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FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL

Cross Border Area Safety Assessment Overview

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Abstract

This document aims at providing an overview of a Cross Boarder Area safety case build up. It also aims at facilitating CBA safety case development by providing generic supporting material derived from practical experience with two EUROCONTROL States.

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EXECUTIVE SUMMARY

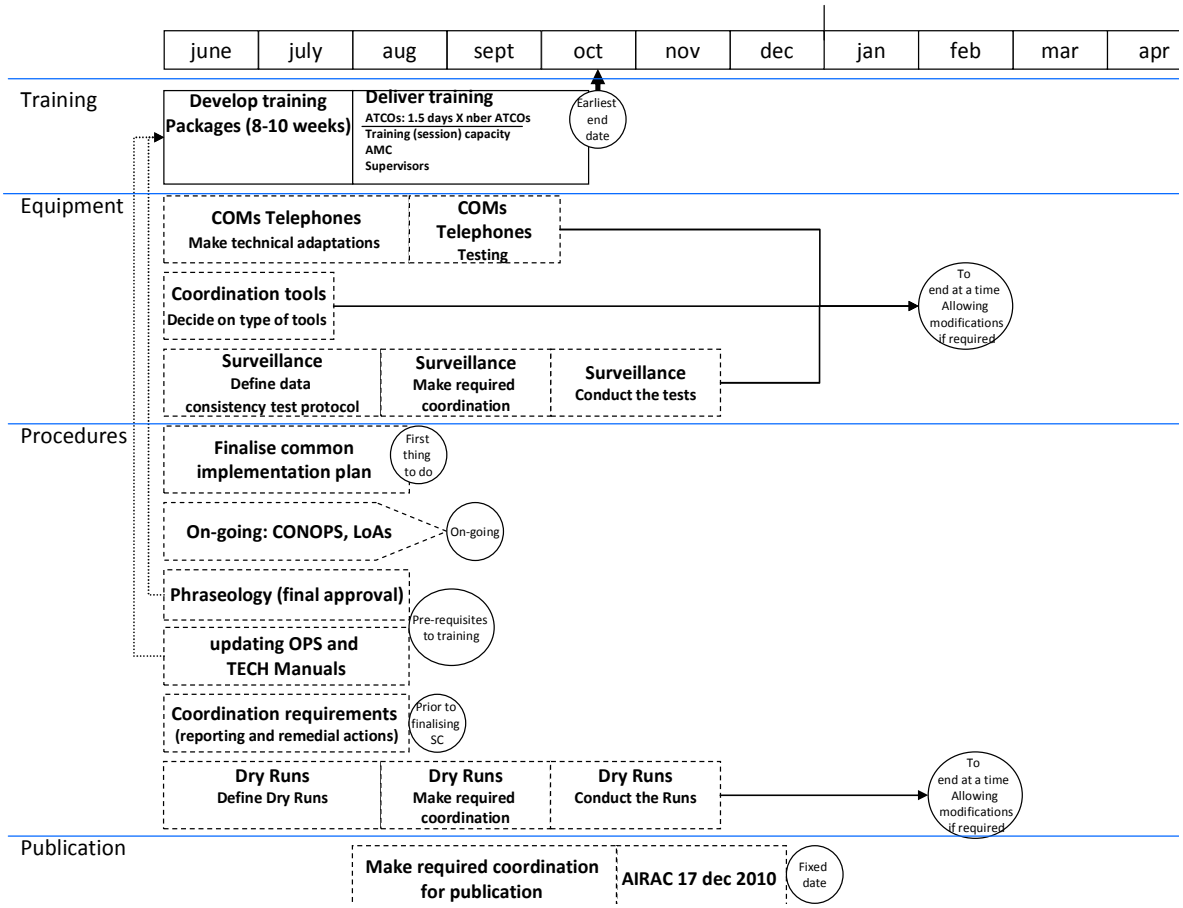
This document aims at providing an overview of a Cross Boarder Area safety case build up. It also aims at facilitating CBA safety case development by providing generic supporting material derived from practical experience with two EUROCONTROL States.

1. AIM

Based on the CBA safety case carried out in between two EUROCONTROL States, this document intends to describe a generic approach to be followed for the build up of a CBA safety case.

2. INTRODUCTION

Implementing a CBA is a rather complex project as can be seen on this example of work plan for CBA implementation.[1]



[1] Note that the institutional issues are not addressed here i.e. States agreements and NSAs agreements

3. CONCEPT OF OPERATIONS

This is the first step as it is the material that is to be assessed.

The Concept of Operations can be defined as the overall idea, based on the need to implement an area to accommodate military activities.

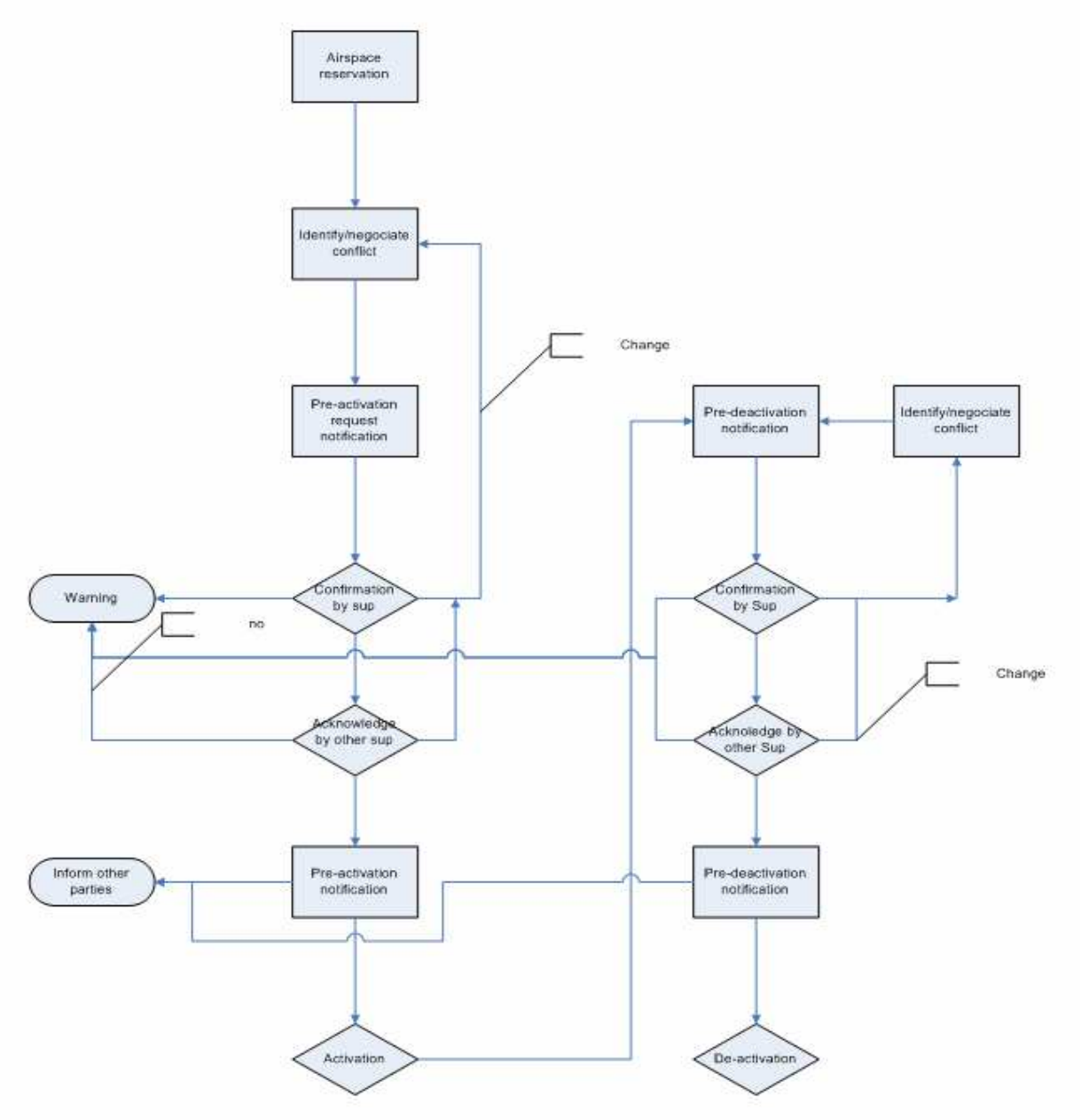
The Concept of Operations[2] details the way the OPS Concept is to be operated at a given place. It therefore describes in details the requirements related to:

- Airspace: the planned CBA;
- Procedures: basically FUA procedures adapted to the OPS concept and the partners involved;
- Equipment: COM, SUR, airborne and possibly NAV, and;
- Human: include operational staff from concerned civil ANSPs, military Control and military pilots.

Some issues to bear in mind:

- With regards airspace, it should be taken into consideration that ICAO does not recognise the concept of reserving airspace over international waters.
- FUA procedures are central to the CBA implementation and in particular with regards the pre-tactical and tactical phases as during these phases only one AMC should be dealing with all interfaces for activation/de-activation of the CBA mainly. The FUA procedures are rather complex, it is therefore highly recommended to use flow charts for both design and assessment of the procedures. (see example below).
- Flow charts are exclusively aimed to all participants to better understand concept of operations and to have a common and unified understanding of how to use CBA. Charts also can be used to evaluate process during the testing of all branches to ensure whether there is a possibility of a errors that would lead to the new hazard. Common understanding of CONOPS of all participants, from the time when request for allocation has sent until CBA is dectivated, will help to reduce the possible hazard.

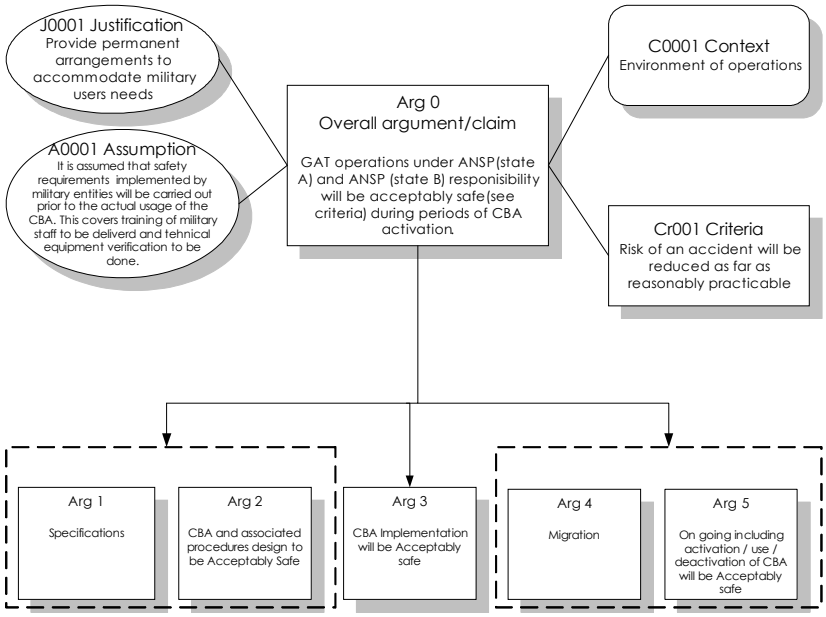
[2] See Annex example of CBA Concept of Operations table of Content



Flow charts for adapted FUA procedures

4. SAFETY CASE STRUCTURE/ARGUMENT

4.1 Safety Case Approach



Important note: The whole safety case proposed as example uses a criteria that may be specific to this implementation. It is argued that operations will be at least as safe as prior to the implementation of the CBA in comparison with a situation where ad-hoc procedures were setup to accommodate the exercises that will be accommodated by the CBA.

It would be totally different case should no military activity have taken place prior to the implementation of the CBA.

5. SAFETY CONSIDERATIONS

Once the Concept of Operations is mature a safety consideration session should be carried out with the purpose to identify all issues that may be brought up by the implementation of the CBA.

See Annex 2 for a description of the Safety Consideration process.

6. OHA SESSION

6.1 Methodology

As any hazard identification and classification this is basically a structured brainstorming session. Note that hazards are identified at operations level (see below).

During brainstorming session any existing historical data (mil area penetration, mil aircraft excursion, emergency descents etc...) should be used. All data can be use only if the validation process under data has already done before.

Refer to Annex 3 for more details.

6.2 Hazards

6.2.1 Hazard Identification

Hazards are generic and shown below. What may differ, although slightly are the causes that underline these hazards. As described in the methodology (Annex 3) the likelihood of the causes to occur determine the likelihood of the hazard to materialise.

Two main categories of hazards were identified with regards to the feared event which is the loss of separation between participating and non-participating aircraft:

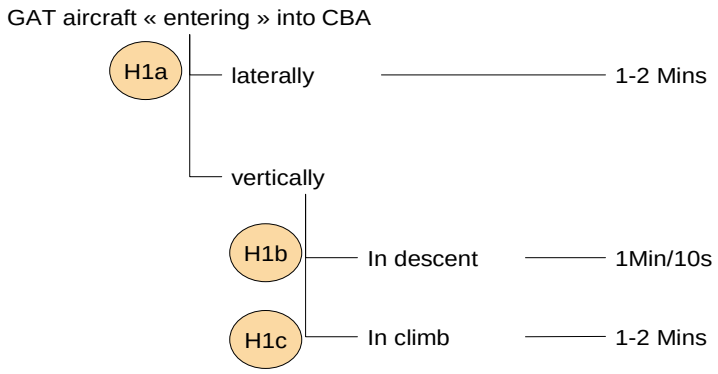
- Non - participating traffic incursion into a CBA; and
- Participating aircraft[3] excursion from the CBA.

In both hazards the incursion respectively excursion can take place through the sides of the CBA, the top or the bottom.

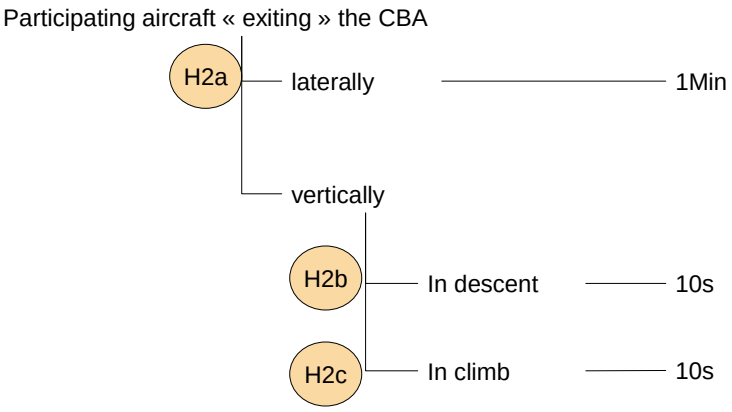
Having regards aircraft performances and typical trajectories the two main hazards differ slightly for what concerns the time from start of hazard developing to possible feared event i.e. the actual loss of separation.

[3] Means aircraft using or intending to use the CBA

This is reflected in the two graphs below:



Hazard 1 “incursion” into CBA by non - participating aircraft



Hazard 2 “excursion” out of CBA by participating aircraft

Note: Cases where an excursion/incursion takes place through the side of the CBA and whether the aircraft is levelled or in climb or in descent are considered equivalent.

Important note: Hazards related to the joining/leaving the CBA may or may not be accounted for here. This is depending on the Concept of operations e.g. the “national procedures” but

also whether it is envisaged that an aircraft from air force A may join the CBA from state A and leave the CBA to State B.

Hazard Numbering System

H1a1			
H1	Non participating aircraft		
	a	Lateral incursion	
		1 to x	Numbering based on causes

Hazard numbering system

6.2.2 Hazard Classification

See note in Annex 3 about risk classification.

To classify hazard, the following template may be used so as to take account of all internal and external mitigations (and identification of the need for further mitigation) that will determine ultimately the likelihood of consequences of hazards to materialise.

Hazard id	Hazard description	Hazard causes/origin	Ph of hazard occurring qualitative	Ph of hazard occurring quantitative	Internal/external mitigations	Pe hazard effect qualitative	Pe hazard effect quantitative	Severity classification	comments
H1a1	Lateral deviation by GAT aircraft due to Civil ATC lack of coordination leading to CBA incursion	The missing coordination may be either a required coordination to cross through an activated CBA (only possible in State A) or; A tactical coordination required due to air traffic situation circumstances e.g. aircraft forgotten on heading which brings the aircraft into the CBA ATS-route that has not been closed due to CBA operations and tactical re-routing is not provided by the ATC.	Rare	10^{-4}	CBA areas are displayed at ATCO radar screens FC detection	Occasional	10^{-3}	3	

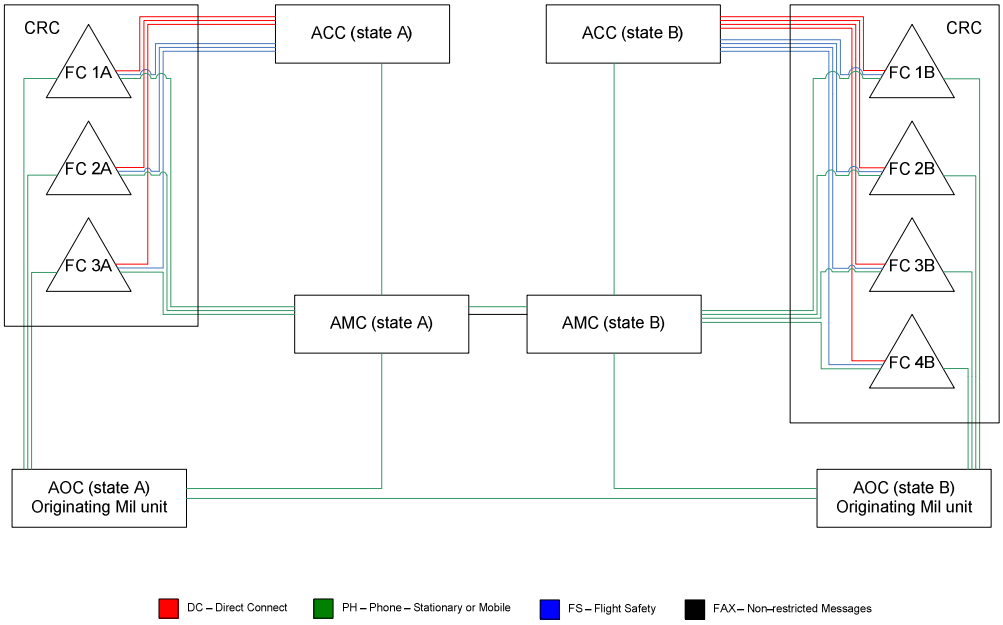
7. OTHER ACTIVITIES

Whether that would be identified/confirmed by the Safety Consideration session, the following items should be addressed in implementing a CBA.

7.1 Equipment Related

- COM Plan: It should be established to ensure that all requirements for communications GND/GND and AIR/GND are satisfied (see ICAO requirements for e.g. adjacent radar controllers).

Example of a COM Plan



- Surveillance: It should be verified that the different surveillance means used by the different partners actually display the targets with an acceptable bias. This may include the Airborne equipment i.e. where aircraft “see” themselves in comparison with ground radar displays.

7.2 Human Related

Training as identified during safety activities should be delivered prior to implementation e.g. English language proficiency (related to example about coordination below).

7.3 ATC Procedures

Safety considerations may have revealed the need for harmonisation of some ATC procedures e.g. coordination procedures especially between partners that have not been coordinating with each other before Civil ANSP State A with Air Force State B.

Annex 1: Example of a Table of Contents – CBA Concept of Operations

Annex 2: How to Run the Safety Consideration Process

To run the Safety Consideration process, use the Excel spread sheet, then follow the instructions.

How to Use the Spreadsheet

Keep in mind what the change is all about; in the example given, the change is the introduction of radar service at an airport where procedural control was provided until now.

Then scan systematically all the fields (and possibly identify missing fields that are specific to your environment) to

- describe the current situation - Then fill in the column “Current operations”

and subsequently ask yourself the following questions:

- Are there functional requirements? (e.g. need for additional frequencies or additional telephone lines)- i.e. description of the future situation - Then fill in the column “Future operations”;
- Are there any safety requirements related to these functional requirements? (e.g. how critical are the telephone lines? - And/or - are possible mitigations e.g. procedures?) - Then fill in the column “Impact on Safety Assessment”;
- how much of a gap does this presents compared to the existing situation (in the example where additional telephone lines are needed, this is not a technical revolution) - Then fill in the column “Gap”, possibly the column “Impact on Safety assessment” is updated as well;
- then ask yourself how these functions are going to be used and what training may be needed for staff to operate them - Then fill in the column “Training Gap/objectives”.

At the end of the exercise:

- the column “Impact on Safety assessment” provides for a list of activities and potential evidence that will feed the Initial Safety Argument (see below) to produce the Safety Plan.
- the column “Current operations” and “Future operations” provide for a good starting for the description of differences between the two which support the comparative exercise required when relative criterion is used.
- The column “Gap” provides good indication as the magnitude of the change i.e. one that requires full formal assessment or not.
- The column “Training gap/objectives” provides basis for setting-up the required training which in turn provides for backing evidence for the safety case.

Annex 3: Risk Classification

Important note: the risk classification table should not be used as such, it should be agreed with your regulator prior to commencing the OHA.

Note: Radar based safety nets were not accounted for as mitigations (as per regulatory provisions) on the other hand Flight Plan based warnings are used as mitigations as they are considered to be ATCO tools rather than safety nets.

The SMS in either state is limited to the boundary of the states and does not allow for the assessment of safety processes in the other state. The procedures applied for hazard mitigation will be limited to the procedures in the particular state. Nevertheless a common OHA has been performed in order to have a common understanding among the involved parties. This will provide a common "pool" of hazards, with assessed probabilities and severities, to be evaluated in both states.

The actual risk classification is consequently dealt with in the National Safety Cases.

To establish probability and severity of a hazard, the following procedure was applied (Note that this classification was done for the purposes of the OHA session and will not be used as is in the national safety assessments):

- From identified hazard, identify possible causes; for each cause(s), assess the possible rate of occurrence of these causes which give **Ph** the probability of the hazard to exist;
- Then assess the **severity** of the worst credible consequence of the hazard; and finally;
- Identify internal/external mitigations that could apply and assess the efficiency to determine **Pe** the probability of the hazard effect to actually exist;
- The probability of the hazard to actually result in a loss of separation of the severity of the worst credible consequence is therefore **P = Ph x Pe.**
    - ❖ Note 1:"Hazard causes/origin" will be further elaborated in the national safety assessments.
    - ❖ Note 2:"Ph" will be adjusted in the national safety assessments, as required, where sufficient applicable statistical data is available
    - ❖ Note 3:"Internal/external mitigations" will be further elaborated in the national safety assessments.
    - ❖ Note 4:As a result of 1 – 3 above, "Pe" is subject to further evaluation in the national safety assessments.

This is described in the diagrams below.

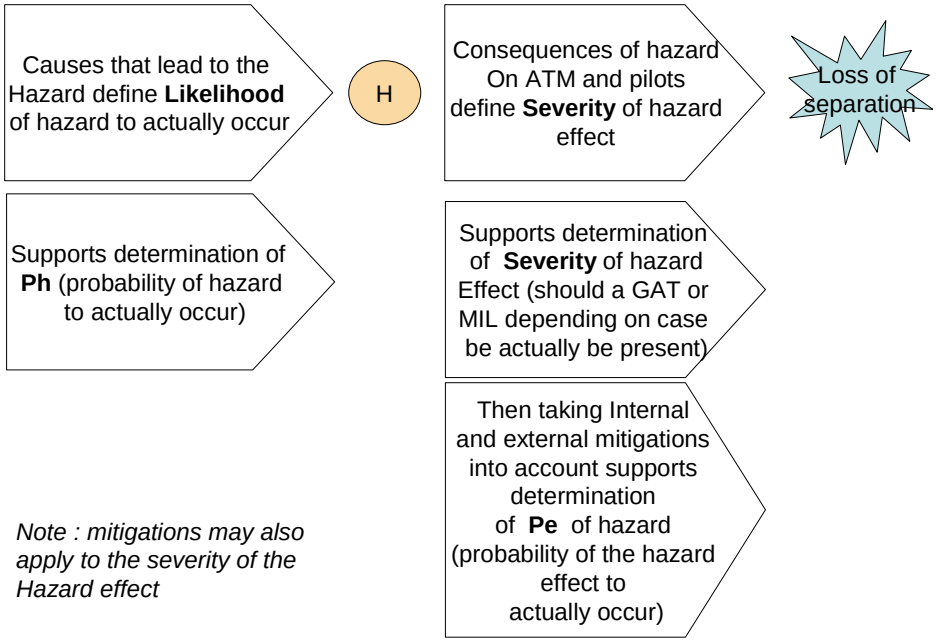


Figure 1-Hazards and causes

Participants to the OHA have expressed their expert judgement about Ph and Pe in qualitative terms e.g. rare, occasional.

To allow the **P = Ph x Pe** calculations these qualitative evaluations have been transposed in to quantitative figures in terms of occurrence rate per operational hours (see also Table 1 below):

- 10^{-5} means an occurrence per 100 thousand hours i.e. per 10 year (see however below §3.2.1 interpretation to be made of that figure)
- 10^{-4} means one occurrence per 10 thousand hours i.e. per year
- 10^{-3} means one occurrence per month
- $5x10^{-3}$ means one occurrence per week
- $3x10^{-2}$ means one occurrence per day

Then **P** was translated back into qualitative terms using the same table.

Note: Operational hours have been retained for calculations; nevertheless the fact that the CBA is not operated all year long is taken into account in the following way:

- *for what concerns incursion of GAT into the CBA, the frequency of such occurrence actually depends on the CBA being activated or not. It was not accounted for this additional condition when classifying hazards, thus the classification of hazards H1 is conservative (higher predicted frequency of occurrence than can be expected) ; and*
- *for what concerns OAT aircraft making an excursion out of the CBA, the military experts judgement values provided at the OHA session (for H2 hazards) necessarily refer to a*

global yearly activity taking the average TSA/TRA activity periods. Therefore judgements can be considered as expressed on a yearly basis.

It is to be noted that the use of the unit “frequency of occurrence per operational hours” provides a very conservative assessment in particular having regards the GAT traffic levels concerned with the implementation of CBA. However this also reflects the low GAT traffic levels affected by both CBA.

Qualitative definition	Frequency	Quantitative definition	Quantitative equivalent
Has never occurred yet throughout the total lifetime of the system.	Extremely rare	Less than once a year	10^{-5}
Only very few similar incidents on record when considering a large traffic volume or no records on a small traffic volume.	Rare	Once a year	10^{-4}
Several similar occurrences on record – Has occurred more than once at the same location.	Occasional	Once a month	10^{-3}
A significant number of similar occurrences already on record – Has occurred a significant number of times at the same location.	Frequent	Once a week	5×10^{-3}
A very high number of similar occurrences already on record – Has occurred a very high number of times at the same location.	Very frequent	More than once a week	3×10^{-2}

Equivalence Qualitative and Quantitative frequencies

(***)