAs from certain Mode-S radars by the Automatic Safety Monitoring Tool (ASMT). With regard to manual reporting, if feedback is not provided the analysis relies heavily on pilot and air traffic controller perceptions and memories of the events rather than on measured or calculated values. When feedback is provided, the information includes ANSP operational investigations along with radar and voice records. Over the last two years manual reporting recorded a decrease in the number of ACAS RAs. In spite of the overall decrease in the number of ACAS RAs, we recorded an increase in the number of States where ACAS RAs occurred while the number of Air Operators experiencing ACAS RAs remained at the same level.

As regards automatic data collection in the region covered by the EVAIR Programme, in 2014 as in 2013, we recorded an average of some three RA events per day. Compared with summer 2014, when there was more VFR traffic, especially charter flights, this is one occurrence fewer each day.

Laser Interference

Laser interferences account for 16% of the overall reports in the EVAIR data repository. The current laser trend shows a decrease. Besides the overall decrease in the number of reports, EVAIR recorded a decrease in the number of locations and Aircraft Operators affected. However, according to information from various safety meetings, it seems that the decrease in the number of reports does not reflect the laser situation very accurately. It seems that there are many more interferences than reports. We have to investigate whether this is true and what could be the reasons for this.

It is very encouraging to see that in the majority of reports which were followed by a narrative from pilots, we found that pilots and air traffic controllers regularly follow the recommendation to report laser interferences immediately; pilots to air traffic controllers and controllers to the police. Ongoing discussions on this subject show that a common European approach is needed since a national approach is not enough to address issues of the utmost importance such as the manufacturing and distribution of laser devices.

RPAS/Drones – An Emerging Threat?

Since 2013, when we received the first report related to the drone/RPAS problem, we see that this trend is increasing rapidly. All reports received occurred within controlled airspace. There was no coordination between the RPAS user and the local ATC. All occurrences were at low altitudes within the approach or departure phase. Unlike the Laser issue, we see with the Drone/RPAS problem a more pro-active approach on the part of the EC and EASA as regulatory bodies. But is this enough? Some areas will be covered by the proposed regulation, but a large area related to low altitudes and light Drones/RPAS will remain outside the regulation, as is the case with the laser issues.

Call sign Confusion

Unexpectedly, after two years in which the number of Call Sign Confusions reported by pilots decreased, an increased number of Air Operators using the EUROCONTROL Call Sign Similarity Tool (CSST), EVAIR recorded a substantial increase in Call Sign Confusions in 2014. Since the situation defied expectations, we launched an investigation into the possible reasons for this trend. Bearing in mind that voluntary reporting is very much dependent on continuous and repeated requests for data, one of the potential reasons could be that through EVAIR Safety Bulletin but also through other channels, e.g. the Call Sign Similarity User Group and various meetings with the Air Operators, we repeated our requests to Air Operators to report Call Sign Confusion occurrences to EVAIR. However, we are continuing to carefully monitor the situation.

Stakeholders' Corner - IATA

An analysis has been conducted of the Air Safety Reports (ASRs) held in IATAs Safety Trend, Analysis, Evaluation and Data Exchange System (STEADES) database. The STEADES database is comprised of de-identified safety incident reports from over 186 participating airlines throughout the world, with an annual reporting rate now exceeding 150,000 safety reports of all types per year. The STEADES database incorporates a number of quality control processes that provide analysis results. The scope of this analysis included research of ASRs for the years 2010 to 2014. During this period a total of 788,305 reports were submitted and collated into STEADES. The airlines participating and submitting data to STEADES represent a total of 45,967,406 flights from 2010 to 2014. This is equivalent to an average of 25% of the world's flights during the period. No analysis was made of report narratives to establish contributing factors.

Airline Air Safety Report data submission to STEADES is a dynamic process. Data can vary from one quarter to the

next, meaning that not all participant data is incorporated each quarter. This can be due to a participant not submitting data, a technical problem or IATA not incorporating the data submitted due to technical data format issues or data not meeting IATAs data quality standards. IATA accounts for this

in the calculation of sectors (number of flights) to ensure that rate-based information is meaningful, and IATA uses other quality processes to recover missing data. Due to these factors, rate-based comparisons are preferable to a comparison of the number of reports. The reader should also bear in mind that the data and rates presented here are based on events reported by flight and cabin crew and therefore influenced by airline reporting cultures.

Security and Confidentiality

In collecting and processing data, EVAIR follows strict security and confidentiality arrangements. The safety data provided are properly safeguarded and de-identified and the information is only used for the promotion and enhancement of aviation safety.

EVAIR Suggestions/Improvements

EVAIR is constantly looking at ways to improve its services and products. Suggestions and proposals are more than welcome. Please forward any thoughts, ideas and comments to Ms Dragica Stankovic EVAIR Function Manager:
dragica.stankovic@eurocontrol.int

ATM EVENTS AND SUPPORT TO EUROPEAN SAFETY ACTION PLANS

In EVAIR Safety Bulletin No 15, we have continued to monitor the selected types of European ATM events in order to make it possible to check the chronology of trends for those events which are related to existing European Action plans, studies or various projects. As usual, in this Safety Bulletin we have provided IATA STEADES statistics to allow our readers to compare European and global trends for the selected number of events.

Voluntary data provision provides information in addition to the mandatory channels. Unlike the mandatory mechanism, the EVAIR mechanism enables the data to be provided on a daily basis. The data cover all types of ATM events and their causes - more than what is required for mandatory reporting. In addition, the EVAIR mechanism facilitates the feedback process, which within a relatively short time frame provides replies in response to the reports submitted. Fast feedback enables a quick reaction to the problem identified and its mitigation or, in the best case scenario, its resolution.

As explained above, five event types have been traditionally part of the statistics we look at (Fig. 2 & 3):

- Level Busts
- Runway incursions
- Missed Approach/Go around
- ACAS RAs
- Call Sign confusion reported by pilots

In 2014 within EVAIR, except for the Call Sign Confusions reported by the AOs and ANSPs, all other areas monitored by EVAIR recorded a decrease in the number of events compared with 2013. This is now the second year showing a downward trend across the

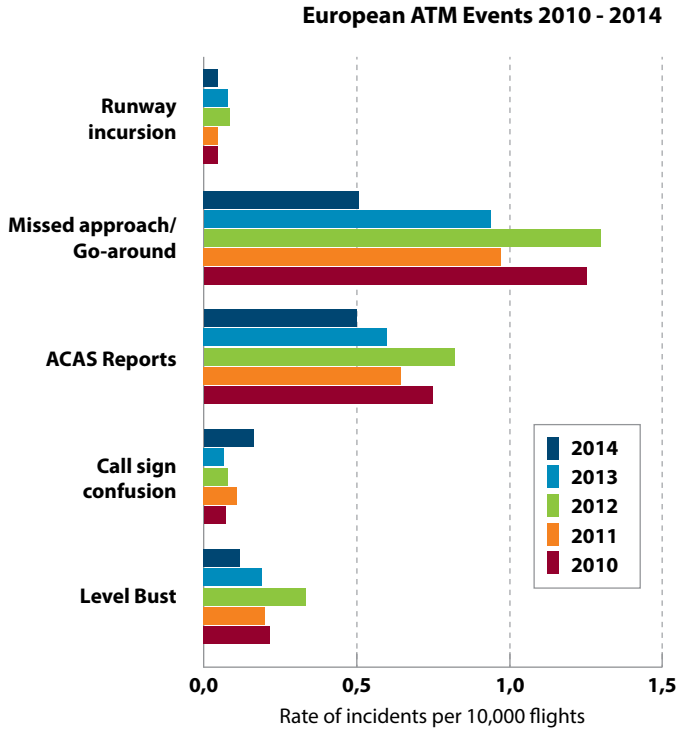


Figure 2: European ATM events 2010-2014

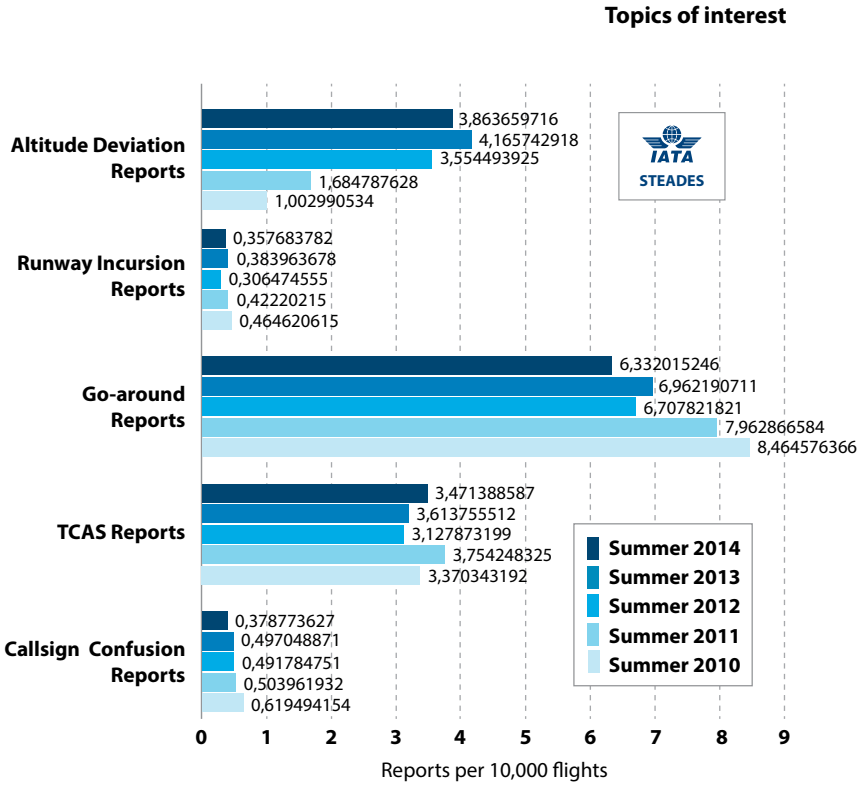


Figure 3: ATM events 2010 – 2014

majority of the events monitored. The same applies to STEADES global trends. The difference is that within STEADES, TCAS RAs recorded an increase while Call Sign Confusions recorded a decrease in 2014.

At the moment it is very difficult to explain the reasons for the downward trend within the main areas tracked. The easiest explanation is that safety performance of both, ANSPs and AOs has improved and as a consequence there were fewer reports. This could indeed be one of the reasons, but it seems that there are other issues which have a major impact on occurrence reporting. As touched on in the introduction to this bulletin, these issues may include reporting culture, a lack of resources due to budget cuts and the migration of staff from positions dealing with occurrence reporting. Issues such as reporting culture, the lack of resources and budgetary cuts are areas where we at EVAIR can have little influence. These issues require wider European action. Some aspects, such as reporting culture have already been addressed through Just Culture activities. However, the migration of staff, especially within Air Operators, from positions dealing with occurrence reporting to other positions within the company or the retirement of such staff is an area where EVAIR would like to work more with our data providers. It would be extremely useful if our data providers could establish a procedure whereby staff new to occurrence reporting were informed that EVAIR forms part of the reporting chain. We have noticed that changes in the personnel dealing with occurrence reporting in some cases causes reporting to EVAIR to cease. In such cases, a reminder helps to re-start this process of reporting to EVAIR. useful if our data providers could establish a procedure whereby staff new to occurrence reporting were informed that EVAIR forms part of the reporting chain. We have noticed that changes in the personnel dealing with occurrence reporting in some cases causes reporting to EVAIR to cease. In such cases, a reminder helps to re-start this process of reporting to EVAIR.

More detailed statistical information for each of the five types of event is presented later in this Bulletin.

You can also find out more about each of the event types and corresponding Action Plans on SKYbrary: *(http://www.skybrary.aero/index.php/European_Action_Plan_for_the_Prevention_of_Level_Bust ;http://www.skybrary.aero/index.php/European_Action_Plan_for_the_Prevention_of_Runway_Incursions;http://www.skybrary.aero/index.php/European_Action_Plan_for_the_Prevention_of_Runway_Excursions_(EAPPRE)*

To learn more about STEADES: *www.iata.org/steades*

CONTRIBUTORS TO ATM OCCURRENCES

For the majority of the different type of events there is a common set of contributors. Figure 4 sets out those contributors which are common to all events presented in Figure 3.

Addressing common contributors by mitigating or resolving issues at the same time improves the picture of the five areas tracked, as presented in Figure 3.

This is the first time that all of the top seven contributors recorded a decrease within the last year on the previous year. It is worth highlighting that two areas with the largest number of reports Mistakes and Air-Ground Communication recorded a decrease for the second year running.

The Air-Ground communication contributor is examined further in the Air-Ground Communication chapter on page 22.

Compared to 2013, the biggest decrease in 2014 (almost 60%) occurred in relation to Traffic Information.

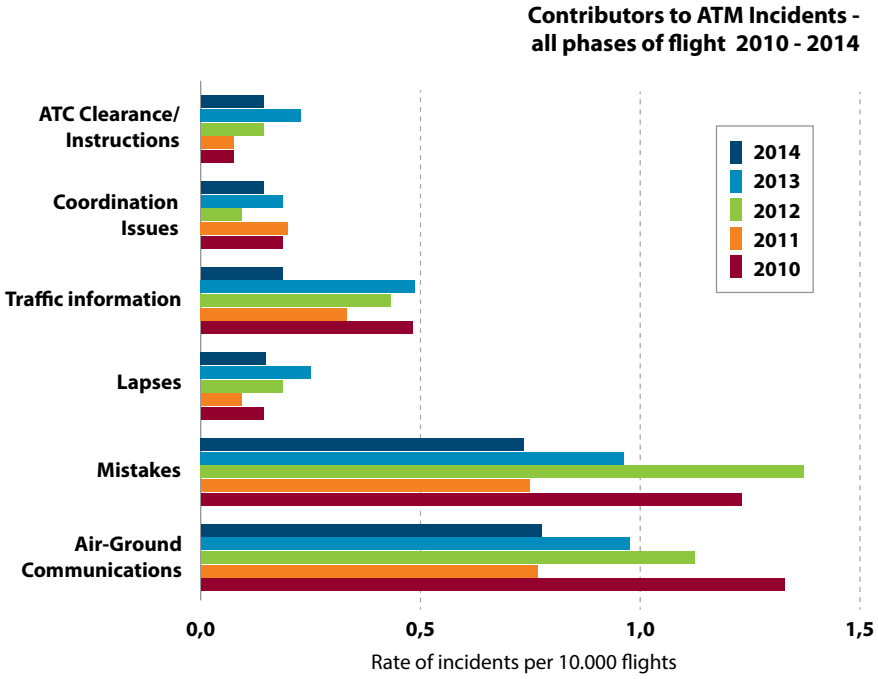


Figure 4: *Contributors to ATM incidents – all phases of flight 2010-2014*

GO-AROUNDS

In each EVAIR Safety Bulletin we explain why we monitor Go-arounds, namely that although this is a normal phase of the flight, it does not mean that there are no safety issues associated with it. This view is supported by common EVAIR and IATA monitoring and high-level statistics, together with the drill down through database and the feedback provided. The aim of EVAIR and IATA STEADES monitoring of Go-arounds, which has been in place for a number of years, is to identify safety issues and broken barriers associated with this manoeuvre.

In addition to the above, the aim of the monitoring work is to support and provide assistance to different EUROCONTROL activities and outside stakeholders working on the mitigation and fixing of problems that precede Go-arounds. Success in mitigating or fixing some of the broken barriers associated with Go-arounds contributes indirectly to flight efficiency, fuel saving and airspace capacity.

Analyses of the location of Go-arounds show that this is not a local problem but a problem with a pan-European dimension.

Go-arounds within the EVAIR database account for about 20% of the total. Over the last two years EVAIR data has shown a decrease in Go-arounds, which has also been the trend over the last five years. IATA recorded a decrease in 2014 and an increase in 2013 but, like the EVAIR figures, the trend over the last five years has been downwards.

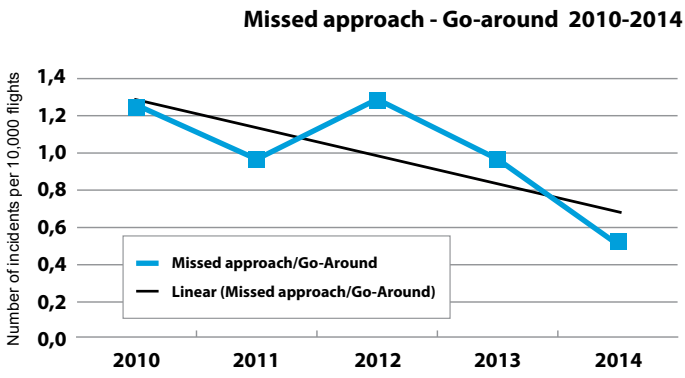


Figure 5: *Missed approaches, Go-arounds 2010-2014*

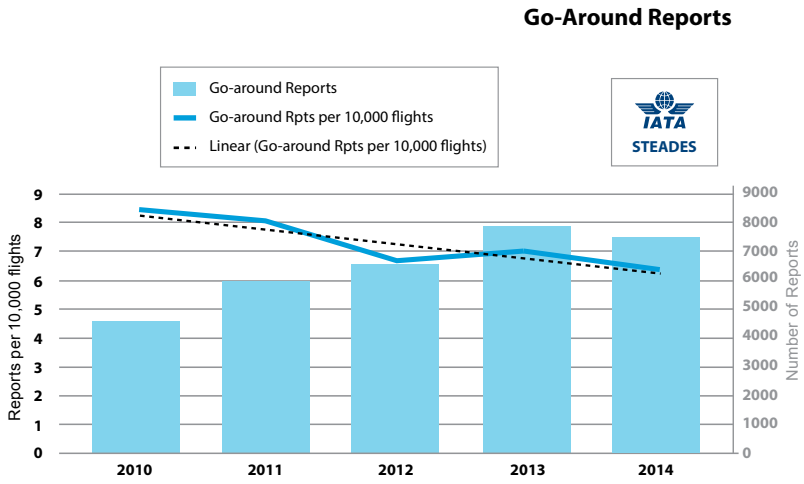


Figure 6: *Go-around reports 2010-2014*

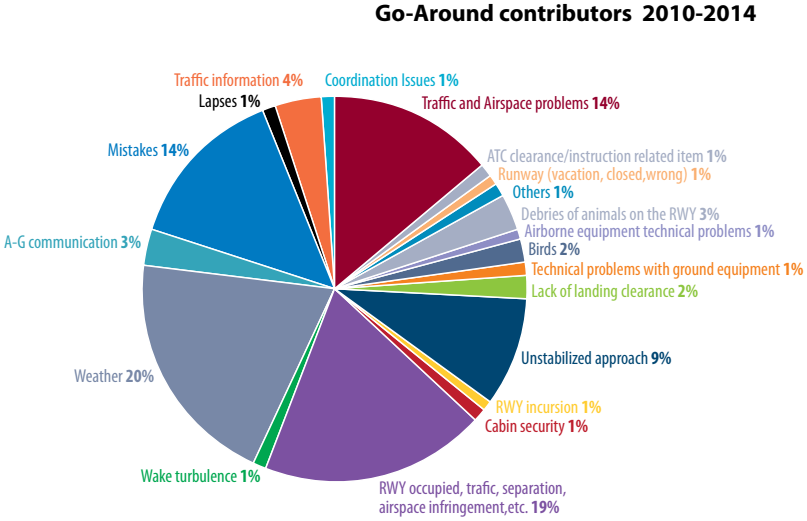


Figure 7: *Go-Around contributors*

EVAIR's in-depth analysis of Go-arounds (Figure 7) recorded 35 different contributors. More than 10 of these 35 contributors were identified only within a few reports. Since their percentage is very low, we decided to show all of them as "Others".

The contributors within "Others" are: Minimum safety altitude warnings, Transfers of traffic, Workload, Airfield fire alarms, Documentation and procedures, Lasers, Aircraft deviation from applicable ATM regulations and Emergency situations.

Traditionally the contributor with the highest percentage is Weather (20%). However, this is an area where there is little room for manoeuvre. The areas with the highest percentage and with human contributions where improvements could be secured through awareness and training are: Mistakes 14%, Traffic and airspace problems 14%, Un-stabilized approach 9%; RWY occupied, Traffic separation, Airspace infringement, etc. 19%.

EUROCONTROL has already devoted a lot of time to Go-around issues. We provide a link on SKYbrary where more details can be found on Go-arounds and its contributors, which were presented at the Go-around Safety Forum held at EUROCONTROL in June 2013.
http://www.skybrary.aero/index.php/Portal:Go-Around_Safety_Forum_Presentations

De-identified Go-around events reported by pilots in 2014:

Nov 2014 - The a/c was 34.5 NM from the RWY passing 25600 and following the STAR procedure for RWY 23L. ATC informed the a/c that the RWY in use had been changed to RWY 05L. Attempts were made using the usual options of gear/flap & speed brake to increase the rate of descent in order to establish the correct path. The descent rate was considerably reduced during a period of confusion when the crew became aware that other a/c were in fact still using RWY 23L, although at this point the controller had reverted to the use of local language. Our local language speaking crew member remedied the issue and the flight continued towards RWY 05L, initially to a point not on the approach chart. Now on the localiser but significantly high on the profile, an FMC Autopilot alert was generated. Offline autopilots disconnected and an amber line was observed through the GP annunciation on the ADIs, probably due to the proximity above the glide path. The autopilot was disconnected and flown manually but with intermittent IMC it became clear that the stabilised approach criteria were unlikely to be met and therefore the approach was abandoned by way of a standard missed approach from 3600 (1700 aal). Having levelled at 6000 in accordance with the charted missed approach profile and en-route to the NDB we were repeatedly asked by ATC to descend to 11000. On challenging ATC on this instruction ATC eventually revised this instruction to a climb to 11000. A series of radar vectors provided an eventual return to the 05L ILS with an uneventful approach and landing. This was clearly a very busy time with a changeover of runways and an excessive use of local language by ATC.

ANSP feedback facilitated by EVAIR:

The flight was the first in sequence for approach to RWY 05L and followed the change of configuration, which implies a high workload on the flight deck as well as on the controller. Flight was crossing the STAR procedure at FL259, slightly higher than the maximum FL established in the STAR for the landing. Since ATC advised a runway change, aircraft was too high. This condition made the landing impossible.

Note: Due to confidentiality reasons all call signs, names of NAV aids, five letters names, RWYs etc. are fictitious.

RUNWAY INCURSIONS

Runway incursions as reported by pilots through the Air Operators SMS made up 1.3% of the reports reported in 2014. Almost the same percentage applies for the period 2010-2014. This represents a relatively low percentage of the reports but the severity of these occurrences is frequently very high therefore, from the risk perspective, Runway Incursions merit considerable attention. Over the last two years EVAIR recorded a decrease in the number of Runway Incursions. However, due to the considerable increase in 2012, the trend line is still upwards (Figures 8). IATA STEADES recorded a decrease in 2014. In contrast with EVAIR, a decrease was recorded in STEADES for 2012 and the overall five-year trend showed a downward trend (Figure 9).

Across Europe for the period 2010-2014, EVAIR data recorded Runway Incursions at almost 70 different locations, which is more than for the period 2008-2013. Runway incursions involved more than 40 different Air Operators, which is also higher than for the previous period.

EUROCONTROL European Action Plans for the prevention of Runway Incursions and Excursions were developed with the major European stakeholders - Air Operators, Air Navigation Service Providers, and professional organisations, which still offer a number of proposals for mitigating or resolving problems related to Runway safety issues:

http://www.skybrary.aero/bookshelf/books/151.pdf http://www.skybrary.aero/index.php/European_Action_Plan_for_the_Prevention_of_Runway_Excursions_(EAPPRE)

http://www.skybrary.aero/index.php/European_Action_Plan_for_the_Prevention_of_Runway_Incursions_%28EAPPRI%29

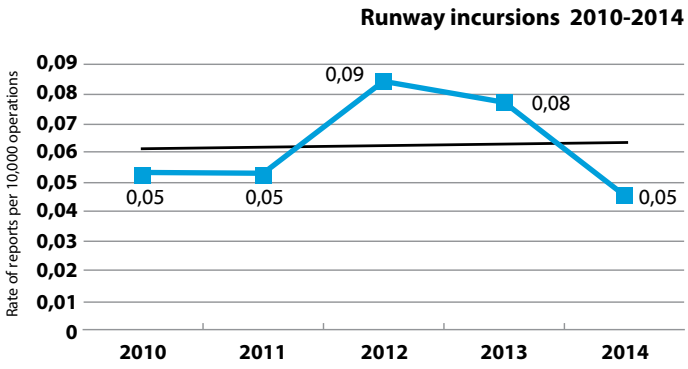


Figure 8: *Runway Incursions 2010-2014*

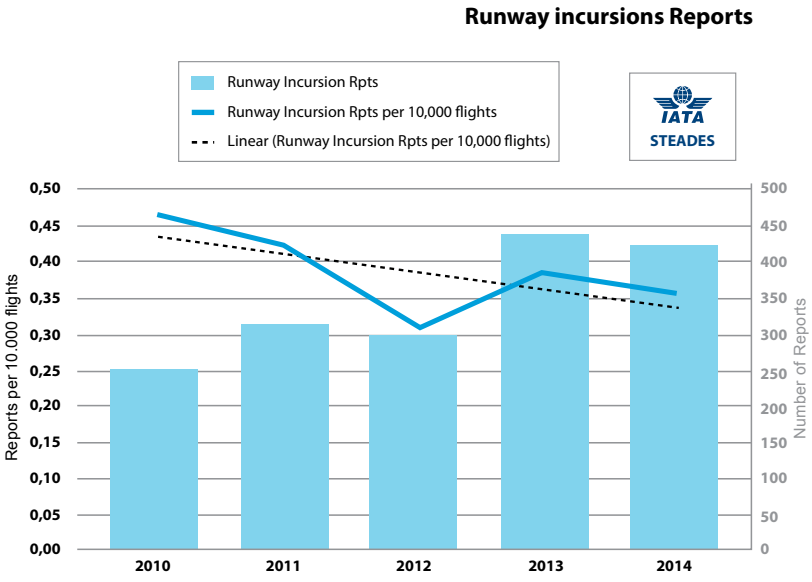


Figure 9: *Runway Incursions 2010-2014*

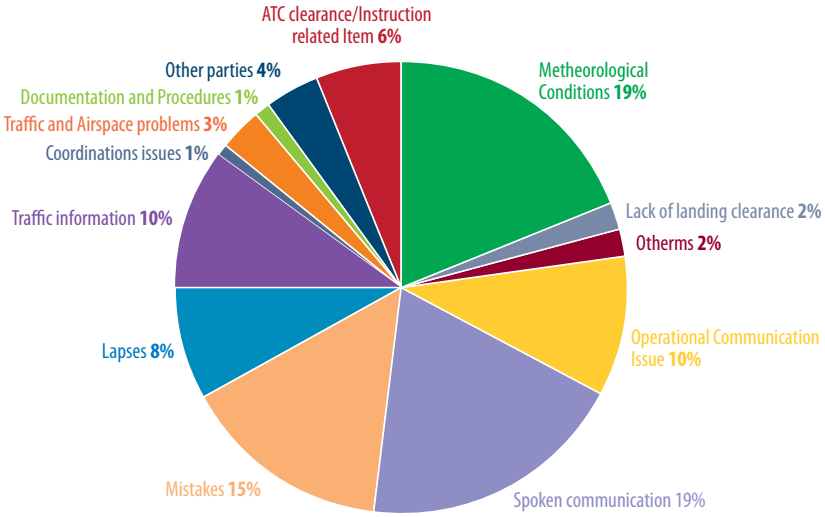


Figure 10: *Runway Incursions, in-depth analysis and cumulative figures for 2010-2014*

The drill-down through the EVAIR Runway Incursion data identified a number of contributors, which are shown in Figure 10.

The areas with the highest percentages are Spoken Communication 19%, Mistakes 15%, Traffic information 10% and Operational communication 10%. It is very important to note that all these areas recorded a considerable fall in 2014.

It would seem that the reason for this fall is a number of European runway safety activities, but also issues related to the reporting culture and motivating factors. In this regard we feel it is important to once again promote the importance of safety reporting.

De-identified Runway incursion events reported by pilots in 2014:

August 2014 - During taxiing on taxiway B the crew was instructed by GND control to hold short at B1 and to contact the tower. The crew contacted the tower and the controller instructed to "hold short at B1". The crew reported "holding short B1 by saying the Call Sign of the flight BAK 333". A few seconds later the controller said "are you ready?" The crew's answer was "affirm BAK333" The controller said "line up and clear for take-off RWY 15L." The crew repeated: "Cleared to line up and take off RWY 15L from BAK333. At this time a second a/c A320 was lining up from full length of the RWY 15L. As soon as the crew of BAK333 saw the A320 moving, they stopped immediately and the controller told them to "STOP BAK333".

ANSP feedback facilitated by EVAIR

The SMS investigation classified the event as a RWY incursion C. Identified contributors to the RWY incursion were: high workload, no read-back by the controller and X/C Coupling operations between GND and TWR frequency, which after the event was suspended. (In "X/C cross Coupling" each communication is retransmitted on the other frequency operating as if they were one.

De-identified Runway incursion events recorded in 2014:

1 Jun 2014 - Approach and landing carried out to runway 05R, aircraft was slowing to about 80kts. When the crew started the turn-off from the RWY they noticed a small white car on the left portion of the runway in relation to the aircraft driving in the opposite direction and towards the aircraft. No evasive action was necessary and the aircraft vacated the runway uneventfully.

ANSP feedback facilitated by EVAIR

The SMS investigation showed that the previous aircraft reported a bird strike when landing. According to the procedure, the Marshall was instructed to check the runway. Following the ATC instruction, the car driver was waiting on the apron. Nevertheless, after the flight landed, ATC cleared the Marshall to enter the runway and check it out without waiting enough time for the aircraft to vacate the runway, thus provoking a runway incursion. When ATC realized that the car and the a/c were on the runway at the same time, ATC instructed the Marshall to stop and hold at the side of the runway until a/c vacated the runway. The controller was interviewed as part of the preventive measure.

Note: Due to confidentiality reasons all call signs, names of NAV aids, five letters names, RWYs etc. are fictitious.

LEVEL BUST

For the period 2010-2014 Level Busts accounted for 4.2% of all reports. As in previous periods, the largest number of Level Bust events, occurred within the en-route phase, i.e. 72%, which is slightly higher than for the previous period. In 2014 TCAS, as the last airborne safety net, acted in almost 14% of the Level Busts. This is almost 5% more than in 2013.

For the period 2010-2014, Level Bust events occurred at more than 140 different locations across Europe, which is more than for the previous period; more than 60 commercial Air Operators reported Level Busts for the 2010-2014 monitored period.

The trend lines in both the EVAIR and IATA STEADES repositories show different directions. EVAIR recorded a downward profile while IATA STEADES had an upward profile, although both repositories recorded a decrease in 2014 (Figures 11 & 12).

One of the potential reasons for the reduced number of Level Bust reports in EVAIR is the ongoing work on Call Sign Similarity as one of the top 5 contributors to Level Bust. Namely, use of the Call Sign Similarity de-confliction tool among Air Operators reduces the risk of Level Busts.

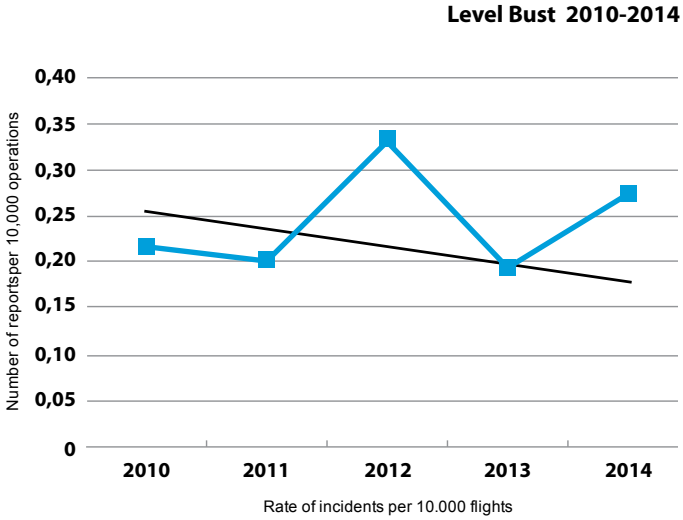


Figure 11: *Level Bust 2010-2014*

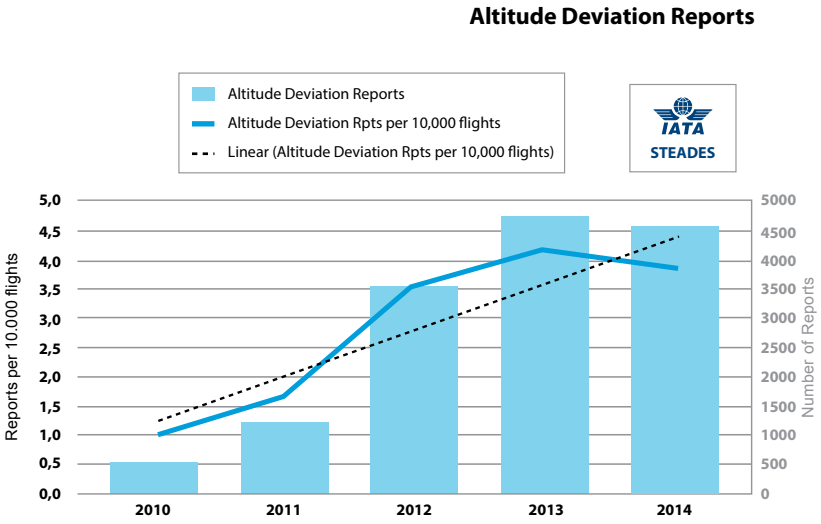


Figure 12: *Altitude Deviations 2010-2014*

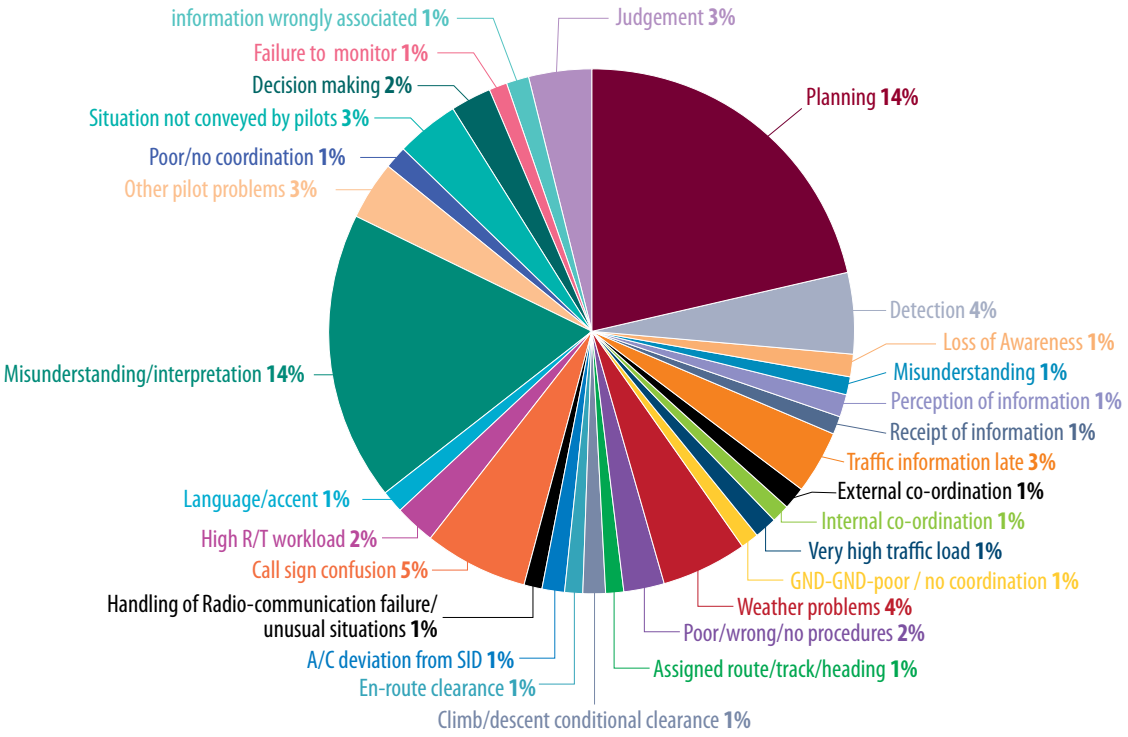


Figure 13: *Level Bust contributors - cumulative figures for 2010-2014*

For the period 2010-2014 within the EVAIR repository we identified almost 50 different Level Bust contributors. However, almost one third of them belong to Air-Ground communication. Figure 13 shows most of the various contributors. Planning, Misunderstanding/misinterpretation, Hear-back omitted, Call Sign Similarity and Pilot problems account for more than 50% of the Level Bust issues. This clearly indicates where to look in order to improve the situation. Call Sign Similarity/Confusion has been already addressed by the Call Sign De-confliction Tool, but most of the other contributors could be addressed by training, as one of the mitigations tools.

De-identified Level Bust event reported by a pilot in 2014:

Aug 2014- The controller requested the speed in descent to be two seven zero. This was misunderstood as descent to FL270. Descent was initiated with approximately 400 pm from FL350, when the error was spotted simultaneously by PIC and ATC. A/c subsequently returned to FL350 immediately.

The ASNPS feedback facilitated by EVAIR

The voice records showed that the crew was instructed to fly a speed of 270kts in the descent. The pilot responded "two seventy by saying the Call Sign". This was accepted by the controller to have been a correct read back. The investigation concluded that the pilot interpreted two seven zero to have been a descent clearance. The incomplete read back was not corrected by the controller

Note: Due to confidentiality reasons all call signs, names of NAV aids, five letters names, RWYs etc. are fictitious.

EVAIR SUPPORT TO CALL SIGN SIMILARITY IMPLEMENTATION PROJECT

The effectiveness of the EUROCONTROL Call Sign Similarity de-confliction Tool (CSST) and the associated CSS Service Level 1 continues to be monitored by EVAIR. The main objective of the monitoring is the detection of CSS/C by means of a single Aircraft Operator (AO) schedule of those AOs which are CSST users and non-users. The EVAIR monitoring results will be used inter alia for CSST safety assessment and as a decision-making element to proceed with Level 2.

CSST Operations Update

The Network Manage (NM) 19.0 Release issued a new version of the CSST, which followed CSST user feedback. The new version of the CSST is more user-friendly with improved CSS detection and de-confliction capabilities. Monitoring of CSST efficiency shows that the percentage of CSS de-confliction stands at over 90%.

Expansion of CSST use helps not only to partially or fully de-conflict call sign similarities within a single AO's flight schedules, but also to reduce the risk of call sign confusion, which is a contributor to various ATM safety events such as Level Busts, TCAS RAs, Runway incursions, etc. We therefore take this opportunity to invite those Aircraft Operators (AOs) which have not yet started using the CSST to join the team of users, thus helping to reduce the risk of the serious safety events mentioned above.

In addition to the AOs, the EUROCONTROL Call Sign Management Cell (CSMC) plays an important and active daily role in the CSS de-confliction process. CSMC reacts at the request of ANSPs or AOs by contacting AOs having problems with the CSS and asking to change call signs of affected flights. In this way, CSMC contributes to the de-confliction of CSS, thus reducing the risk of more serious ATM safety events.

In other news, as well as supporting European-based airlines, the CSS project team is reaching out to other areas of the world and recently Etihad airways started to trial the use of alphanumeric call signs for some of their scheduled services to/from European destinations from their base in the Gulf. We await the results of this trial with keen interest. Moreover, IATA is considering establishing a CSMC type body in the Middle East to address call sign similarity/confusion issues in the Region.

Meanwhile back in Europe, readers may also be aware that the new EC Implementing Regulation (EU) 2015/1018 classifying the occurrences that are to be reported iaw with EU Reg 376/2014 on the Reporting and Analysis and Follow-up of Occurrences in Civil Aviation (effective 15 November 2015), includes a specific requirement (Annex III, 1. (11)) for controllers to report call sign confusion related occurrences. Whilst many, if not all, ANSPs already encourage Air Traffic Controllers (ATCOs) to do this we may see a further increase in the number of confusion events as controllers are now legally obliged to report them. For the airline/pilot community (EU) 2015/1018 is less specific in that it does not mention call sign confusion explicitly by name but it may be interpreted that these events could be included within the context of Annex 1, 3. (4), namely, "Misinterpretation of radio-communication which has or could have endangered the aircraft, its occupants or any other person." Either way, as described previously, we will continue to monitor the situation closely.

CSS User Group

The CSS User Group 13 meeting was held at EUROCONTROL HQ in Brussels on Tuesday 26 January 2016.

CSST Access and Additional Tokens

An NM token is required for access to CSST. The service can be added to the existing token or an additional token can be purchased for only €200. This is a small price to pay set against the time saved by using CSST; once added, CSST access will be guaranteed for the remaining life of the token. We hope that the fee will not discourage AOs from signing up to use the tool as it represents good value for money.

To make things run more smoothly, AOs need to clearly identify the request for access to the CSST. To that end, AOs who apply for a new token or ask to extend an existing one must ensure

that CSST is put in the Purpose of Request box. To extend an existing token, it will also be necessary to insert user ID (CCID). The application form can be found at http://www.eurocontrol.int/network-operations/access-service-request-form

Call Sign Management Cell (CSMC) Support

The CSMC (nm.csmc@eurocontrol.int) is also on hand to help AOs navigate the application process. The CSMC prepares the CSST for the forthcoming season and is available to discuss AO training requirements. Familiarisation sessions can be provided in Brussels or, if requested and subject to CSMC staff availability, may be provided on-site at the AO's premises.

Learn More About Call Sign Similarity

If you are interested in learning more about the CSS Project then please contact the CSS Project Manager and Co-chair of the CSS User Group, Mr Richard Lawrence, at: richard.lawrence@eurocontrol.int or via callsign.similarity@eurocontrol.int

You can also contact the Call Sign Management Cell (CSMC) at nm.csmc@eurocontrol.int

and find more information on the Call Sign Similarity Project at: http://www.eurocontrol.int/services/call-sign-similarity

The latest Call Sign Similarity/Confusion data reported to EVAIR and the comparison with IATA STEADES data is shown below.

EVAIR Call Sign Similarity/Confusion monitoring relies on two sources, airlines and ANSP reports. Reports from the airlines mainly relate to confusions and in many cases are followed by a Level Bust, TCAS RA, or in some cases Runway incursions. Reports from ANSPs mainly address Call Sign Similarities, although there are Call Sign Confusions too.

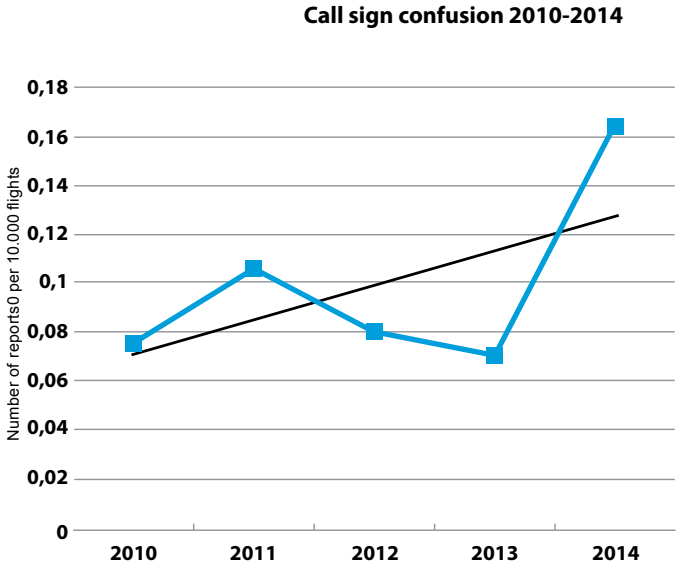


Figure 14: *Call sign Confusions 2010-2014*

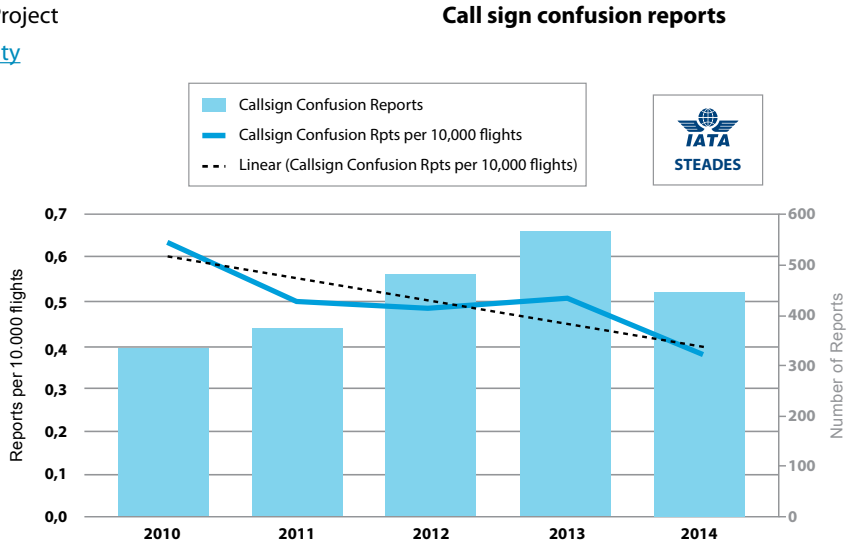


Figure 15: *Call sign Confusions 2010-2014*

PILOTS' REPORTS – CALL SIGN CONFUSIONS

A comparison between EVAIR, which is the European repository and the IATA STEADES, a global repository, shows different trends. The EVAIR repository shows an upwards trend while IATA shows a downward trend. In 2014, unlike IATA, EVAIR recorded a considerable increase in Call Sign Confusions communicated by the airlines. The increase came after two successive years of decrease.

One of the potential reasons for this increase could be the repeated requests to the airlines to report Call Sign Confusions to support EVAIR monitoring of the efficiency of the EUROCONTROL Call Sign Similarity De-confliction Tool. It is also important to note that the increased number of reports assists the EUROCONTROL Call Sign Management Cell in coordinating daily changes to similar call signs with the affected airlines. This is one of the ways of mitigating the problem. We want to highlight that, although changing call signs is a voluntary act on the part of airlines, so far we have had full airline cooperation and readiness to contribute to the success of this activity.

Call sign confusion contributors cumulative figures 20010-2014

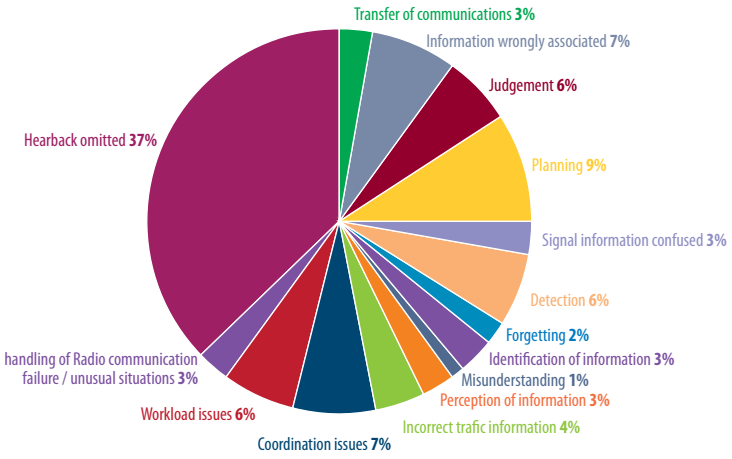


Figure 16: *Call Sign ATM contributors 2010-2014*

Besides changing similar call signs, the real contribution to safety is use of the Call Sign Similarity De-confliction tool. Records show that there has been no change in the number of tool users compared with the previous year. There are 35 airlines using the tool today.

In order to make further improvements in this area, it would be very much appreciated if more airlines could give consideration to starting to use the tool for de-conflicting their own similarities. Therefore we would request all airlines that still do not use the tool to join the team of tool users and support further improvements in this field.

For the period 2010-2014, Call Sign Confusions as reported by airlines occurred at more than 70 different locations across Europe, which is 16% more than for the previous period. Traditionally the en route phase records the biggest number of Call Sign Confusion occurrences.

Single Air Operator Call Sign Confusions for 2010-2014 accounted for 71% of the overall Call Sign Confusions, which is 5% more than for 2009-2013. In 2014, 73% of the confusions occurred within the same Air Operator, an increase of 13% on 2013. This is an area we will focus on in order to gain a much better understanding of this increase. As we said above, one of the reasons could be the constant promotion of Call Sign Similarity/Confusion reporting; however we would like to establish whether there are other issues associated with this problem.

Figure 16 shows that, of the various contributors, Hear Back Omitted recorded the highest percentage (37%). It indicates where, besides the Call Sign Similarity De-confliction tool, a way of mitigating the situation might be sought.

De-identified Call Sign Confusion event reported by pilot in 2014:

Oct 2014 - 40 miles south of MBR the crew of BBB 77R changed frequency and contacted the next sector, giving Call Sign BBB 77R. ATC responded with a clearance to climb to FL360 and to route direct to BMG.

Clearance was read back. Climb was initiated to FL360. The crew then determined that BMG was not on their route. The crew requested ATC to route to LADOS (the FIR boundary on the route). ATC responded that the BBB77R was to maintain FL340 and route to LADOS and the climb clearance to FL360 was intended for the BBB779. Both pilots from BBB77R understood that the clearance to climb to FL360 and the routing had been addressed to BBB77R. VS was pushed at FL345, cleared the level, reconfirmed with ATC and descended to FL340. Later, via the company frequency, BBB779 informed BBB77R that they had heard the exchange on the frequency, having just transferred to it.

Feedback facilitated by EVAIR:

The SMS investigation found that it was a level bust (LB) with (±) 600 feet deviation. The causes of the event were: Similar Call Signs between BBB77R and BBB779 and omitted hear-back by the controller who did not detect that the clearance for BBB779 was taken by BBB77R.

AIR NAVIGATION SERVICE PROVIDRS' CALL SIGN SIMILARITIES AND CONFUSIONS

For the period 2010-2014, eighteen (18) ANSPs communicated to EVAIR some 12,000 Call Sign Similarity/Confusion reports.

A glance at the Call Sign Similarity/Confusion data sets provided by the ANSPs and AOs shows that the ANSP data set is much bigger. Unlike AOs, ANSPs provide EVAIR with Call Sign Similarity information as well as Call Sign Confusions. The information provided on Call Sign Similarity, especially if done so on a daily basis, allows the CSMC to act pro-actively by opening the coordination process for changing the Call Sign. Coordination activities led by CSMC prevent potential Call Sign Confusion from occurring. We have been very pleased to note that, since we started with the Call sign change coordination, AOs have demonstrated a readiness to change an affected Call Sign(s) whenever possible, even during the current scheduled season.

No of AOs identified with CSS/C &
No of ANSPs data providers of CSS/C 2010-2014

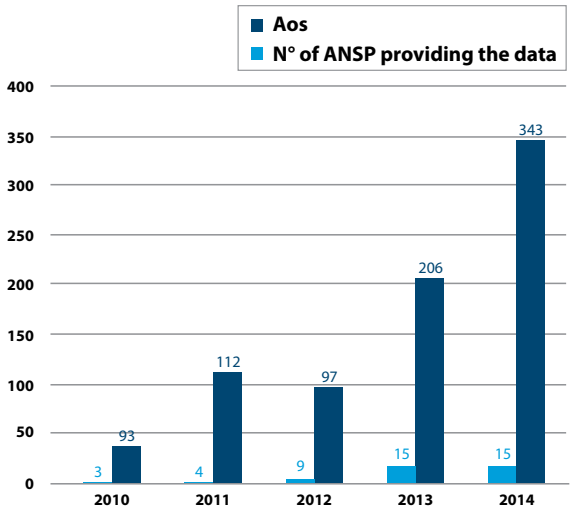


Figure 17: *Number of AOs with the CSS/C as identified by ANSP 2010-2014*

The graph in Figure 17 shows that over the last two years there has been a significant increase in the number of AOs identified with Call Sign Similarity/Confusion issues. In 2013 the increase was 112% and in 2014 it was 66,5%. The main reason for this is the significant increase in the number of ANSPs who provided Call Sign Similarity/Confusion reports and improved reporting mechanism.

Figure 18 shows relative figures of Call Sign Similarities within the same AOs Non-tool users (Same AO CSS NN); Different AOs Non-tool users (Diff AO CSS NN); Same AO Tool users (Same AO CSS UU); and Call Sign Similarities between Tool users and Non-tool users (CSS UN). The graph shows the period 2012-2014 because the real use of the Call Sign Similarity de-confliction tool started in 2012.

The graph shows that the number of CSSs per 10,000 operations among Non-tool users is higher than among Tool users. In spite of the high increase in the number of reports in 2014 CSSs within the same AOs Tool users recorded decrease while within Non-tool users the number of reports increased. The highest increase EVAIR recorded between different AOs Non-tool users and then between Tool users and Non-tool users.

Figure 19 shows relative figures of: Call Sign Confusions within the same AOs Non-tool users (Same AO CSC NN); Different AOs Non-tool users (Diff AO CSC NN); Same AOs Tool users (Same AO CS UU); Different AOs Tool users (Diff AO CSC UU) and Call Sign Confusions between Tool users and Non-tool users (CSC UN).

Figure 19 gives a very interesting picture. In 2014 EVAIR recorded a decrease in the number of reports within the Same AOs Non-tool users and between Different AOs Non-tool users versus 2013. At the same time in 2014, there was an increase in the number of CSC within the Tool users same AOs; however, the level of confusions is still lower than CSC within the Same AO Non-tool users. One of the potential reasons for the increase of the number of confusions amongst Tool-users is the increase of the number of AOs using the tool. Levels of confusions between Different AOs Tool users is very low and the same as between Tool users and Non-tool users.

It is premature to make hard and fast conclusions although the current picture indicates that the Call Sign Similarity de-confliction tool and associated actions is producing positive results. We will continue to monitor the situation and expect to be able to draw more robust conclusions after collecting at least five years of CSS Tool use data .

CSC Non-Tool Users and Tool Users relative figures 2012-2014

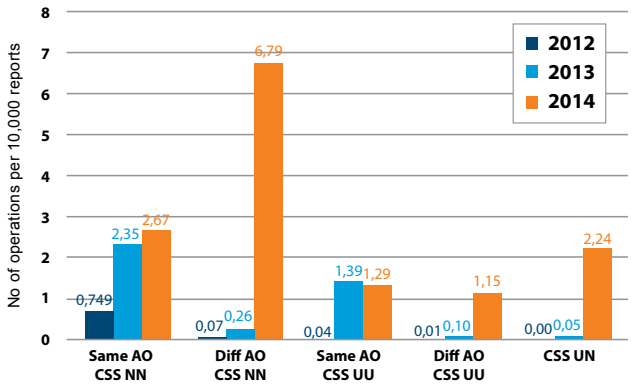


Figure 18: *CSS Non-Tool Users and Tool Users-relative figures 2012-2014*

CSC Non-Tool Users and Tool Users relative figures 2012-2014

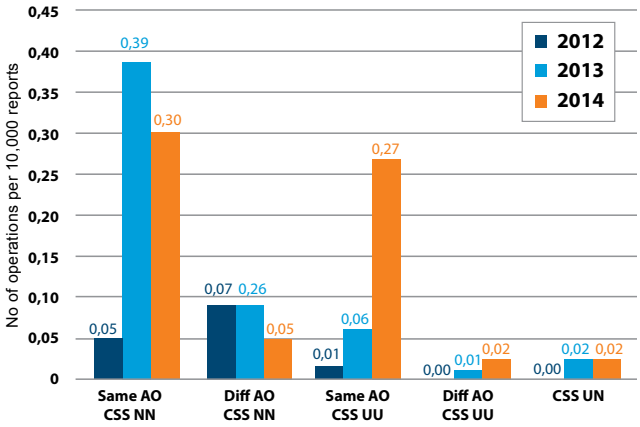


Figure 19: *CSC Non-Tool Users and Tool Users-relative figures 2012-2014*

AIR-GROUND COMMUNICATION

For a better understanding of the taxonomy used, it should be clarified that air-ground communication according to the EUROCONTROL HEIDI taxonomy covers two main areas: spoken and operational communication (see definitions on page 43).

Air-ground communication as presented in Figure 20 is one of the most frequent contributors among the top seven contributors common to all events monitored by EVAIR (Runway Incursions, Level Busts, ACAS RAs, Call Sign Similarities/Confusions, Go-arounds, etc.).

Further analysis shows that spoken communication accounts for 69% of air-ground communications, while operational communication accounts for the remainder, i.e. 31% (Figure 21).

In 2014, within spoken communication (Figure 22) six areas of nine recorded an increase in the number of reports compared to 2013. The highest increase recorded within Call Sign Confusion stood at almost 160%. The most probable reason behind this high increase, as we have mentioned above, was the repeated requests to our data providers to report this type of event in order to support EVAIR in its monitoring of the efficiency of the Call Sign Similarity De-confliction tool. One of the reasons could be also a relatively small number of reports so that by having a few more reports the percentage jumps highly. We continue to monitor this area to see whether the trend continues. The second area of increase was Misunderstanding/misinterpretation, with a 40% rise in 2014.

Within operational communication (Figure 23), two areas out of five recorded an increase in 2014, one of them being "Transfer of communication". The increase was 57% in 2014 compared to 2013. The second area of increase in 2014 compared to 2013 was "Hear back omitted", with 11%. In the EVAIR database, Hear back omitted contributes to the number of different types of occurrence events, such as Level Bust, Call Sign Confusion, Runway incursion/ excursion, etc.

Contributors to ATM Incidents cumulative figures 2010-2014

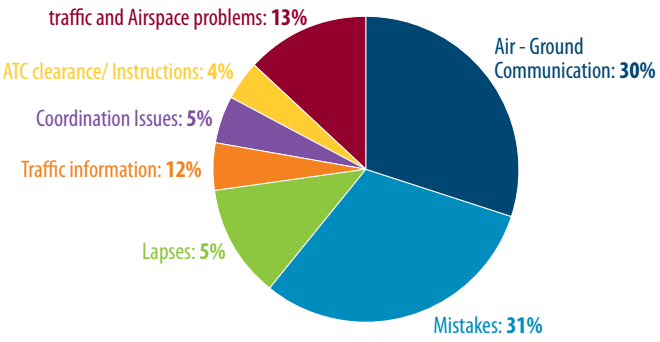


Figure 20: *Contributors to ATM Incidents cumulative figures 2010 - 2014*

Air - Ground communication cumulative figures2010-2014

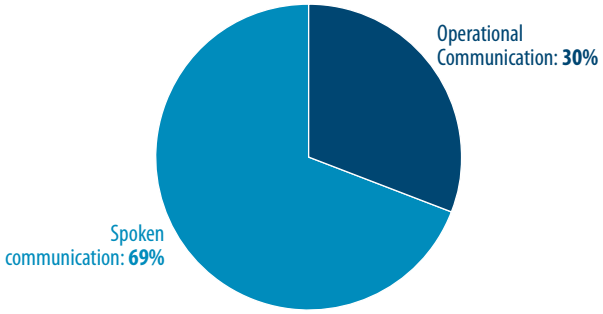


Figure 21: *Air-Ground communication cumulative figures 2010 - 2014*

De-identified air-ground communication event reported by pilot in 2014:

Jan 2014 – Without ATC clearance the crew landed on RWY 23L. There was no clearance either from APP or from TWR. When the crew was called on 121.5 the flight was already on the ground. The crew said that they got the clearance for landing and thought that it had been done by the previous sector. However APP did not confirm it.

ANSP Feedback facilitated by EVAIR

The ANSP SMS investigation concluded that the incident was a runway incursion. During the runway incursion there was no need for an evasive manoeuvre by the aircraft making the runway incursion or the other traffic. The incident was classified as C. The main cause of the incident was that the aircraft landed without ATC authorisation. The aircraft obtained clearance from the approach sector for the ILS approach and was transferred to the TWR controller. The crew did not try to establish contact with TWR. In the absence of a landing clearance, the crew did not make a go-around manoeuvre but landed as if landing clearance had been given. The TWR controller indirectly contributed to the incident since the first attempt to establish contact with the crew was when the aircraft was over the threshold of the runway. When the aircraft landed, the TWR controller established contact with the crew on the emergency frequency.

Spoken Communication 2010 - 2014

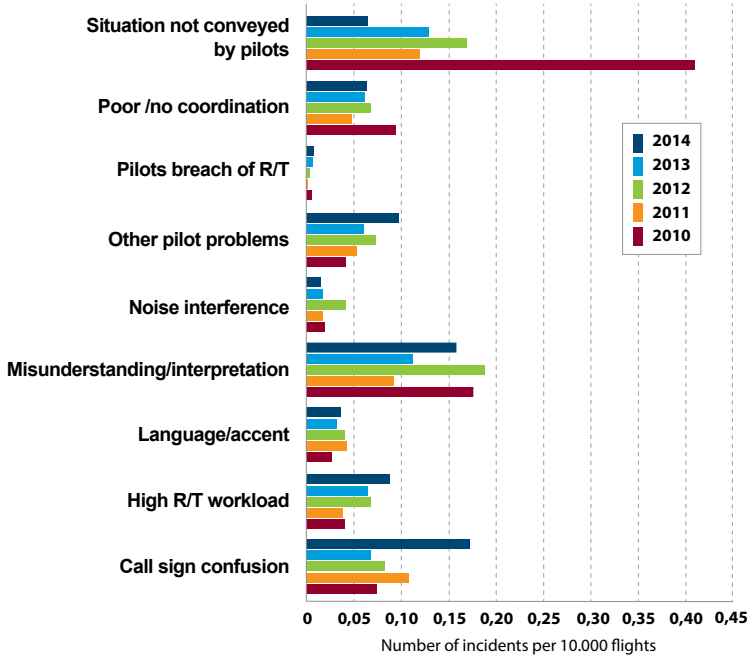


Figure 22: *Spoken communication 2010 - 2014*

Operational Communications 2010 - 2014

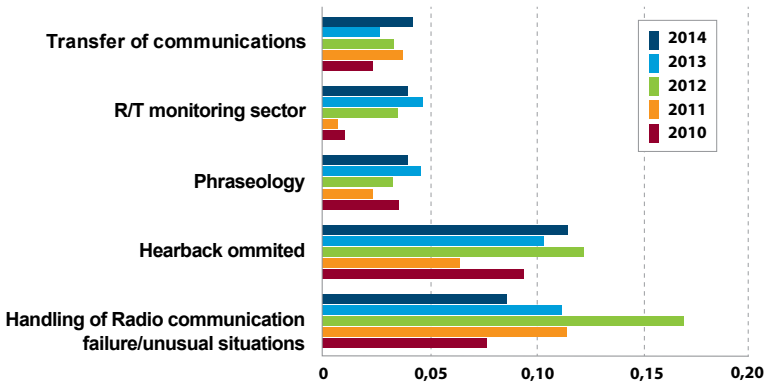


Figure 23: *Operational communication 2010 - 2014*

LOSS OF COMMUNICATION 2010 - 2014

In addition to the activities related to data collection and its analysis and loading in the EVAIR database, EVAIR customised analyses at the request of stakeholders or various EUROCONTROL projects. One such analysis produced upon request is "Loss of communication". Bearing in mind the importance of the subject, we think that sharing this information across the aviation community is essential, which is why we included it in the EVAIR Safety Bulletin.

For the period 2010-2014, EVAIR recorded 318 Losses of communication. After 2012, the highest number of reports (74) was recorded in 2014. Losses of communication were recorded in 2014 at 52 different locations within 24 different states. These figures are much higher than in 2013, when "Loss of communication" was recorded at 36 locations within 16 states. The duration of the "Loss of communication" varied from a few minutes to more than 30 minutes. Five of these "Loss of communication" occurrences were followed by military interception as part of State security measures.

A comparison between EVAIR and IATA STEADES data highlights different trends. EVAIR data indicates a slight upward trend whereas IATA data shows a downward movement per 10,000 flights.

Figure 26 shows that the largest number of losses of communication occurred during the en-route phase. "Loss of communication" en-route occurs most often when air traffic controllers forget to make the traffic hand-over from one sector to the next or from one FIR to the next. Pilots are also contributors in this area. In the majority of cases pilots do not check compulsory points where they have to change to a new frequency. Usually pilots wait for controller instructions but, as mentioned above, controllers do occasionally forget to issue the appropriate instructions. In some instances there have also been equipment failures.

For the period 2010-2014, as for the previous period, operational communication is one of the main contributors to "Loss of communication". Within operational communication, "Handling of radio communication", which includes incorrect frequency selection by pilots, lack of air traffic controller instructions or incorrect frequency instructions, is the area with the highest percentage.

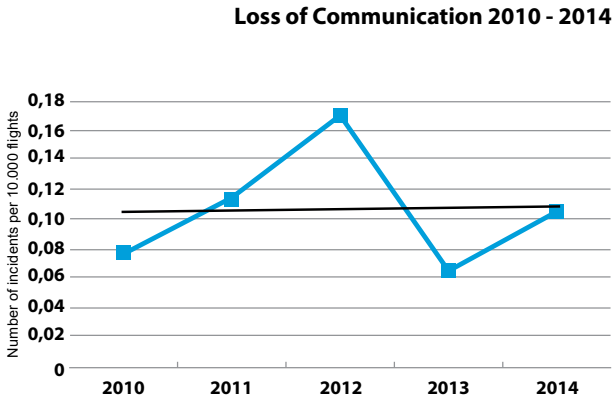


Figure 24: *Loss of communication 2010 - 2014*

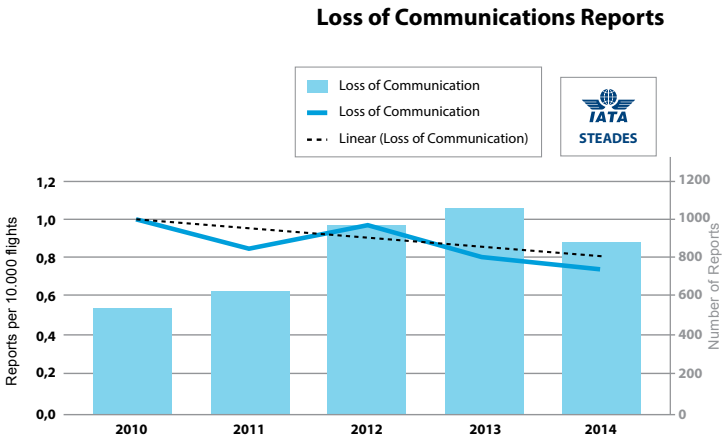


Figure 25: *Loss of communication 2010 - 2014*

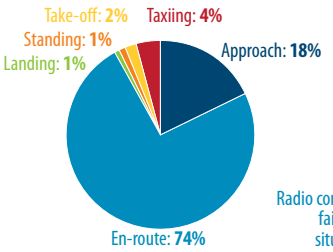


Figure 26:
Loss of communication – Phases of flight 2010 - 2014

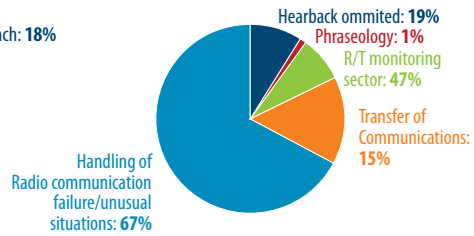


Figure 27:
Loss of communication – Operational communication 2012 - 2014

Loss of Communication - ATM system contribution cumulative figures 2010 - 2014

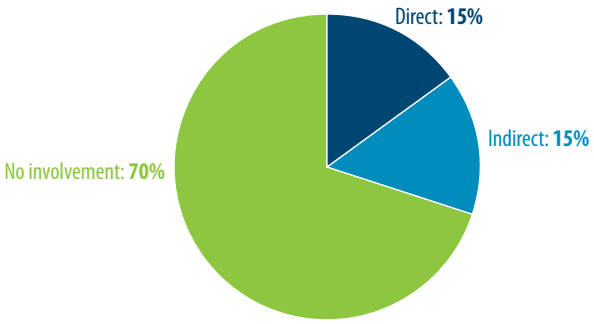


Figure 28:
"Loss of communication" – ATM system contribution 2010-2014

Figure 28 shows that in 70% of cases there was no ATM contribution. It is a much higher percentage than that recorded for the previous period, when there was no ATM contribution in just 46% of cases. This could be interpreted as being the result of an improvement in ATM performance. Pilots were the most common contributors to "Loss of communication" outside ATM. The most frequent pilot contribution involved incorrect frequency selection, incorrect read-back and not checking the points where they have to change frequency.

Other contributors from outside ATM were ground commercial radio stations interfering with the operational frequency. It is interesting to note that in 2012 one "Loss of communication" occurrence contributor was a solar storm.

Usually the most frequent ATM contributory factors were lack of internal coordination, hand-over of traffic to neighbouring sector, operational and spoken communication, R/T interference, high R/T workload and incorrect frequency provided to the pilot.

De-identified "Loss of communication" event reported by pilot in 2014

Apr 2014 - The aircraft was on instructed routing. Both pilots were monitoring the given frequency and guard on 121,500. The Mode S transponder was active all the time. Both pilots also stated that they had constantly been wearing headsets. When the pilots notice interception from military aircraft they immediately contacted the adjacent sector from the neighbouring FIR. They were told that the aircraft had not responded for quite a while and radar contact had occasionally been interrupted.

ANSP feedback facilitated by EVAIR

ATM investigation found that the occurrence was due to incorrect communications. The provisional severity assigned to the occurrence, based on the information available, was C. The cause of the incident was a lack of communication from the crew on the frequency in use, including the emergency frequency. The duration of "Loss of communication" was more than 25 minutes. Air traffic controllers tried many times to contact the crew on the frequencies in use and on the emergency frequency. According to the crew's report, radio contact was restored within the airspace of the neighbouring FIR when the crew realised that a military aircraft was intercepting the aircraft. They immediately contacted the adjacent sector belonging to the neighbouring FIR. The crew also changed the SSR code following the communications failure procedure. In their notification, the crew said that both pilots were monitoring the emergency frequency. It should be noted that the controllers from two sectors from the FIR who were in contact with the aircraft did not detect the "Loss of communication". For these reasons, the investigation found that ATC indirectly contributed to the incident. It is important to point out that this incident was not notified by ATC.

De-identified "Loss of communication" event reported by pilot in 2014

Nov 2014 - During radar vectoring for final approach with the given track for VOR approach, radio communication was lost due to a technical problem with radio management panel 1. During descent the aircraft was cleared to intercept the final track of the VOR on heading 180 around 20 NM from the RWY. Around 12NM from the RWY the crew was called on 121.5. After replying on the guard frequency the crew was able to get back on the frequency in use and remain on this frequency until landing.

ANPS feedback facilitated by EVAIR

The air traffic controller made two attempts to call the crew on the frequency in use. The answer arrived on freq. 121.5. The aircraft was still far from the RWY when it managed to get back on the frequency in use and proceed without further problems.

SPECIFIC EVENTS - LASERS THREATS ACROSS EUROPE

Laser issues are another set of statistics which EVAIR prepares at the request of stakeholders. For the period 2010-2014 laser interferences account for 16% of all reports in the EVAIR data repository. This is slightly more than for the previous period.

After a slight increase in 2013, in 2014 we recorded a decrease in the number of laser reports. In all laser statistics the most affected phase of the flight is, unsurprisingly, approach. However, from time to time we receive reports for other phases of flight. Very recently we received information that one laser attack was reported when the flight was at FL340!

In the majority of the reports which were followed by a pilot narrative, we found that pilots and air traffic controllers regularly follow the recommendations to report laser interferences immediately: pilots to air traffic controllers and controllers to the police.

Immediate reporting laser attacks to the police is of the highest importance, since it allows the police to react quickly. We saw in some reports that the police managed to catch the laser perpetrators.

A good deal of ongoing discussions on this subject show that the laser issue is still a major problem and that we need a common European approach to this subject, since the national approach is not enough to address issues such as laser manufacturing and distribution. In this regard there is a need for the involvement of European judicial and regulatory stakeholders. It is a matter of urgency, since we can find very powerful lasers on the market, including blue lasers, which are more dangerous than green lasers. In 2014 we recorded an increase in the use of blue lasers, which can cause permanent eye damage. Recently we received a report that a pilot, following a laser attack, was unable to continue to flying the aircraft and the co-pilot had to take over the command. Following a medical examination it was found that the pilot had a retinal injury.

Laser 2010-2014

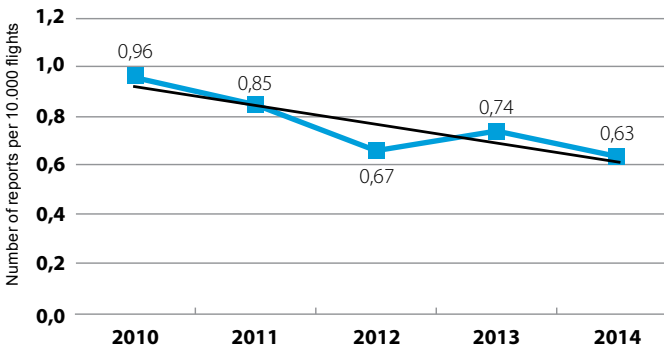


Figure 29: *Laser 2010-2014*

Laser occurences per phase of flight 2008- 2012

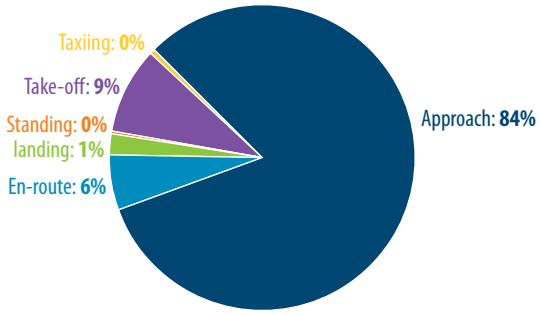


Figure 30: *Laser phases of flight 2010-2014*

Laser interference N° of locations and N° of affected carriers 2010 - 2014

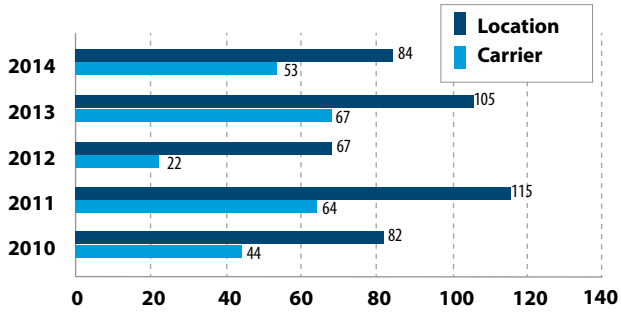


Figure 31: *Laser interference - N° of locations and No of affected carriers 2010-2014*

The number of air carriers affected by laser interference in 2014 was lower than in 2013. Fifty three (53) different carriers were affected in 2014 versus sixty seven (67) in 2013. At the same time we saw a decrease in the number of locations affected - in 2014 eighty four (84) locations were affected versus one hundred and five (105) in 2013.

Laser interference continues to be monitored and, as for other types of ATM occurrences, our data providers can send their reports to:
Dragica.stankovic@eurocontrol.int

More information about lasers is available on SKYbrary (www.skybrary.aero).

De-identified laser event reported by pilots in 2014

Nov 2014 – A blue laser on approach was notified by ATIS. A/c on ILS between 3-4 miles from touchdown (approx. 1100 ft). Blue light observed illuminating flight deck from low position at 1 o'clock. Despite ATIS advice, distraction caused FO to look towards the source and the laser shone direct into FO's eyes. FO was immediately dazzled by laser and handed control to the capt. Approach continued uneventfully. On roll-out FO experienced blurred vision in right eye. ATC was informed of all aspects. A/c was shut down on stand and police attended a/c to take statements. FO was advised by paramedics in attendance. FO experienced right eye pain on a/c shutdown.

GPS OUTAGES

As described in the previous EVAIR Safety Bulletin, the first reports of GPS outages were submitted to EVAIR in November 2013. Bearing in mind potential threats to GNSS service continuity, EUROCONTROL joined with IATA in initiating measures to better assess these threats and to develop mitigations in order to be able to deal safely with any outages at a strategic and tactical level. In this regard, EUROCONTROL and IATA established a small GPS reports review group consisting of experts from EVAIR, IATA and the EUROCONTROL Navigation unit. The group will be making a first reading and analysis of the GPS reports and will identify issues which may require coordination and communication with different GNSS stakeholders to better determine a probable cause of the problem and to raise awareness across the aviation community.

Use of the EVAIR data collection mechanism and of the network of data providers in this regard are of the utmost importance. Without the reports provided, it would be almost impossible to identify potential threats and propose strategic and tactical improvements and mitigation measures.

More details on the problem experienced and its impact on the flight (narrative part of the safety report) make it easier to:

- Identify the probable cause of the GPS outages
- Monitor threats to GNSS and assess risks in a data-driven manner
- Support States in the enforcement of spectrum regulation and resolution of significant interference cases and
- Enable reliance on GNSS and associated aviation benefits by adequately managing associated risks

The minimum information we need is first the basic part of the Flight Plan (FPL): date and time of the flight, call sign and type of the aircraft. In addition we need the location of the occurrence in terms of geographical coordinates or position description vs NAV aid or known geographical location and finally a narrative describing the GPS problem experienced in as much detail as possible.

We would repeat our request to air operators and also to ANSPs to provide EVAIR, as the focal point for data collection, with all reports which could be related to GPS outages. Reports should (like all other types of ATM occurrence) be sent to: Dragica.stankovic@eurocontol.int or evair@eurocontrol.int

High-level findings

In total, from Nov 2013 to Jul 2015, EVAIR received 52 GPS outage reports provided by 12 air operators.

GPS Outages Locations 2013 - Jul 2015

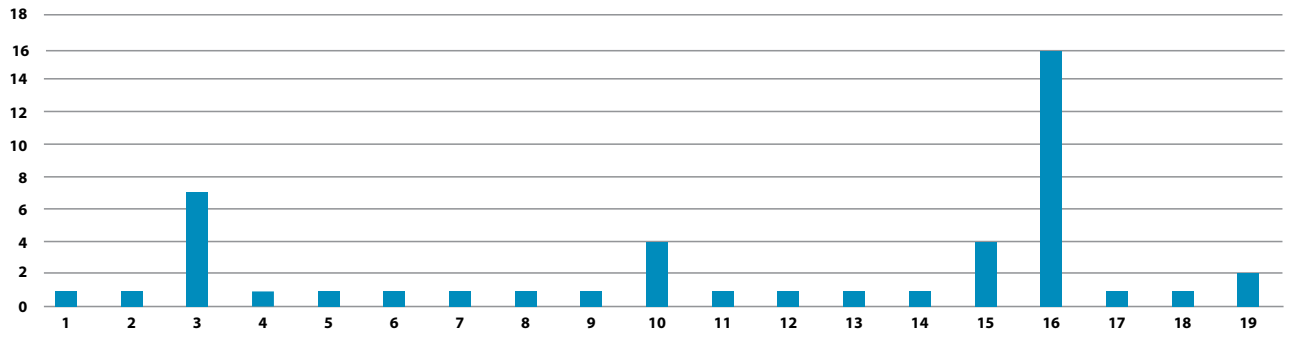


Figure 32: *Locations of GPS outages*

Figure 32 shows that we identified 19 different locations where GPS outages were reported. For reasons of confidentiality, we are not able to disclose the locations, but we can say that most are in areas with ongoing political tensions. It is interesting that some locations are within the central part of European airspace. Certain locations experienced recurring problems, which caused certain airlines to issue internal NOTAMs to raise awareness and warn pilots to be ready to use other navigational equipment when flying through the area affected.

The most affected phase of flight was en-route, with 92% of the reports. The duration of the loss of GPS ranged from 1 to 90 mins. About 50% of the events lasted for between 10-30 mins.

For the period Nov 2013-Jul 2015, according to the narrative part of the pilot safety reports, the GPS-related problems were no different to those already presented in EVAIR Safety Bulleting No 14, namely:

- Loss of GPS signal
- GPS outage
- GPS jamming (in this case the pilot is likely to have made an assumption on the probable cause)
- Total loss of GPS
- GPS 1 and 2 lost
- GPS 1 lost

GPS System Failure 2013-July 2015

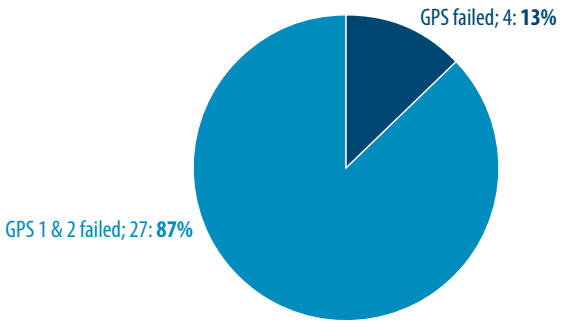


Figure 33: *GPS failures*

Figure 33 presents the situation regarding GPS failure. For certain number of reports we haven't received the information which type of the failure there was on board (GPS 1 of GPS 1&2 failed). Reports which contained the information about the type of the GPS failure recorded that the majority of them (87%) relate to the total loss of GPS by an individual aircraft.

De-identified GPS outage pilot report:

The traffic was en-route when the crew first received a GPS-L INVALID message. Shortly thereafter the crew also received a GPS-R INVALID message, followed by a MASTER CAUTION, GPS light and TERR POS message on ND. QRH NNC. ANP quickly degraded to more than 2.00, and with a planned RNAV STAR with RNP 1 required, the crew declared "Unable RNAV" and requested a non RNAV STAR. This was granted. Just after commencing the STAR, the GPS signal returned and ANP quickly improved to less than 1. The crew elected to continue the current STAR. Approach and landing was uneventful. On the return flight, the crew had the same problem in the same area, however this time with only one GPS signal invalid. ATC told the crew that several other aircraft had reported the same problem. Upon crossing the border between two states and leaving the area GPS was normal.

RPAS – Remotely Piloted Aircraft Systems (Drones)

Since 2013, when we received the first report related to the drone/RPAS problem, this trend has been increasing rapidly. After just a few reports in 2014, we recorded a sharp increase in 2015. For the period Jan- Jul we received 17 reports. As mentioned in the previous bulletin, all reports received occurred within controlled airspace. There was no coordination between the RPAS user and the local ATC. All occurrences were at low altitudes within the approach or departure phase.

We believe that there are many more events? , as perusal of newspapers and aviation internet sites turns up reports different from those we have in the database.

In the previous bulletin we mentioned that a number of measures are being taken by different international bodies - ICAO, EC and EASA. EUROCONTROL is also active in this field and is working on the ATM part of RPAS integration across Europe. Here we provide links to the main documents drafted by the above organisations:
ICAO Manual on RPAS (Doc 10019) http://www.wyvernltd.com/wp-content/uploads/2015/05/ICAO-10019-RPAS.pdf
EC Roadmap for the integration of civil RPAS into the European aviation system
www.ec.europa.eu/transport/modes/air/news/2015-03-06-drones_en.htm
EASA Concept of operations for drones
http://easa.europa.eu/easa-and-you/civil-drones-rpas

We see a number of similarities between the drone/RPAS problem and the laser problem. On the one hand there is a lack of proper regulation while on the other hand all kinds of drones/RPAS are available on the market and are being used by people who are not part of the aviation system. Specifically, the problem is related to those drones/RPAS which are not covered by the current and future regulation since they are being misused, and the same situation applies to the laser problem.

De-identified RPAS event recorded during summer 2014:

Jul 2014 – During the departure phase the crew observed an object which resembled a big bird, but it became clear that it was a drone. It was difficult to estimate the distance but it was close and the crew kept an eye on the object without changing the flight trajectory.

De-identified RPAS event reported by pilot in 2014:

Dec 2014 - During the approach phase, descending to 4000, the crew observed an orange, spherical unidentified flying object. The object was a few hundred feet below their flight. The flying object crossed the final approach axis. This was reported to ATC, which was not aware of any flying object of this type in the area in question.

ACAS REPORTING

ACAS occurrences are a constant feature of EVAIR statistics. The reason for regular monitoring on the part of EVAIR is that it has for a number of years been tasked with monitoring the operational, procedural and technical elements of ACAS. The aim of this monitoring is to support the continued safe and effective operation of ACAS by identifying and measuring trends and issues associated with Resolution Advisories (RAs).

ACAS is the generic term for the Airborne Collision Avoidance Systems and TCAS II is the only implementation so far. ACAS is designed to improve air safety by acting as a last-resort method of preventing mid-air collisions or near collisions between aircraft. Although ACAS II implementation was completed in 2005, ACAS monitoring continues to improve safety by identifying technical, procedural and operational deficiencies. In the coming years the monitoring will also focus on TCAS II version 7.1 equipages and performance which will be mandated in European Union airspace on all civil aircraft over 5700 kg MTOM or 19 passenger seats as of 1st December 2015.
http://www.skybrary.aero/bookshelf/books/1749.pdf

ACAS data have been collected either automatically via the Automated Safety Monitoring Tool (ASMT) developed by EUROCONTROL, or manually thanks to reports from airlines and Air Navigation Service Providers (ANSPs).

It is very important to highlight that a number of ACAS/TCAS statistics from manual reporting rely on pilot and air traffic controller perceptions and memories of the events rather than measured or calculated values. However, other statistics are supported by ANSP feedback based on operational investigations, which includes radar and voice records. In any case, care must be taken when comparing data collected manually and data captured automatically.
Messages about typical performance should generally be taken from the automatic recording of events. Manual reporting tends to emphasise the more significant events and gives insights into perception of the ACAS II system.

MANUAL ACAS REPORTING

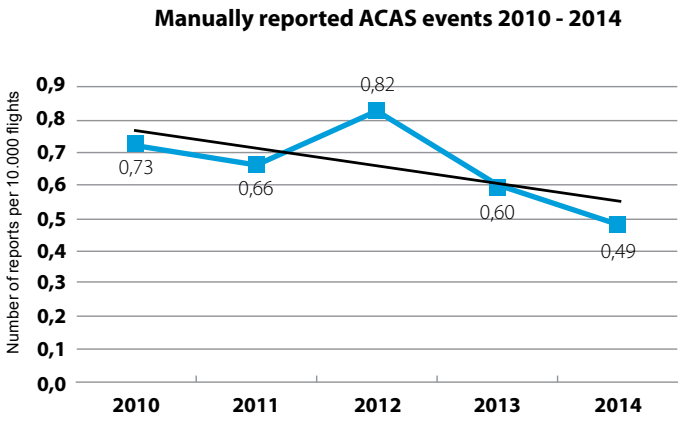


Figure 34: *Manually reported ACAS incidents 2010-2014*

The trend line shows a slight decrease over the whole period monitored. In 2014 we recorded a decrease in the number of reports per 10,000 operations, numbering 0.5 reports per 10,000 operations. This means that during the summer seasons when in average there were about 30,000 operations there were 1.5 ACAS RAs, which is less than in 2013 when it stood at 1.7.

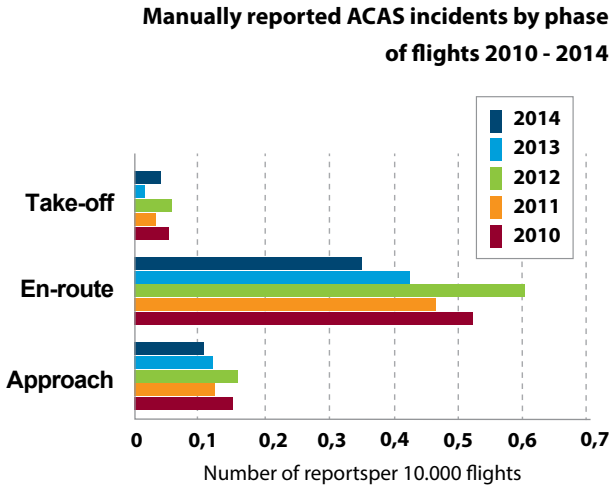


Figure 35: *Manually reported ACAS incidents by phase of flight 2010-2014*

Similarly to the previous reporting cycle, the largest number of RAs reported by pilots occurred within the en-route phase. The picture for automated monitoring is slightly different. There the biggest number of reports is at low altitudes. In the last two years, with the exception of the take-off phase, we recorded a drop in reports for all flight phases monitored.

Manually reported ACAS incidents per states, locations & carriers 2010 - 2014

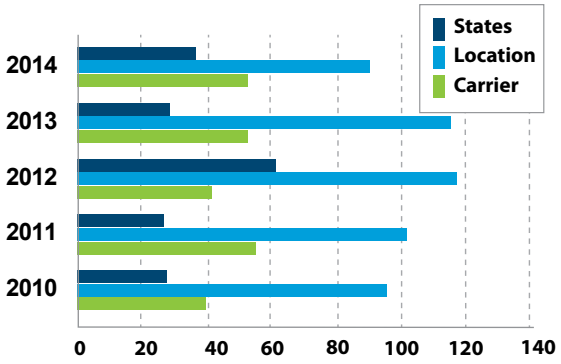


Figure 36: *Manually reported ACAS incidents per states, locations & carriers 2010-2014*

Figure 36 shows that the number of carriers which experienced TCAS RAs is almost the same in 2014 as it was in 2013. However, in spite of the general decrease in the number of ACAS RAs, the number of states where these incidents were recorded increased from 29 in 2013 to 37 in 2014. The number of locations decreased from 116 in 2013 to 91 in 2014. EVAIR recorded the largest number of reports within the core area of the European airspace. This is understandable, bearing in mind the number of daily operations within that airspace. The data shows that at certain locations there was quite a high yearly trend of ACAS RAs. This should be studied and action should be taken by the local ANSPs.

The ICAO ADREP definitions of RA types are shown below.

- Useful RA - The ACAS II system generated an advisory in accordance with its technical specifications in a situation where there was or would have been a risk of collision between the aircraft.

- Unnecessary (Nuisance) RA - The ACAS II system generated an advisory in accordance with its technical specification in a situation where there was not, or would have not been, a risk of collision between the aircraft.

- Unclassifiable RA - The ACAS II system generated an advisory that cannot be classified because of insufficient data.

ACAS RA Classification 2010 - 2014

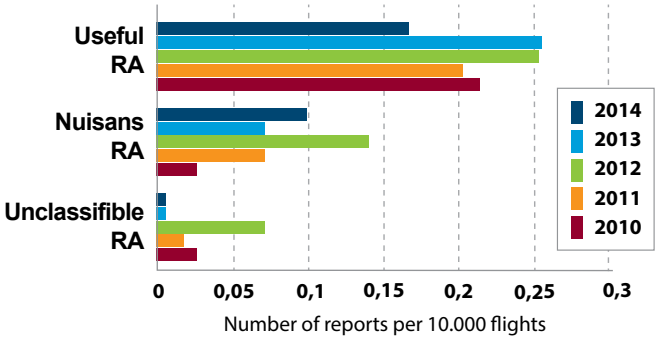


Figure 37: *ACAS RA Classification 2010-2014*

In spite of the overall decrease in the number of TCAS RAs, EVAIR recorded an increase in nuisance RAs. The cause of the majority of nuisance RAs is a high vertical rate, thus is fair to remind pilots to follow the ICAO standard, which states that vertical rate of climb for the last 1,000ft of a climb/descent should not be more than 1500 ft/min.

By clicking on the link below, readers can find ACAS bulletins, including one describing how high vertical rates before level off can cause RAs:
http://www.eurocontrol.int/publications?title=&field_term_publication_type_tid=233&year%5bvalue%5d%5byear

ACAS RA INSTRUCTIONS 2010 -2014

In 2014 EVAIR recorded reversal and crossing RAs. Luckily, these types of RA do not happen often. More information about reversal and crossing RAs is available in ACAS Bulletin 13: http://www.eurocontrol.int/sites/default/files/publication/files/acas-bulletin-13.pdf

Reduce/adjust RA in the new TCAS 7.1 version level off - level off recorded a significant decrease in 2014 vs 2013, but this is nevertheless still the area with the biggest number of reports recorded by EVAIR. More information about this problem, together with the conclusions and lessons learned, is available in ACAS Bulletin No 17: www.eurocontrol.int/sites/default/files/publication/files/acas-bulletin-17.pdf

ACAS RA Instructions 2010-2014

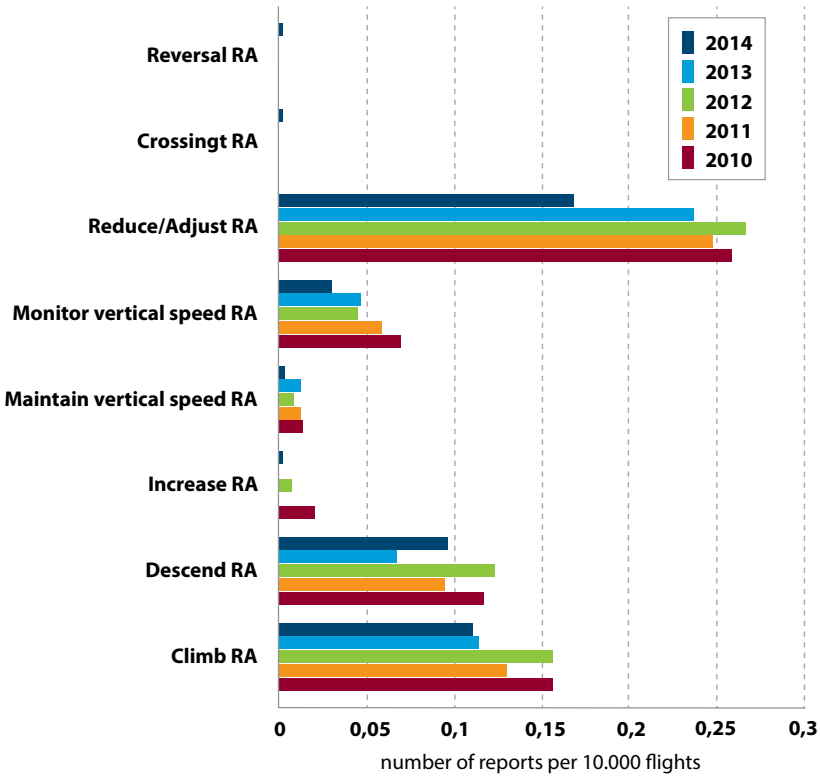


Figure 38: *ACAS RA Instructions 2010-2014*

De-identified ACAS event reported by pilot in 2014

Apr 2014 - During climb the crew was cleared to FL 80 with no speed restriction. At 1000fpm climb rate, the aircraft got a TCAS traffic alert. The other traffic was in the opposite direction, also climbing the same level. Approximately 10 secs after TCAS TA ATC issued immediate avoiding action to turn left 270 degrees, a 90 degree track change. According to the TCAS screen separation reduced to 2.5-3.0 nm with100ft difference in altitude. ATC apologised and advised they would be filing a report. The other traffic got a TCAS RA and climbed quickly during the event.

ANSP feedback facilitated by EVAIR

Due to the closure of the RWY 15L, heavy traffic DAB 656 departed from RWY 16R. Medium traffic BAZ 370 departed from RWY 17R and to resolve the conflict between DAB and BAZ the controller stopped the climb of BAZ. Then BAZ was cleared to climb FL80 according to the DAB, whereas the third traffic ROB44MX was cleared to descend to FL70 initially. As the climb of BAZ370 had been delayed, the crew was cleared to climb with no speed restriction, which increased the hazard with the arriving traffic ROB44MX cleared to descend to FL70 initially. The TCAS-RA climb for ROB44MX cancelled the ATC turning instruction and BAZ370 received an avoidance heading and had a TCAS-TA. The ATC involved were interviewed in order to draw attention to the problem and avoid its recurrence.

De-identified ACAS event reported by pilot in 2014

Feb 2014 -Approaching RWY11L the crew requested heading 260 to avoid bad weather. Now, near the LOC, the crew was given heading 210. Intercepting the LOC slightly ahead of the other approaching traffic already established on the ILS for the RWY11R, the crew received a TA and then an RA level off - level off. Being in contact with the ground and having the traffic in sight at all times the crew ignored the RA instructions.

Note: Due to confidentiality reasons all call signs, names of NAV aids, five letters names, RWYs etc. are fictitious.

TCAS RAS COLLECTED AUTOMATICALLY FROM MODE S RADARS

The Automated Safety Monitoring Tool (ASMT) is being used to record and analyse a set of TCAS RAs downlinked by a number of Mode S radars in Europe. The EVAIR Programme monitors RA downlink data from thirteen radars supplied by two ANSPs. **The set of statistics presented in this document has been compiled from data collected over the entire period 2011-2014.** Since the absolute number of RA events differs each year, figures in this document will mainly be presented as percentages in order to reflect the true TCAS performance over time.

Definition	
RA event	A sequence of RAs (i.e. the initial RA and secondary RAs if any) received from an aircraft
Initial RA	First RA of an RA event
Secondary RA	All other RAs of an RA event (i.e. RA received after the initial RA)
Reversal RA	A resolution advisory that reverses the sense of the initial RA (e.g. a Climb RA after a preliminary Descend RA)
Strengthening RA	A subsequent RA that increases the intensity of the preceding RA, e.g. a Climb or Descend RA after a preliminary "Level-off, Level-off" (LOLO) or "Adjust Vertical Speed, Adjust" (AVSA) RA, or an Increase Climb or Descent RA after a preliminary Climb or Descend RA
Weakening RA	A subsequent RA that requests pilots to level-off after the initial Climb or Descend RA once the risk of collision is resolved with the objective of limiting the deviation caused by TCAS to ATC clearances
Own aircraft	As defined within ICAO Annex 10, the aircraft fitted with the TCAS that is the subject of the discourse, which TCAS is to protect against possible collisions, and which may enter a manoeuvre in response to a TCAS indication. In the context of EVAIR, we only consider own aircraft on-board which RAs are triggered
Intruder	As defined within ICAO Annex 10, a transponder-equipped aircraft within the surveillance range of TCAS for which TCAS has an established track. In the context of EVAIR, we only consider intruders against which RAs are triggered
Aircraft	As defined by ICAO, any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface
Aeroplane	As defined by ICAO, a power-driven heavier-than-air aircraft, deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight
1,000ft level-off encounter	Either an aircraft in vertical evolution levelling-off 1,000ft apart from a level aircraft (i.e. a single level-off encounter) or two aircraft in opposite vertical evolution both levelling-off 1,000ft apart from each other (i.e. a double level-off encounter)

High-level findings

The following table provides an average of daily and monthly rates for RA event occurrences for each year since 2011.

Year	Daily RA event rate (average)	Monthly RA event rate (average)
2011	~2	~60
2012	2-3	~80
2013	~3	~90
2014	~3	~90

***Table 1**- Averages of RA events recorded (2011-2014)*

The figures presented in Table 1 show an increase to 2013 in the number of RA events recorded by the EVAIR Programme. This increase is due in part to an increase in radar coverage and traffic since 2011, and also possibly to the improved quality of RA-downlink messages (e.g. fewer empty RA-downlink messages). Indeed, the detection and correction of RA downlink anomalies handled by the EUROCONTROL Mode S monitoring team might have contributed to this improvement. Since 2013, the number of RA events recorded by the EVAIR Programme is stable (no increase in radar coverage).

On average, around three RA events were recorded per day during 2014 in the region covered by the EVAIR Programme, compared to about four in the 2014 summer period (more VFR traffic and more commercial traffic, especially charter flights in the summer season).

Some aircraft were detected as reporting RAs on more than one occasion. The Mode S address was looked at for those reporting on several occasions and the data from 2014 shows that these are mostly military aircraft (it is very rare for commercial aircraft to receive more than one RA in a year). Since military and civil operations are very different, this bulletin adds some statistics on the type of aircraft involved in RA event encounters.

Although military aircraft are not subject to TCAS II mandate (except in Germany), many military aircraft are equipped.

Air Traffic involved in RA events

At the request of our stakeholders, this new chapter is introduced in order to shed more light on occurrences between civil and military traffic in the context of TCAS RAs. The figures below provide the type of air traffic involved in RA events recorded in 2014. For the purpose of the study, the type of air traffic has been split into three different categories:

- **Civil aeroplanes**;
- **Military aeroplanes**; and
- **Helicopters** (both civil and military).

The first figure details own aircraft type, and the second one details the type of intruders for the RA events triggered on-board civil aeroplanes, based on the Mode S address.

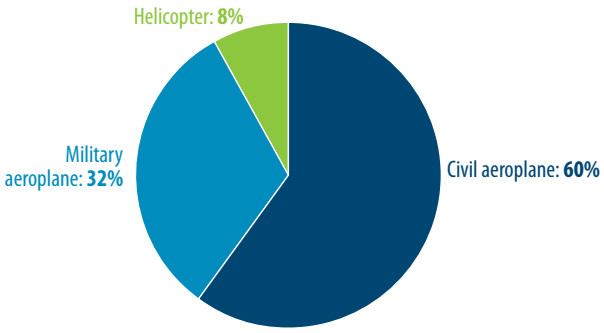


***Figure 39:** Type of own aircraft on which RAs have been triggered (2014)*

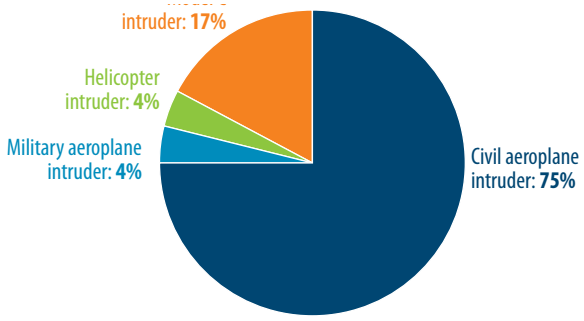


***Figure 40:** Type of intruders having triggered RAs on-board civil aeroplanes (2014)*

These figures show that about 60% of 2014 RA events, as recorded by Mode-S radars, were from civil aeroplanes, about 30% from military aeroplanes whilst the remainder were from helicopters. At least 75% of the RA events recorded from civil aeroplanes were triggered against civil aeroplane intruders. (There is no information of aircraft types for the 17% of Mode C intruders.)

The overall statistics provided in this document reflect RA events involving civil aeroplanes for the most part, but not exclusively. Indeed, a great proportion of RA events also involve military aeroplanes and helicopters.

Note: The statistics provided in this section may significantly vary in different parts of Europe. Therefore, the objective of providing these numbers is to understand the following set of statistics (e.g. the type of RAs triggered and how pilots respond to RAs), which is highly dependent on the type of air traffic and not to provide statistics on the type of aircraft equipped with TCAS in Europe

RA events by flight level band

Distribution by own aircraft type

Continuing the monitoring of TCAS RAs depending on air traffic type, the figure below provides the number of 2014 RA events recorded by flight level band, depending on own aircraft's air traffic type.

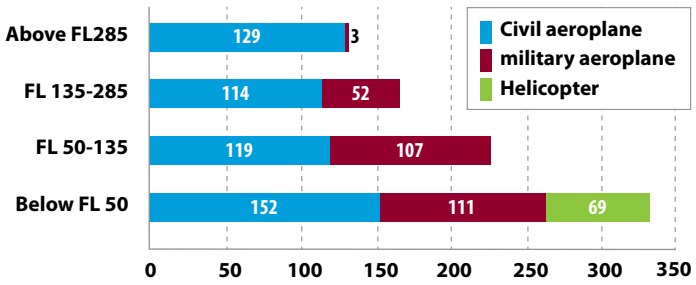


Figure 41: *RA events by flight level band and own aircraft type (2014)*

This figure shows that:

- As expected, RA events recorded from helicopters occurred only below FL50;
- The number of RA events recorded from civil aeroplanes is relatively constant for the four flight level bands; and
- Mainly civil aeroplanes are concerned by the triggering of RAs above FL285.

Distribution by type of intruder equipage

The following figure provides the number of 2014 RA events recorded by flight level band, depending on the type of intruder equipage[1]:

- **TCAS II equipped with a coordinated RA**;
- **Mode S** (i.e. TCAS II equipped without any triggered RAs to a large extent but also Mode S transponder equipped without TCAS); or
- **Mode C** (e.g. VFR or military traffic).

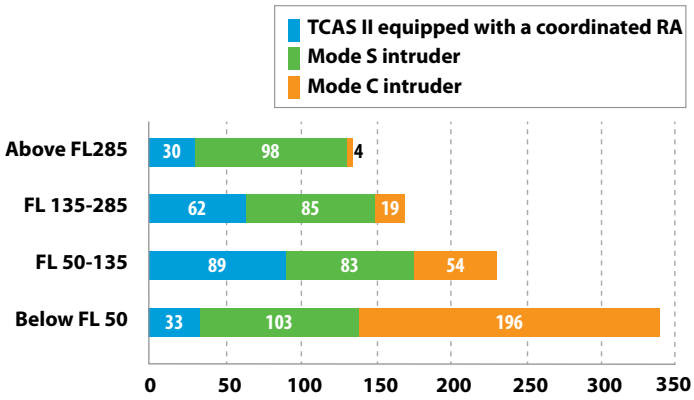


Figure 42: *RA events by flight level band and type of intruder equipage (2014)*

At low levels, the majority of RA events are triggered against Mode C intruders. This is due to IFR/VFR interaction (e.g. 500ft vertical separation and airspace class structure) and some military operations at low altitudes.

[1] *In order to achieve a better match with European operations, the FL band scheme presented in this document has been slightly modified compared to previous safety bulletins*

In a large majority of RA event encounters, only one aircraft out of two receives an RA, even though both are TCAS equipped. Indeed, TCAS does not always symmetrically generate RAs (e.g. in 1,000ft single level-off encounters). A greater number of coordinated RA encounters can be seen in the flight level band FL50-135 in Figure 42 (in blue). Indeed, the crossing of arrival and departure aircraft in vertical evolution (e.g. in 1,000ft double level-off encounters) mainly takes place in this flight level band, which explains the higher proportion of coordinated encounters at these flight levels. These results are in line with the observations for 2011-2013.

Type of RA

In December 2011, the European Commission published Implementing Rule 1332/2011 mandating the carriage of TCAS II version 7.1 within European Union airspace from 1st December 2015 by all aeroplanes with a MTOM exceeding 5700 kg or authorised to carry more than 19 passengers or voluntary equipped with TCAS II . One of the two reasons for developing version 7.1 was the identification of recorded and reported events in which pilots unintentionally responded incorrectly to "Adjust Vertical Speed, Adjust" (AVSA) RAs (i.e. the vertical rate was increased instead of reduced). To prevent incorrect pilot responses, AVSA RAs have been replaced by a new "Level Off, Level Off" (LOLO) RA.

An RA event includes an initial RA (i.e. the first RA triggered on-board own aircraft) and may in some cases include secondary RAs (i.e. all other RAs triggered on-board own aircraft received after the initial RA to weaken, strengthen or reverse the initial RA received). The following sub-sections separate the results by initial versus secondary RAs to provide a better understanding of the full sequence of RAs received during RA events.

Initial RAs

The following figures provide the type of initial RAs recorded in 2014 overall (first figure) and depending on own aircraft type (second figure).

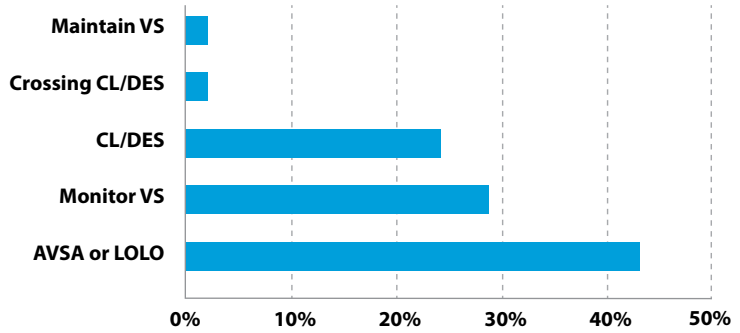


Figure 43: *Initial RAs (2014)*

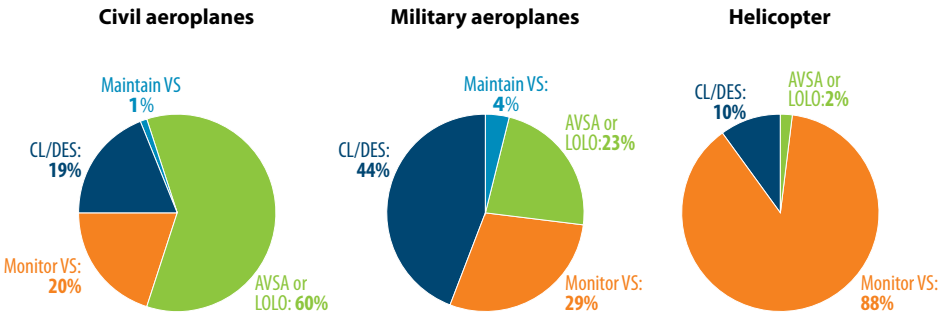


Figure 44: *Initial RAs by own aircraft type (2014)*

EU 1332/2011 does not apply to State aircraft. Those can be equipped with TCAS I, TCAS II version 6.04a, 7.0 or 7.1, unless they operate in German airspacewhere ACAS II (i.e. TCAS II version 7.0 or 7.1 is required).

These figures show that the initial RAs triggered are highly dependent on own aircraft type:

- Civil aeroplanes predominantly receive AVSA or LOLO RAs (e.g. the type of RA typically triggered during 1,000ft level-off encounters);

- Military aeroplanes predominantly receive Climb and Descend RAs (e.g. the type of RA triggered when aircraft are very close); whereas

- Helicopters essentially receive preventive Monitor Vertical Speed RAs (e.g. the type of RA typically triggered during 500ft VFR encounters).

About 80% of the RAs triggered on board civil aeroplanes do not require a deviation from ATC clearance (i.e. AVSA or LOLO, Monitor and Maintain Vertical Speed RAs).

The very great majority of RAs triggered on-board civil aeroplanes are believed to be compatible with ATC clearances (i.e. AVSA / LOLO and Preventive Monitor Vertical Speed RAs). Additionally, RAs requiring aircraft to cross in altitude are very rare.

RAs in 1,000ft level-off encounters

AVSA or LOLO RAs are the great majority of RAs triggered during 1,000ft level-off encounters. A majority of these RAs are perceived as operationally undesired by air traffic controllers and flight crews and could be avoided by complying with the following ICAO Annex 6 recommendation, in force since 2009:

"Recommendation.— Unless otherwise specified in an air traffic control instruction, to avoid unnecessary airborne collision avoidance system (ACAS II) resolution advisories in aircraft at or approaching adjacent altitudes or flight levels, operators should specify procedures by which an aeroplane climbing or descending to an assigned altitude or flight level, especially with an autopilot engaged, may do so at a rate less than 8 m/sec or 1 500 ft/min (depending on the instrumentation available) throughout the last 300 m (1 000 ft) of climb or descent to the assigned level when the pilot is made aware of another aircraft at or approaching an adjacent altitude or flight level."

For information, about 70% of AVSA or LOLO RAs recorded in 2014 were triggered on-board aircraft with vertical rates above 1,500 fpm.

This recommendation is not always ollowed as pilots are not always aware of another aircraft at or approaching an adjacent altitude or flight level. Furthermore, some pilots have reported not being comfortable in modifying autopilot settings when approaching the selected altitude because an erroneous action may lead to an altitude bust while there is another aircraft at or approaching an adjacent altitude.

It should be noted that some operators have introduced a standard operating procedure to always approach the cleared level with a reduced vertical speed (regardless if there is another aircraft at the adjacent level or not). That contributed to the significant reduction of RAs in level-off geometries.

For information, to prevent the triggering of RAs in 1,000ft level-off encounters, an aircraft function exists relying on new altitude capture laws which consist in reducing own vertical speed automatically at the approach of the selected altitude, subject to various conditions, to allow these RAs[4] to be safely removed.

[4] *The EUROCAE ED-224 document provides guidance for designing, installing and testing Flight Guidance System, coupling to TCAS for an automatic vertical speed reduction near altitude target when aware of nearby traffic at or approaching an adjacent altitude or flight level.*

Secondary RAs

Secondary RAs may be split into three different categories:

- **Weakening RAs** (i.e. AVSA or LOLO RAs), requesting pilot to level off after the initial Climb or Descend RA once the risk of collision has been resolved in order to limit the deviation caused by TCAS to ATC clearances;

- **Strengthening RAs** (e.g. Climb or Descend RA after an initial AVSA or LOLO RA, or an Increase Climb (resp. Descent) RA after an initial Climb (resp. Descent) RA) requesting to increase the vertical rate requested by the initial RA; and

- **Reversal RAs** (e.g. Climb RA after a Descend RA or vice versa) requesting to manoeuvre in the opposite direction to the initial RA.

In this section, only statistics concerning civil aeroplanes will be presented since statistics on secondary RAs on-board military aeroplanes cannot be easily analysed. Indeed, more secondary RAs are triggered on-board military aeroplanes as these include deliberate non-compliance to RAs. Only about 15% of RA events triggered on-board civil aeroplanes include secondary RAs, compared to about 40% for military aeroplanes).

The following figure sets out the secondary RAs triggered on-board civil aeroplanes in 2014.

On-board civil aeroplanes, only 15% of RA events include secondary RAs, with 85% of these being weakening RAs.

Reverse and Increase RAs are very rare and represent less than 3% of the secondary RAs triggered on-board civil aeroplanes.

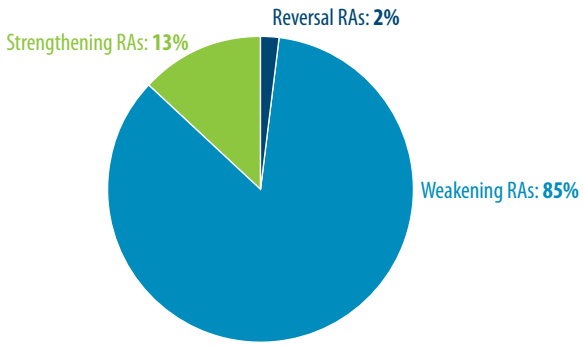


Figure 45: *Secondary RAs triggered on-board civil aeroplanes (2014)*

Pilot response to RAs

For the purpose of the study, pilot responses to RAs have been split into three different categories:

- **Followed**, i.e. the pilot responded to the RA as intended by TCAS;
- **Excessive**, i.e. the pilot responded to the RA but by unnecessarily exceeding the vertical rate requested by TCAS; and
- **Not followed**, i.e. the pilot either continued without modifying the aircraft trajectory or started to initiate a manoeuvre but too slowly to achieve the vertical rate requested by TCAS.

Note: Pilot responses to RAs are not easy to assess as the initial trajectory (i.e. in the hypothesis that no RA was triggered) is unknown and so the deviation created by following (or not) the RA is difficult to measure. Therefore, there are limitations in the calculations performed to classify each RA event into one of these categories. Nevertheless, these limitations were analysed and allow a satisfying overall vision of pilot responses to RAs in Europe.

Pilot response to Initial RAs

The safety benefits provided by TCAS are highly dependent on pilot responses to RAs.

The following figure provides information concerning pilotresponses to initial RAs (overall types of aircraft) for 2011-2014

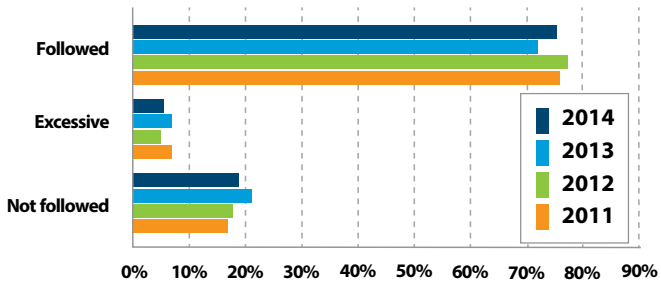


Figure 46: *Pilot response to initial RAs (2011-2014)*

The results obtained on 2014 year period are in line with those from 2011 to 2013 with about **75% of the pilots achieving the requested vertical rate**, 5% exceeding it and 20% not following the requested RA.

For information, most of the incidents involving opposite responses concern military aeroplanes.
The following figure provides the type of pilot response to initial RAs recorded in 2014, depending on own aircraft type.

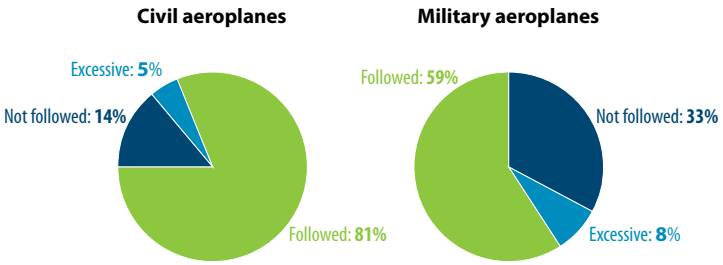


Figure 47: *Pilot response to initial RAs by own aircraft type (2014)*

Some 14% of initial RAs are not followed by pilots of civil aeroplanes.
We would highlight that, if maximum safety benefits are to be achieved from TCAS II, pilots must follow all RAs promptly and accurately in accordance with ICAO PANS-OPS Doc 8168.

For information, to help further enhance compliance with RAs, and thus safety, there is an aircraft function which carries out automatic responses to RAs[5].

[5] *The EUROCAE ED-224 document provides guidance on designing, installing and testing Flight Guidance System coupling to TCAS for Automatic guidance (Autopilot) and/or display cues to support pilot guidance (Flight Director) upon RAs. Such a function enables an automatic and accurate response to the RA.*

Example of an automatic response to an RA

The following figure provides an example of an actual RA event as recorded in the EVAIR database. It involves two TCAS II equipped aircraft: one aircraft climbing and levelling off at FL390 and another one level at FL400. The level aircraft is an Airbus A380 equipped with an autopilot TCAS RA mode (i.e. automatic response to RAs). They are in horizontal collision course with a minimum distance of 1NM at closest point of approach. As the aircraft are converging both horizontally and vertically, both aircraft receive RAs. The climbing aircraft receives a LOLO RA and the level aircraft receives a Climb RA. This Climb RA is followed automatically by the autopilot TCAS RA mode. The radar data shows a constant climb at 1,650 fpm. When the Clear of Conflict is triggered the autopilot TCAS RA mode returns to the initial flight level (i.e. FL400). This is one of the first cases identified of a recorded automatic response to an RA within the EVAIR Programme.

The following figure provides an illustration of the vertical profile on the left side and of a generic TCAS II RA display during the automatic response to the Climb RA on the right side.

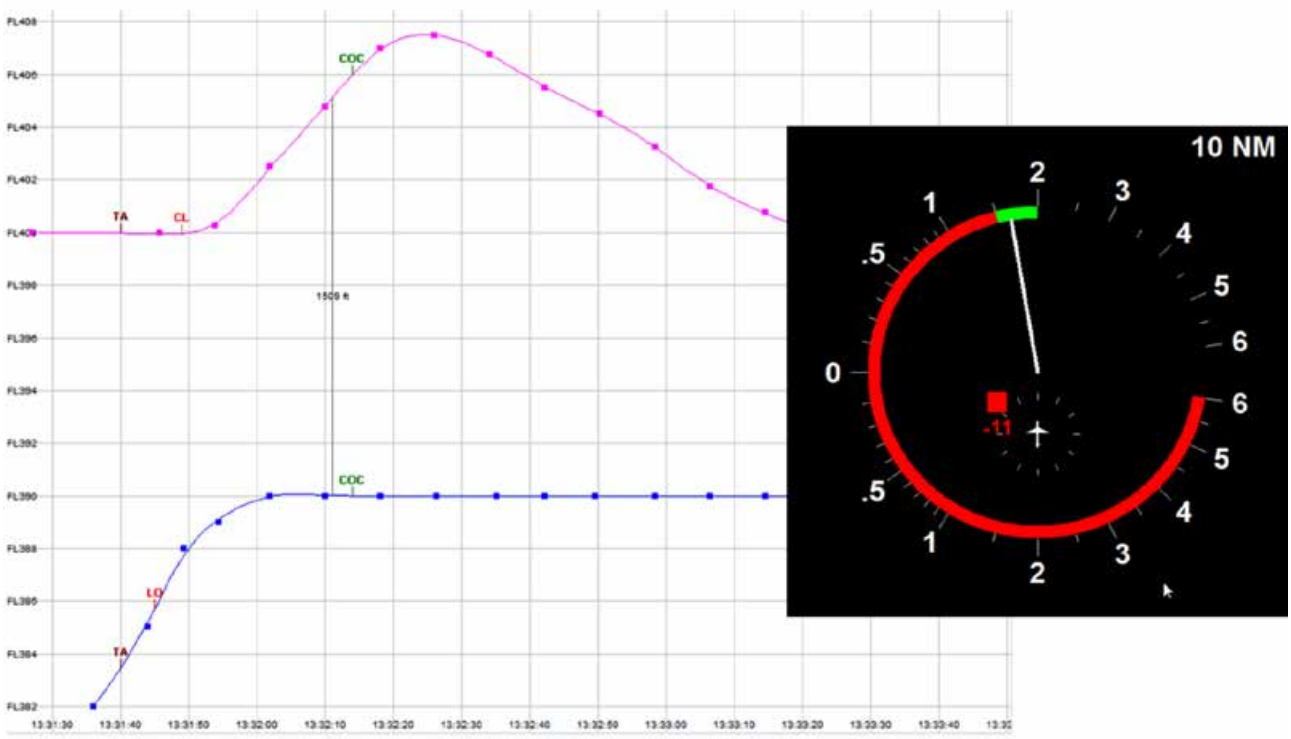


Figure 48: *Example of an automatic response to an RA (actual RA event)*

Note: The TCAS II RA display is provided for information only. It does not correspond to actual implementation on-board Airbus A380.

Pilot response to secondary RAs

In this section (as in the section on secondary RAs) only statistics concerning civil aeroplanes are presented. The figure below shows pilot response to secondary RAs triggered on-board civil aeroplanes in 2014.

Compliance with secondary RAs is not as good as for initial RAs, with almost 30% of secondary RAs not followed by pilots.

These figures should serve to emphasise the need for pilots to be trained to follow the full sequence of RAs they receive, including weakening RAs (to minimise the vertical deviation and avoid the resultant risk of collision with a third aircraft).

ICAO PANS-OPS Doc 8168 states that *"Pilots shall promptly comply with any modified RAs"*.

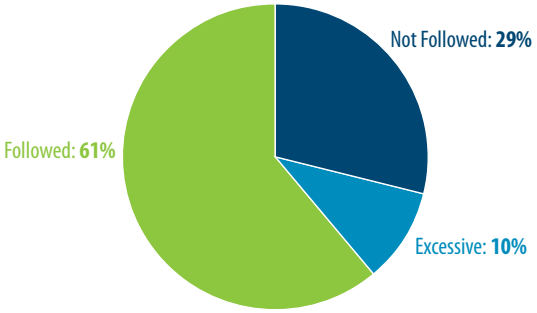


Figure 49: *Pilot response to secondary RAs on-board civil aeroplanes (2014)*

Hybrid Surveillance False RAs

Since 2012 a number of European ANSPs reported instances of false TCAS RAs that have occurred in their airspace. The common factor in these events is that the RA receiving aircraft is fitted with TCAS II version 7.1 with the hybrid surveillance function. The hybrid surveillance function has been introduced together with version 7.1 in order to reduce active interrogations and RF pollution.

The RAs are triggered when two aircraft are crossing at the same level, or in vertical convergence, but the conditions for RA generation are not met and ATC standard horizontal separation is assured. Typically, the unexpected RA is generated only on the 'front' aircraft against an aircraft that is crossing between 5 to 7 NM behind it.

In all reported cases, there has been no erosion of horizontal separation or possible risk of collision between the two aircraft at the time when the RA was issued. In the majority of cases, the pilots have, quite properly, followed the RA instructions. Whilst this is correct, from an air traffic management viewpoint the manoeuvres disrupt the flow and increase cockpit and ATC workload; they may also cause follow-on conflicts, especially in congested airspace when adjacent flight levels are often occupied. Reported vertical deviations were as much as 1200 feet and an average RA last 25 seconds.

Altogether, 67 cases have been recorded, 25 of them in the first six months of 2015. Manufactures, EASA and FAA are aware of the problem and a technical solution is sought.

ANNEX 1 – EUROPEAN ACTION PLANS

EUROPEAN ACTION PLAN FOR AIR-GROUND COMMUNICATIONS SAFETY

The Air-Ground Communication (AGC) Safety Improvement Initiative was launched by the EUROCONTROL Safety Team in 2004, and is addressing communication issues identified in the Runway Incursion and Level Bust Safety Improvement Initiatives as well as other issues of concern, such as call sign confusion, undetected simultaneous transmissions, radio interference, use of standard phraseology, and prolonged "Loss of communication". Communication between air traffic controllers and pilots remains a vital part of air traffic control operations, and communication problems can result in hazardous situations. A first step towards reducing the incidence of communication problems is to understand why and how they happen. The Action Plan is available on the ALLCLEAR Communication Toolkit

http://skybrary.aero/index.php/Solutions:ALLCLEAR

THE EUROPEAN ACTION PLAN FOR THE PREVENTION OF LEVEL BUST

Reducing Level Busts is one of EUROCONTROLs highest priorities. EUROCONTROL began raising awareness of the Level Bust issue in 2001, organised a series of workshops, and established a Level Bust Task Force to define recommendations and formulate an action plan to reduce Level Busts.

The Level Bust action plan is the product of work carried out by EUROCONTROLs cross-industry Level Bust Task Force, which was set up in 2003. The Task Force reviewed the evidence available, identified the principal causal factors, and listened to the Air Navigation Service Providers and aircraft operators with experience in reducing Level Busts.

The Action Plan contains recommendations for Air Traffic Management, Air Traffic Controllers, and Aircraft Operators. It is designed to reduce the frequency of Level Busts and reduce the risks associated with Level Busts. Implementation of the Action Plan will be monitored by the Task Force monitoring group reporting to the EUROCONTROL Safety Improvement Sub Group (SISG).

http://www.eurocontrol.int/safety/public/standard_page/Level_bust.html

THE EUROPEAN ACTION PLAN FOR THE PREVENTION OF RUNWAY INCURSIONS (EAPRI)

The number of runway incursion reports is on the rise. Accidents continue to take place on runways. Findings from those incidents and accident reports have been used to determine the new recommendations contained in the updated European Action Plan for the Prevention of Runway Incursions.

The increasing availability of runway incursion incident reports is a positive indication of the commitment of organisations and operational staff to prevent runway incursions and runway accidents by learning from past accidents and incidents and sharing this information across Europe.

The new recommendations contained in the Action Plan are the result of the combined and sustained efforts of organisations representing all areas of aerodrome operations.

The organisations that contributed to this action plan are totally committed to enhancing the safety of runway operations by advocating the implementation of the recommendations that it contains. These organisations include, but are not limited to, Aerodrome Operators, Air Navigation Service Providers, Aircraft Operators, and Regulators.

http://www.eurocontrol.int/documents/european-action-plan-prevention-runway-incursions

CALL SIGN SIMILARITY (CSS)

The European Action Plan for Air Ground Communication Safety (conceived inter alia by EUROCONTROL, aircraft operators (AOs) and the Flight Safety Foundation) identified call sign similarity (CSS) as a significant contributor to air-ground communication issues. Analysis of ATC reported events shows that 5% involve incidences where CSS is involved. Some aircraft operators are trying to find solutions, but the only ANSP known to be actively operating a service to de-conflict call signs is France's DSNA.

Research and CBA studies show that the most cost-efficient way of providing a long-lasting, Europe-wide solution is to create a central management service to de-conflict ATC call signs. This strategy provides economies of scale and rapid pay back of investment (3 years). More importantly, it is calculated that it will eliminate over 80% of CSS incidents and thus improve safety.

http://www.eurocontrol.int/documents/european-action-plan-prevention-runway-incursions

ANNEX 2 – DEFINITIONS

Following definitions are extracted from the HEIDI and/or HERA Taxonomies.

HEIDI

(Harmonisation of European Incident Definitions Initiative for ATM) intends to finalise a harmonised set of definitions (taxonomy) for ATM related occurrences.

More information can be found at:
http://www.eurocontrol.int/articles/esarr-2-reporting-and-assessment-safety-occurrences-atm

HERA

(Human Error in European Air Traffic Management) develops a detailed methodology for analysing human errors in ATM, including all error forms and their causal, contributory and compounding factors.

More information can be found at:
http://www.eurocontrol.int/articles/esarr-2-reporting-and-assessment-safety-occurrences-atm

DEFINITIONS

ATC clearance/instruction (HEIDI):

Related to incorrect aircraft action. Authorisation for an aircraft to proceed under conditions specified by an air traffic control unit and deviations from the clearance which cause runway incursions, taxiway incursions, apron incursions, Level Busts, unauthorised penetration of airspace etc.

Coordination (HEIDI):

Internal coordination encompassing coordination with sectors within the same unit and sectors within the ATC suite, external coordination, civil/civil and civil/military and special coordination, covering expedite clearance, prior permission required, revision and other special coordination.

Contributory factors (HEIDI):

A part of the chain of events or combination of events which has played a role in the occurrence (either by facilitating its emergence or by aggravating the consequences thereof) but for which it cannot be determined that the course of events would have been altered if it had not arisen.

Decision-Making (HERA):

incorrect/late decision or complete failure to make a decision

Failure to Monitor (HERA):

failure to monitor people, information or automation

Judgement (HERA):

mainly associated with separation

Lapses (HEIDI):

Psychological issues encompassing the receipt of information, identification of information, perception of information, detection, misunderstanding, monitoring, timing, distraction, forgetting and loss of awareness.

Level Bust (HEIDI):

Any unauthorised vertical deviation of more than 300 feet from an ATC flight clearance departing from a previously maintained FL, overshooting, undershooting, levelling-off at a level different to the cleared level.

Mental/Emotional/Personality issues (HERA):

Include the following items:

- Mental capacity: loss of picture or safety awareness
- Confidence in self, in others, in information, in equipment, in automation
- Complacency
- Motivation/morale
- Attitudes to others
- Personality traits: aggressive, assertive, under-confident, risk taking
- Emotional status: stressed, post incident
- Misplaced or insufficiently learned information
- Planning: insufficient, incorrect or failed
- Recall of information: troubled, inaccurate, rare information, past information
- Violations: routine, exceptional

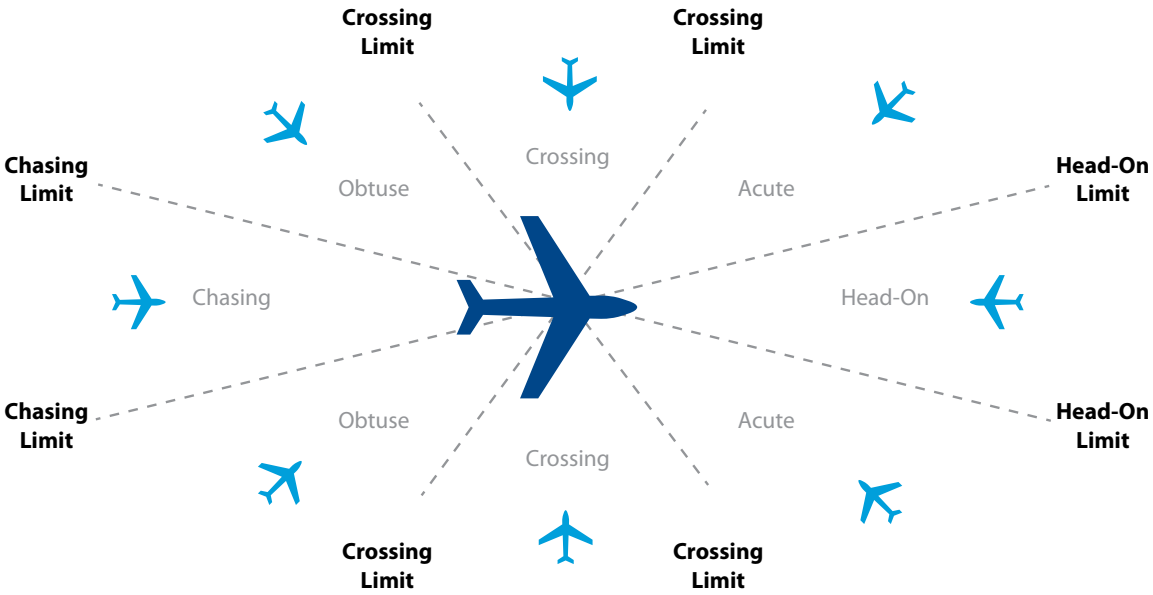
Mistakes (HEIDI):

Psychological issues encompassing information wrongly associated, workload issues, information not detected, failure to monitor, recall of information, misunderstanding or insufficiently learned information, judgement, planning, decision making, assumptions and mind-set.

Operational communication (HEIDI):

Air-Ground, Ground-Ground and use of equipment verification testing. Air-Ground communication encompasses hear back omitted, pilots read back, standard phraseology, message construction, R/T monitoring including sector frequency monitoring and emergency frequency monitoring, handling of radio communication failure, unlawful radio communications transmission. Ground-Ground communication refers to the standard phraseology, speech techniques, message construction, standard use of equipment such as radio frequency, telephones, intercoms etc.

RA geometry between two Aircraft (ASMT)



Runway Incursion (ICAO):
Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.

Spoken communication (HEIDI):
Human/human communication, encompassing air-ground and ground-ground communications but also call sign confusion, noise interference and other spoken information provided in plain language. Air-ground communication refers to language/ accent, situation not conveyed by pilots, pilots breach of radio telephony (R/T), workload, misunderstanding/misinterpretation and other pilot problems. Ground-ground communication refers to misunderstanding/misinterpretation, poor/no coordination.

Taxiway Incursion (HEIDI):
Any unauthorized presence on a taxiway of an aircraft, vehicle, person or object that creates a collision hazard or results in a potential loss of separation

Traffic & Airspace problems (HEIDI):
There are four set of causal factors under this element

- **Traffic load & complexity**, encompassing excessive and fluctuating load, unexpected traffic demand, complex mix of traffic, unusual situations (emergency, high risk, other), abnormal time pressure, under load and call sign confusion
- **Airspace problems** composed of flights in non-controlled and controlled air space, airspace design characteristics (complexity, changes, other) and temporary sector activities (military, parachuting, volcanic activity, training)
- **Weather problems** such as poor or unpredictable (snow, slush, ice, fog, law cloud, thunderstorm, wind shear)
- **Pilot problems** concerning language, culture and experience aspects.

Traffic Information (HEIDI):
Essential and local traffic information provided by an air traffic controller to the pilot. Essential information is related to the provision of traffic information containing:

a) direction of flight of aircraft concerned;

b) type and wake turbulence category (if relevant) of aircraft concerned;

c) cruising level of aircraft concerned; and

d) estimated time over the reporting point nearest to where the level will be crossed; or

e) relative bearing of the aircraft concerned in terms of the 12-hour clock as well as distance from the conflicting traffic; or

f) actual or estimated position of the aircraft concerned.

Local traffic in this context consists of any aircraft, vehicle or personnel on or near the runway to be used, or traffic in the take-off and climb-out area or the final approach area, which may constitute a collision hazard to the other aircraft and about which the information has to be provided.

Workload issues (HERA):
Concern both minimal and excessive workload

ANNEX 3 – ACRONYMS

ACAS	Airborne Collision Avoidance System
ANSP	Air Navigation Services Provider
AO	Aircraft Operator
AP/FD TCAS	Automatic guidance (Autopilot - AP) and/or display cues to support pilot guidance (Flight Director - FD) upon Resolution Advisories – defined within ED-224 MASPS
ASMT	ATM Safety Monitoring Tool
ASR	Air Safety Report
ATC	Air Traffic Control
ATM/CNS	Air Traffic Management/Communication, Navigation, Surveillance
CSC	Call Sign Confusion
CSS	Call Sign Similarity
CSST	Call Sign Similarity Tool
ECAC	European Civil Aviation Conference
ELFAA	European Low Fare Airlines Association
ERAA	European Regional Airlines Association
EUROCAE	European Organisation for Civil Aviation Equipment, a non-profit organisation dedicated to aviation standardisation including MOPS for TCAS
EVAIR	EUROCONTROL Voluntary ATM Incidents Reporting
FL	Flight Level
GSIC	Global Safety Information Centre
HEIDI	Harmonisation of European Incident Definitions Initiative for ATM
HERA	Human Error in European Air Traffic Management
IACA	International Association of Charter Airlines
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization

[6] *MASPS are focused on systems (which can be implemented by different equipment) while MOPS are focused on the equipment itself*

IFR	Instrument Flight Rules
LAN	Local Area Network
MASPS[6]	Minimum Aviation System Performance Specification
Mode C	Altitude Reporting Mode of Secondary Radar (ICAO)
Mode S	SSR selective mode of interrogation
MOPS[3]	Minimum Operational Performance Standards
NM	Network Manager
OPS	Operations
PAN-OPS	Procedures for Air Navigation - Operations
RA	Resolution Advisory
RF	Radio Frequency
RTCA	A United States volunteer organization that generates minimum performance standards for CNS/ATM systems and equipment, including MOPS for TCAS
RPAS	Remotely Piloted Airborne Systems
SARPS	Standard And Recommended Practices
SISG	Safety Improvement Sub-Group
STEADES	Safety Trend Evaluation and Data Exchange System
TCAS	Traffic Collision Avoidance System
TA	Traffic Advisory
TCAP	"TCAS Alert Prevention". Altitude capture laws to prevent RAs during level-off encounters – defined within ED-224 MASPS
VFR	Visual Flight Rules
WT	Wake Turbulence