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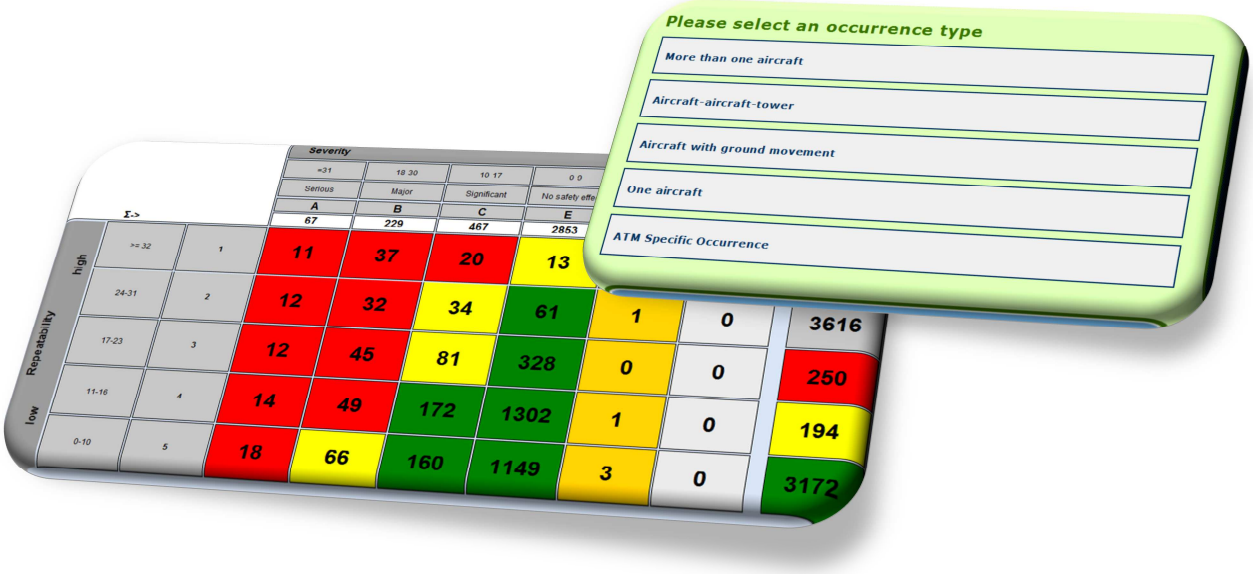
EUROCONTROL

Risk Analysis Tool - RAT

Guidance Material



Released Issue

Version 2.0 - 04/12/2015

Version Control Sheet

No.	Date	Section Affected	Reason for Change
0.25	01/07/13	Purpose of Document	Editorial and update of the legal references.
		Legal Background	Legal references updated.
		Section 1.2.2	Legal references updated.
		Section 2.2.1.2	Guidance added for scoring rate of closure in case of aircraft flying in holding patterns.
		Section 2.2.2.2	ATM Ground planning guidance updated.
		Section 2.2.2.5	Recovery guidance updated.
		Section 4	Repeatability text making reference to the RP2 plans deleted
		Section 1.2.2.1	ATM Ground scope guidance updated.
		Section 1.2.2.1	Aircraft with Ground Movement – Update of the 'Out of scope' examples.
		Appendix IV	"Incorrect entry into Oceanic Airspace" and "Deviation from clearance within Oceanic airspace with no mitigating contextual factors" tables updated.
0.3	01/06/14	All	Various comments during CCB
1.0	01/10/14	Section 3.3.2.5	Updated T1 values for ATM Specific occurrences
1.1	01/06/15	Section 2.2.2.6	Examples of how to score "Airborne Safety Nets" have been added.
		Section 3.3	Renamed ATS services to ATC Automation and subsequent changes to underlying functions.
		Section 3.3.1.1	Duration renamed to "Entry Criteria" and modified the graphs explaining how to score an ATM Specific event, this item was moved up to 3.3.1.

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Purpose of the Document

Risk is a factor that exists in every human endeavour, including operations involving aircraft – whether in the air or on the ground. Each aircraft movement involves some level of risk because the system, being human-based, is fallible. Identifying and mitigating risk is critical to increasing the safety levels. The Risk Analysis Tool methodology (RAT) provides a method for consistent and coherent identification of risk elements. It also allows users to effectively prioritise actions designed to reduce the effect of those elements.

The RAT has evolved over time to be a sophisticated, yet simple, mechanism for quantifying the level of risk present in any ATM related incident. Requiring only a brief series of inputs to produce a valid result, the RAT expresses the relationship between actions and consequences and provides a quantifiable value to these relationships.

The RAT is not a risk mitigation tool. It allows the analysis of a single event in order to understand the factors involved and then place the event in context with other events.

The objective of this document is to provide guidance on how to use the RAT methodology developed by EUROCONTROL.

The format of these guidelines has been kept simple and easy to read in order to facilitate understanding.

The present document has been developed by the RAT User Group. The screen shots used in this guidance material are taken from the RAT web-tool developed by EUROCONTROL.

We recommend that you read this document fully before using the RAT in conjunction with evaluating a few real incidents.

This will allow investigators to understand the mechanism of the barrier model behind the RAT and to apply them in a consistent manner.

Based on experience of the developers, to be fully conversant with using the RAT, an occurrence investigator would need approximately 1 ½ days.

Legal Background

The second Key Performance Indicator (KPI), developed in the framework of the Commission Regulation (EU) No 691/2010 on the performance scheme for air navigation services and network functions (performance scheme regulation), concerns the application of the Risk Analysis Tool (RAT) methodology for the severity assessment of Separation Minima Infringements, Runway Incursions and ATM Specific Occurrences. The scope of the RAT assessment is twofold: ATM Ground and ATM Overall.

Furthermore, paragraph 5.1.6 of ESARR2 requires the EUROCONTROL Member States that: “the severity of each occurrence is determined, the risk posed by each such occurrence classified and the results recorded”.

Risk assessment shall include, in addition to the determination of the severity, the likelihood of recurrence of such incidents and their most probable consequences. The repeatability part of the methodology is not mandated by the (EU) No. 691/2010.

1 General Information

1.1 Key Terms and Concept

The following definitions shall be considered when using this guidance material:

Risk of collision	ICAO Doc 4444: Airprox – Risk of Collision: "The risk classification of an aircraft proximity in which serious risk of collision has existed."
Severity	Describes the level of consequences of hazards on the safety of flight operations (i.e. combining level of loss of separation and degree of ability to recover from hazardous situations). The overall severity of one occurrence is composed of risk of collision/proximity (separation and rate of closure) and the degree of controllability over the incident.
Risk	The combination of overall probability, or frequency/likelihood, or occurrence of a harmful effect induced by a hazard and the severity of that effect.
Reliability Factor (RF)	The level of confidence in the results of the scoring using the RAT methodology based on the available safety data related to a given occurrence.

The interrelationships of these definitions are expressed in

Figure 1 below:

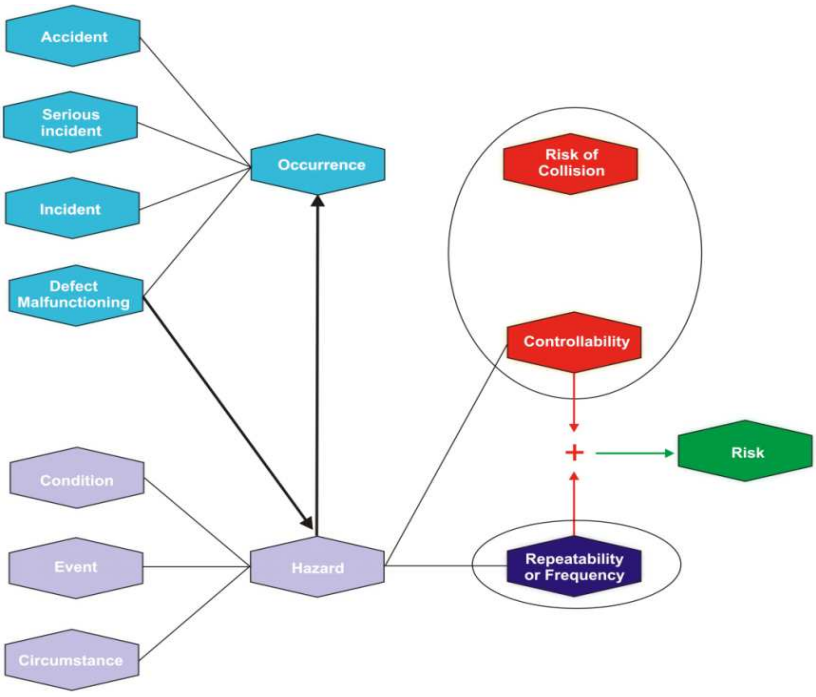

Figure 1 -*Schematic Representation of Definitions*

1.1.1 Components of Risk Analysis Tool Methodology

Risk in the RAT methodology is calculated taking into account '*Severity*' and '*Repeatability*' of the occurrence, as shown below in Figure 2 Risk Analysis Model.

The Severity component involves two main elements: 'Risk of Collision' and 'Controllability'. Risk of Collision has been defined as a combination of the achieved separation and the rate of closure. The controllability refers to the level of control exhibited by the ATCO's and pilots involved in the occurrence, as expressed in the "Barrier Model" below.

The Repeatability component is composed of prevailing systemic and non-systemic issues and the window of opportunity.

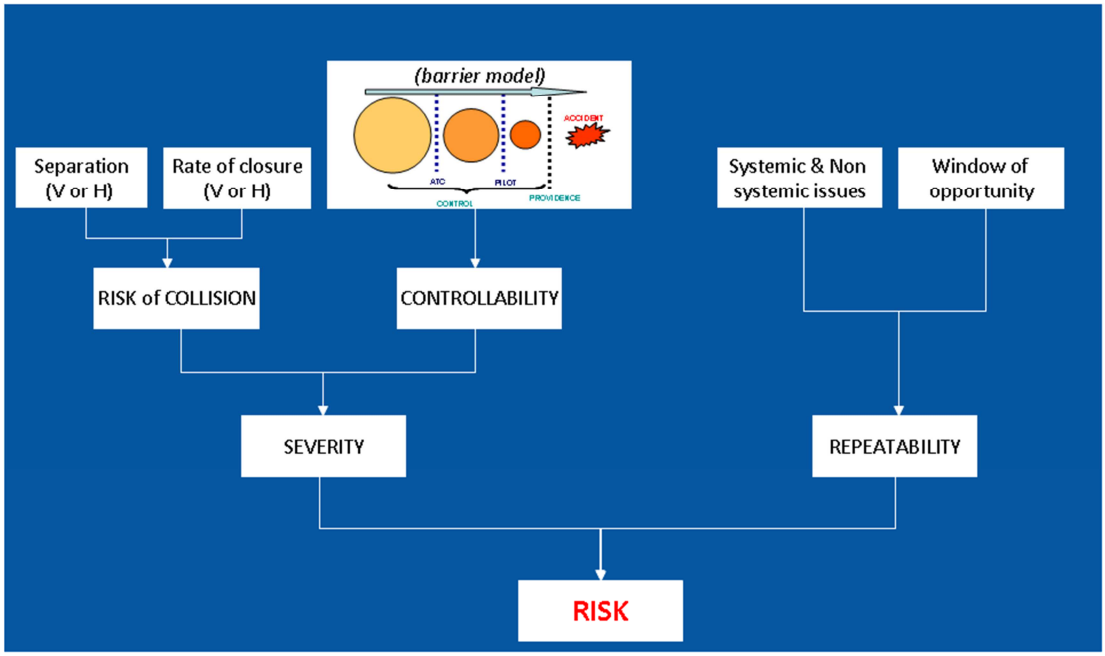

Figure 2 Risk Analysis Model

1.1.2 Logic of the 'Barrier Model'

The defence barrier model used is the one introduced by the EUROCONTROL Strategic Performance Framework and further refined by Sequentially Outlining and Follow-up Integrated – SOFIA methodology. Hence there are three safety related functions of an ATM system: hazard generation, hazard resolution and Incident Recovery.

For the purposes of this guidance document, the term ATM system is taken in its widest possible sense and includes both ground and airborne elements. For the severity purposes we will be looking at Hazard resolution and Incident recovery functions of the model. The third function – Hazard generation – will be considered in the systemic issues part and therefore, in the repeatability criteria.

Figure 3 – *Barrier Model*

Detailed guidance and explanation of the barrier model is to be found in SOFIA Reference manual, section 1.2. There is no intent herewith to reproduce any of the information already available elsewhere in EUROCONTROL documents, for the sake of brevity of these guidelines.

It is to be noted that the hazard resolution barrier is composed of the following sub-barriers:

- DETECTION
- PLANNING
- EXECUTION

These sub-barriers should be scored as part of the severity assessment of all operational occurrences.

1.1.3 Principles for Scoring an Individual Occurrence

Within the RAT methodology, the assessment of the risk induced by operational occurrences is based on a set of marksheets that retain the principles of a question-based scoring system as it provides an objective basis for judgment.

The severity of the ATM Specific Occurrences is established based on the use of a 'look-up' table that contains pre-defined severities for all possible failure combinations. The likelihood of recurrence is further determined based on a question-based scoring system available in the repeatability section of the marksheet.

A user shall determine the most appropriate RAT marksheet based on the type of occurrence and the number of aircraft involved (see Table 1 – *Types of Scoring Mark sheets*).

RAT is a post-investigation tool. Therefore, the data needed to complete the risk assessment shall derive from the investigation process and not vice-versa.

RAT shall enable a user to classify the risk induced by an occurrence in a more objective manner.

The safety data collected as part of the investigation of an occurrence should normally be sufficient for the use of the RAT methodology. In case the collected data is insufficient the RAT user shall revert to the investigator in the attempt to collect

the missing data. In this respect it is acknowledged that the RAT could work as a 'push' for the investigation.

Whenever there is not enough information available to score a criterion or the RAT users cannot reach an agreement on the scoring, the disputed criterion should not be scored. This would nevertheless affect the Reliability Factor (RF).

1.1.4 Principles for Scoring Multiple Occurrences

The approach towards scoring multiple occurrences (either operational or ATM Specific) is driven by the safety targets established internally by each ANS provider. The principles behind the safety targets differ from one ANS Provider to another focusing either on the total number of reported occurrences or only on the ones induced by the ATM Ground.

Consequently the RAT User Group acknowledged the two different approaches currently used when scoring the severity of multiple occurrences:

- score each event and retain all severities for statistical purposes;
- score each event and retain only the highest severity for statistical purposes.

1.2 Assessment Process

1.2.1 Overview

The RAT is composed of a set of marksheets that should be used for the assessment of the risk induced by an occurrence, taking into account the type of occurrence and the number of aircraft involved in the event. A user should take into account the guidance contained in this document for each scenario.

Number of aircraft involved	Purpose
More than one aircraft	When 2 or more aircraft are involved in the occurrence - usually for incidents with airborne aircraft (e.g. usually involving separation minima infringements or inadequate separations).
Aircraft – aircraft tower	When the occurrence is an encounter between two aircraft under tower control. This includes situations where: a) both aircraft are airborne; b) both aircraft are on the ground; c) one aircraft is airborne and one aircraft is on the ground. In addition, this sheet shall be used for occurrences involving one aircraft and a vehicle that at the time of occurrence was occupying/intersecting an active runway.
Aircraft with ground movement	When the occurrence is an encounter between aircraft and a vehicle, excluding the situation when the vehicle is occupying/intersecting an active runway. In this scenario, the aircraft could either be on the ground or airborne.
One aircraft	When only one aircraft is involved in the occurrence (e.g. an airspace infringement, a level bust without a second aircraft involvement, a loss of separation with ground and/or obstacles). This marksheet shall also be used for assessing near-CFIT occurrences.
ATM specific occurrence	To be applied in the cases of technical occurrences affecting one's capability to provide safe ATM services.

Table 1 – *Types of Scoring Mark sheets*

Although the use of the RAT methodology would considerably increase the objectivity of the risk assessment, it should be noted that the RAT does not provide 'the golden truth' but rather a starting point for further discussion. Therefore, there is a clear need for the establishment of additional procedures, such as moderation panels and associated operating procedures. The latter would enable users to ensure the adjustment of the results based on the operational experience of the investigators involved in the process. In addition, the RAT would allow investigators from various stakeholders with different backgrounds and cultures (e.g. where appropriate: ANSPs, REGs, airlines, AAIBs) to achieve harmonized and consistent results. To this end it is not recommended to adjust the final RAT score as a matter of routine, but to use this resort only when the expertise of the investigators would call for a different outcome.

1.2.1.1 Types of Occurrences

Below you may find the necessary explanations concerning the use of the set of marksheets listed in the Table 1 above based on the type of occurrence analyzed.

- **More than one Aircraft**

This sheet should be used in case of occurrences involving more than one aircraft (for example separation minima infringements or inadequate separations), unless the occurrence falls under the scope of ACFT/ACFT Tower or Aircraft with ground movement.

- **Aircraft-Aircraft Tower**

This sheet should be used when the occurrence is an encounter between two aircraft under tower control.

In addition, the sheet is also suitable for assessing the severity (risk) of occurrences involving aircraft, either airborne or on the ground, and vehicles occupying or intersecting an active runway.

The following types of runway safety related events where all parties act within the bounds of normal operating procedures, although actions might be needed to ensure safety margins are maintained, are **out of the scope**:

- Aircraft does not roll or turn as early or as quickly as anticipated which results in the need to take appropriate action to ensure safety margins are maintained.
- An unexpected go around that is resolved correctly by ATC.
- Minor reductions in final spacing that are correctly resolved by ATC (whether by go around or switching)

- **Aircraft with Ground Movement**

This sheet should be used when the occurrence is an encounter between aircraft and a vehicle, excluding the situation when the vehicle is occupying/intersecting an active runway. In this scenario the Aircraft – Aircraft Tower scenario should be used, where the conflicting aircraft could either be on the ground or airborne.

The following types of runway safety related events where all parties act within the bounds of normal operating procedures, although actions might be needed to ensure safety margins are maintained, are **out of the scope**:

- Events on the Apron and all events involving push backs are only in scope if sudden abrupt braking is required to avoid a potential collision.
- Events on the manoeuvring area (excluding active runways) are only in scope if one party has to stop or vacate the area in order to avoid the possibility of a collision.

- **Only One Aircraft**

This sheet should be used for occurrences involving only one aircraft (e.g. an airspace infringement, level bust without a second aircraft, loss of separation with ground and/or obstacles). In addition the marksheet is also appropriate for assessing Near Controlled Flights into Terrain (N-CFIT) occurrences.

- **ATM Specific Occurrences**

This sheet should be used for technical occurrences affecting one's capability to provide safe ATM services.

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1.2.2 Structure

RAT is built around the set of marksheets listed in Table 1 – *Types of Scoring Mark sheets* above. A user should select the most appropriate one, based on the occurrence that is subject to risk assessment. Although for each type of marksheet both quantitative and qualitative versions are available, **this guidance material covers only the quantitative type**.

The development of the qualitative version has been discontinued based on a decision taken by the RAT Users Group (RUG), considering its limited degree of flexibility offered to the user.

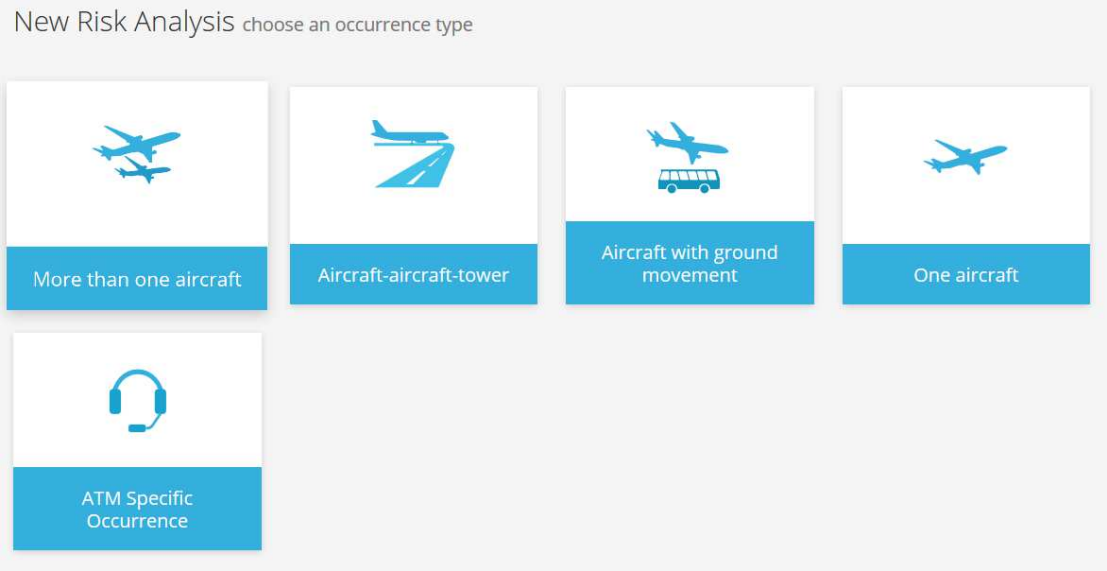

Figure 4 – *RAT Structure*

The severity and risk calculated by using RAT provides, as mentioned in the section above, an objective starting point that could be eventually further adjusted by a panel of investigators. In such case, the Risk ATM Overall and Risk ATM Ground boxes should be used to record the final risk values as modified by the panel. However, such modifications should be exceptions rather than the norm. The user shall document the rational for taking such a decision, for further reference.

Each marksheet contains two key sections: Severity and Repeatability. In addition, the user is provided with a section used for capturing some additional data (Description).

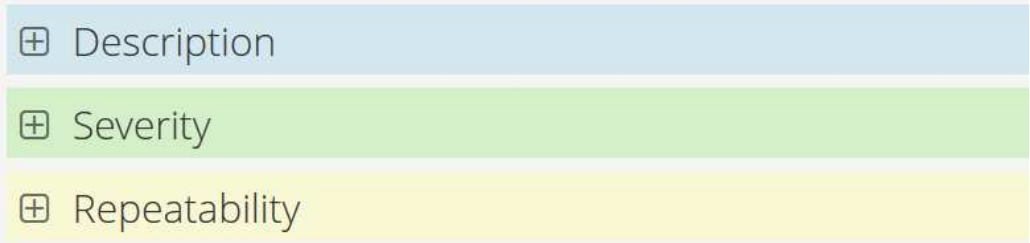

Figure 5 – *Marksheets' Structure*

The appropriate fields of the ATM Ground and ATM Airborne columns are available to score all the criteria listed under severity and repeatability sections. The values for ATM Overall are automatically calculated by the tool for any given criterion.

In the risk of collision section, only one column should be used to record either the ATM Ground or the ATM Airborne part, *never both*.

For each specific situation the values are not fixed and can be adjusted by the investigator within the provided thresholds. The comment box allows the user to record the particular considerations that led to a certain score for future reference.

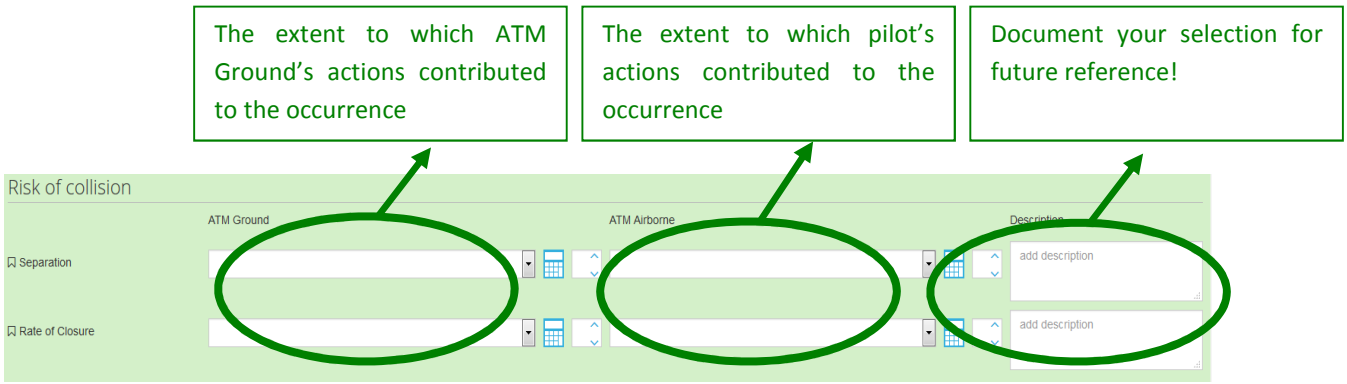

Figure 6 – *Risk of Collision*

Repeatability – this section computes the probability that a similar occurrence will reoccur in the future.

At the top of each marksheet a dynamic view of how the severity and risk of reoccurrence classification is progressing as users work through the marksheet. This feature could be hidden in order not to affect the objectivity of the investigator.

The risk classification matrix follows the risk ATM Overall and risk ATM Ground values through colour coding, while the marksheets compute potential values for all ATM segments (Ground and ATM Overall).

In addition to the ATM risk classification matrix a new category 'N' has been added to cater for situations where the ANS provider performing the investigation of the occurrence had no contribution to the event. This value is only available to be selected for ATM Ground. However, by classifying an occurrence in category N for ATM Ground does not limit the scoring options for ATM Overall (i.e. the ATM Overall value can be A, B, C, E or D).

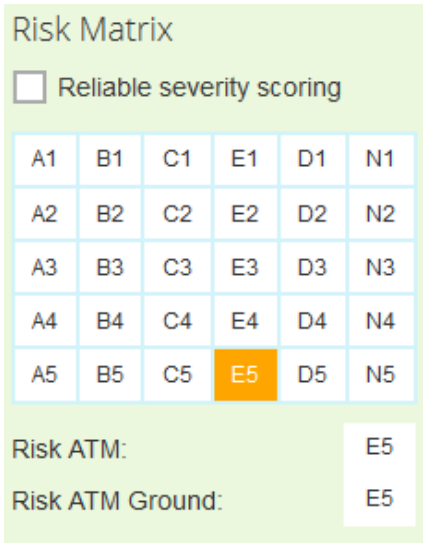

Figure 7– Risk Matrix Operational Occurrences

The determination of the ATM Overall risk is normally a regulatory task that takes into account the combined ATM Ground and ATM Airborne contribution to the occurrence. This value should be made available through the Annual Summary Template (AST) as required by the applicable regulatory requirements.

Moreover, the AST vehicle is used in the framework of the Commission Regulation (EU) No 691/2010 of 29 July 2010 laying down a performance scheme for air navigation services and network functions, to get the States' feedback on the second key performance indicator (the use of RAT for assessing the severity of certain categories of occurrences). As part of the reporting exercise the Member States would have to indicate, at the level of occurrence, whether RAT was used for deriving the risk and whether the scope of the assessment is either ATM Ground or ATM Overall.

The ATM Ground (i.e. ANS provider) performance is particularly important in case of complex events involving several ANS providers. The following options are available for scoring the ATM Ground performance:

Direct (Causal):

Where at least one ATM Ground contribution was judged to be DIRECTLY in the causal chain of events leading to an incident. Without that ATM Ground contribution, it is considered that the occurrence would not have happened.

Indirect (Contributing):

Where no ATM Ground event was judged to be DIRECTLY in the causal chain of events leading to an incident, but where at least one ATM event contributed to the level of risk or played a role in the emergence of the occurrence encountered by the aircraft. Without such ATM Ground contribution, it is considered that the occurrence might still have happened.

Indirect (Aggravating):

Where no ATM Ground event was judged to be DIRECTLY in the causal chain of events leading to an incident, but where at least one ATM event increased the level of risk or worsened the occurrence encountered by the aircraft. Without such ATM Ground contribution, it is considered that the occurrence would still have happened.

None (no involvement):

When no ATM Ground contribution was judged to be either direct or indirect in the causal chain of events leading to an incident.

Not Assessed:

Self-explanatory

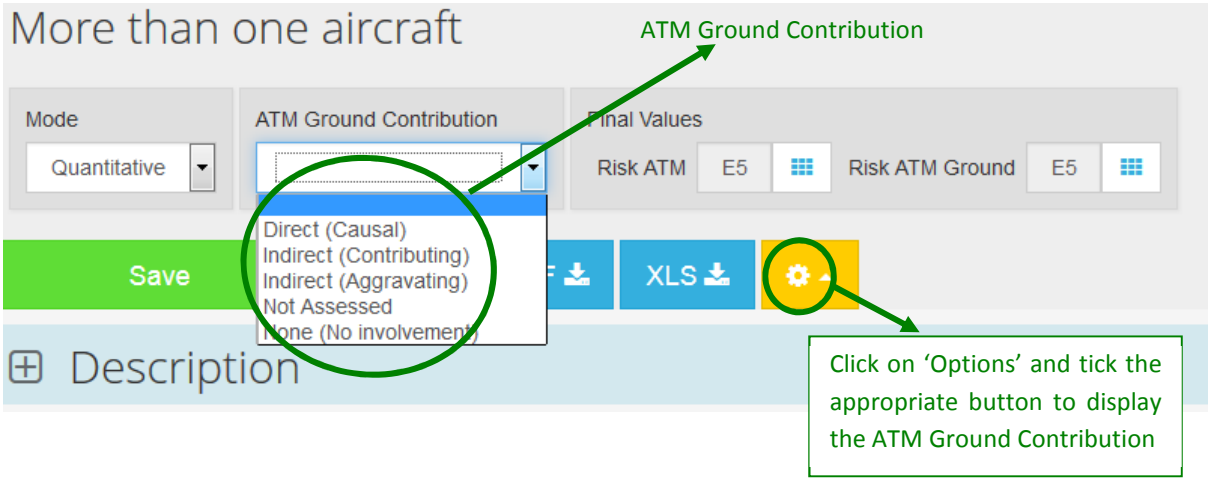

Figure 8 – *ATM Ground Contribution*

In case that the option 'None' is selected the risk associated with the ATM Ground for the respective occurrence is automatically set to 'N' and adequately displayed in the Risk matrix.

The RAT also enables a user to record the final values for the overall risk ATM and Risk ATM Ground, at the level of occurrence (see Figure 9 below).

This feature is very important especially for cases where a panel of investigators decides to modify the risk values automatically calculated by RAT. Consequently, such decisions get properly documented and stored in the RAT file associated to the occurrence.

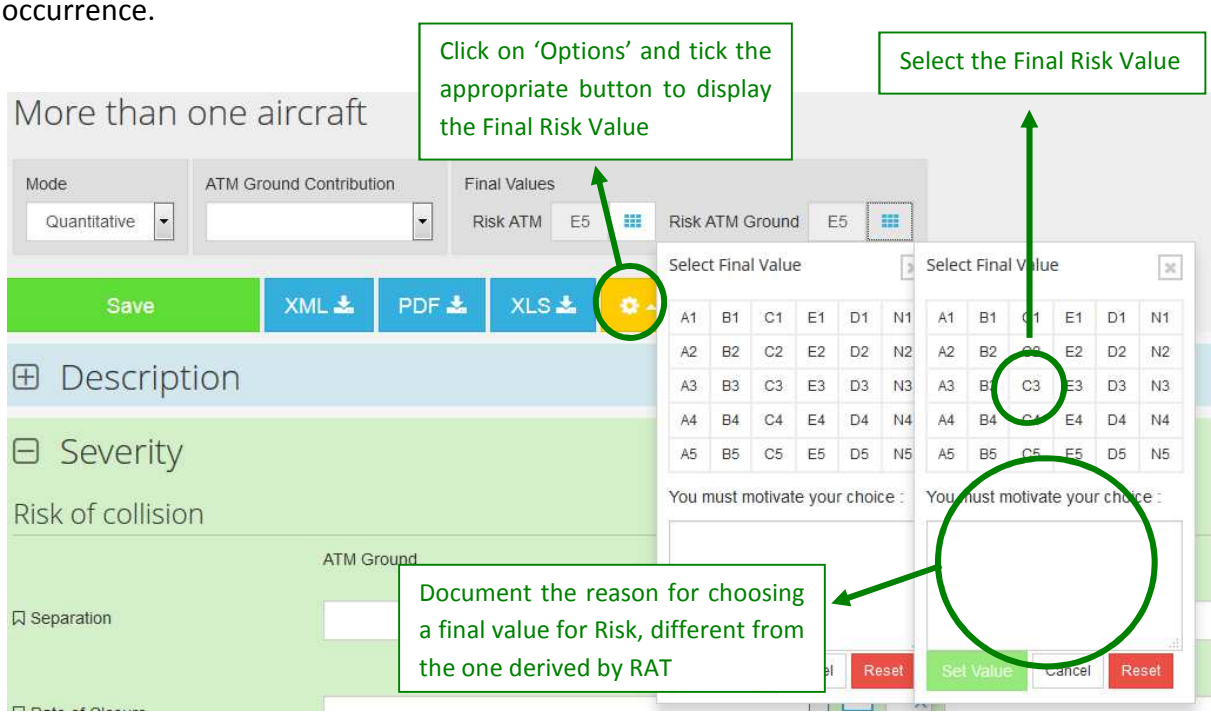

Figure 9 – *Final Risk Value*

1.2.3 Reliability Factors

On the basis of the figures derived from the severity and repeatability assessment, the ESARR2 risk matrix automatically calculates the level of risk for overall ATM and ATM ground. However, the ATM ground contribution to a risk is assessed based on information gathered during an investigation, and is not the result of any scoring combination.

Two Reliability Factors (RF) are tracked; one for Severity (RF_S) and one for Repeatability (RF_R).

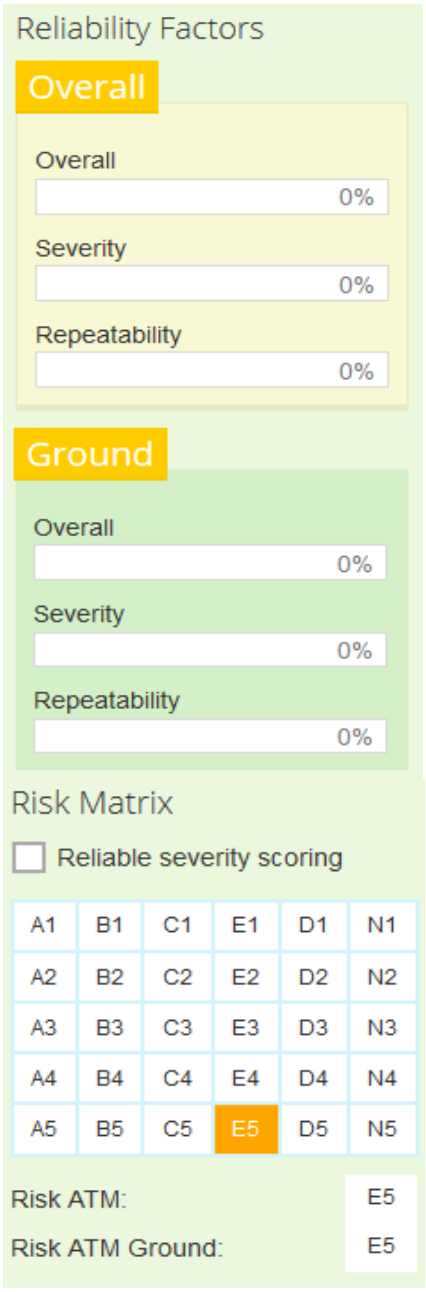

Figure 10– *Risk Matrix and Reliability Factors*

The notion of a RF is multi fold:

- The reporting and assessment scheme does not have the same maturity in all ECAC States;
- Not for all safety occurrences will the data be available to quantify all the criteria;
- Not for all safety occurrences will all the criteria be applicable;
- There is a need to have a certain level of trust when trend analysis is performed with safety data from different sources.

The RF will measure the level of confidence in the scoring, based on the data available to answer the questions of the marksheets.

If enough data is available to the investigator to answer all the questions in the marksheet, then the risk is correctly calculated and the RF will measure that confidence (RF=100%).

Whenever a criterion is scored, the RF will automatically be computed. Whenever the criterion for one reason or another is not applicable for a certain occurrence (e.g. if the potential conflict was detected by an ATCO, then the STCA criterion is N/A) then that criterion should be scored as zero.

If the criterion is applicable but some information is missing or there are disputes/no agreements on which values are to be recorded, then the criterion should not be scored and the field left blank (select Unknown in the RAT web-tool). This will nevertheless have an impact on the score of the RF.

It should be noted that a user should not score 0 points when the information is not available, as this should be erroneously interpreted either as not applicable, or the barrier has worked perfectly.

When using the web tool the user has the possibility to tick the 'Reliable Severity Scoring' box (Figure 10 above). This ensures that in case the RF does not reach the 70% threshold the severity score, both for the ATM ground and ATM overall, is automatically set to D.

Situations when the Reliability Factor(s) can be declared as being too low are where several criteria are pertinent but the investigation team and/or the moderation panel does not have sufficient information to be able to score them.

The investigation team and/or the moderation panel should make a final decision for how many criteria and from which percentage of Reliability Factor should declare the Occurrence classified as D - Not determined.

The types of criteria that might not be easy to score are usually those in the controllability section of the tool. There is less difficulty in scoring the risk of collision sub-criterion.

However, it is recommended that once the RF_S is <= 70% the Occurrence is pertinent to be classified as Severity D (RF_S is the Reliability Factor for the Severity part). The Reliability Factor for Repeatability (RF_R) will be a parameter to indicate the confidence in the determination of the likelihood of recurrence.

The overall Reliability Factor for the occurrence Risk will be the average of the two Reliability Factors $RF = (RF_S + RF_R) / 2$.

When the occurrence investigation concludes that there is no ATM Ground contribution and the appropriate selection of the drop-down menu of the web-tool is made (see Figure 8 – ATM Ground Contribution), the ATM ground induced risk is automatically set to 'N'.

1.2.4 Risk Classification Schemes

The following Risk Classification scheme is applicable for the following Operational matrix:

- More than One Aircraft
- Aircraft – Aircraft Tower
- Aircraft with Ground Movement
- One Aircraft Involved

>= 32	very frequent	1	A1	B1	C1	E1	D1
24 to 31	frequent	2	A2	B2	C2	E2	D2
17 to 23	occasional	3	A3	B3	C3	E3	D3
11 to 16	rare	4	A4	B4	C4	E4	D4
0 to 10	extremely rare	5	A5	B5	C5	E5	D5
			A	B	C	E	D
			serious	major	significant	No safety effect	no determined
			>= 31	30 to 18	17 to 10	9 to 0	RF too low

Figure 11– *Risk Classification Scheme for Operational Occurrences*

The following Risk Classification scheme is applicable for the ATM Specific Occurrence marksheet:

>= 32	very frequent	1	AA1	A1	B1	C1	E1	D1
24 to 31	frequent	2	AA2	A2	B2	C2	E2	D2
17 to 23	occasional	3	AA3	A3	B3	C3	E3	D3
11 to 16	rare	4	AA4	A4	B4	C4	E4	D4
0 to 10	extremely rare	5	AA5	A5	B5	C5	E5	D5
			AA	A	B	C	E	D
			Total inability to provide safe ATM services	Serious inability to provide safe ATM services	Partial inability to provide safe ATM services	Ability to provide safe but degraded Services	No effect on ATM services	Not determined
			60	59 to 31	30 to 18	17 to 10	9 to 0	RF too low

Figure 12– *Risk Classification Scheme for ATM Specific Occurrences*

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2 RAT Methodology for Operational Occurrences

2.1 Description

This section allows the user to record the data related to the occurrence subject to risk assessment such as:

- Reference number: the unique national number associated to the occurrence.
- Date and time: the date and time when the occurrence took place. This information could be either selected from the drop down boxes or typed in manually.
- Description: the box to be used to record the description of the occurrence for future reference.

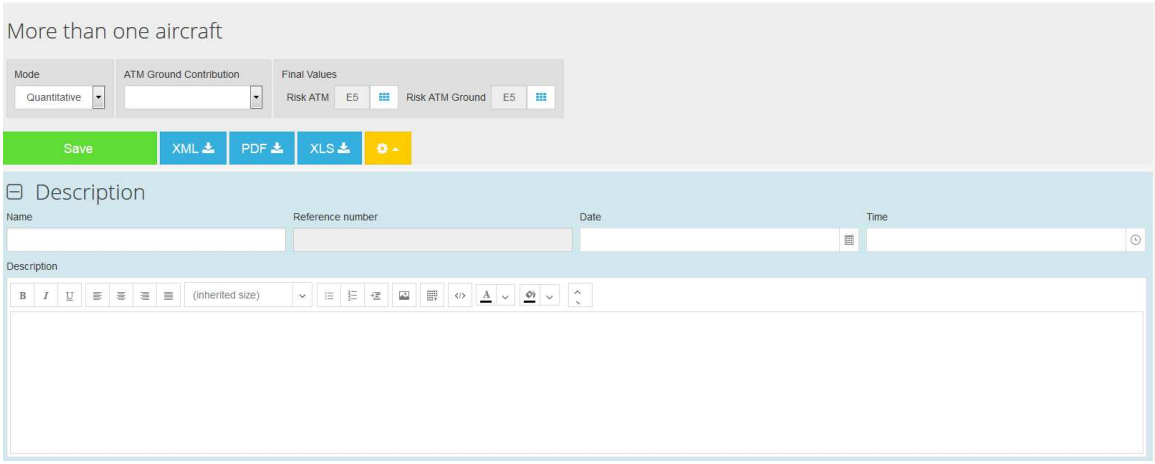

Figure 13– *More than One Aircraft 'Description'*

2.2 Severity

This section provides guidance on scoring all the sub-criteria that finally derives the severity of the occurrence.

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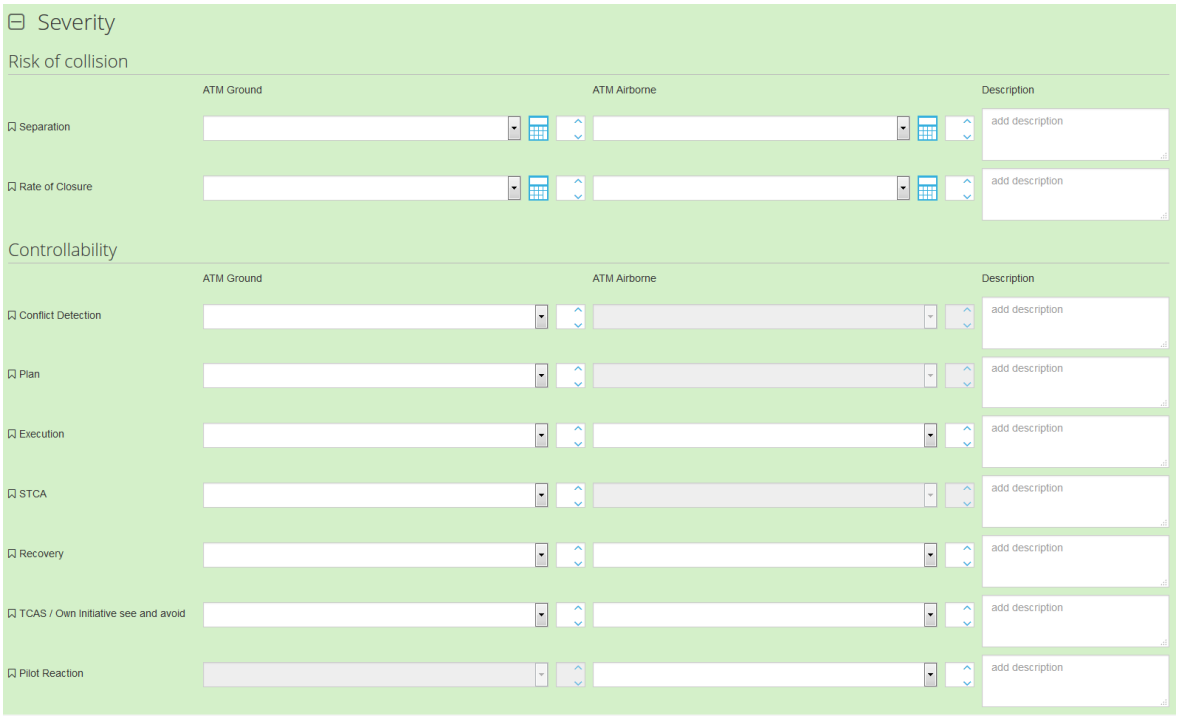

Figure 14– *More than One Aircraft – 'Severity'*

2.2.1 Risk of Collision

Risk of collision criterion refers to the physical space measured between the conflicting aircraft and, according to the ICAO definition, it is a **proximity criterion**.

The score for risk of collision, either from the achieved separation or the rate of closure, could be lowered if there is positive visual identification of the encounter by the pilot(s) involved in the occurrence. Certain encounters are inherently more severe than others (e.g. head-on encounters are more severe than aircraft moving in the same direction).

If there are no defined separation minima, then the moderation panel/investigators will choose a score between 0 and 10, based on their expert judgment. If no agreement could be reached, this criterion should not be scored and the associated field should be left blank. This will, however affect the RF.

2.2.1.1 Separation

Geometry of the encounter is very important and the overall risk of collision will be derived from the achieved separation combined with the rate of closure.

More than one aircraft

- The separation refers to the achieved horizontal and vertical distances between the aircraft at the closest point of approach.
- When scoring separation, the "best" value of the achieved horizontal and vertical separation shall be taken into consideration.

- Example: The standard separation minimum is 5 NM horizontally and 1000 ft vertically. The achieved horizontal separation was 2.5 NM (50%) and the achieved vertical separation was 600 ft (60%). In this case the best value, 60% shall be used.

Aircraft - aircraft tower

- 'Runway Incursion' is 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 an aircraft. *(Reference ICAO Definition)*
- The separation refers to the achieved horizontal and vertical distances between aircraft.
- When scoring separation, the "best" value of the horizontal and vertical safety margins shall be taken into consideration.

More detailed guidance on scoring separation for different types of encounters can be found in the **Appendix II Aircraft – Aircraft Tower.**

Aircraft with ground movement

- In order to score the separation sub-criterion members of the moderation panel/investigators will choose a score between 0 and 10, based on the geometry of the encounters and their expert judgment.
- The separation refers to the achieved horizontal and vertical distances between aircraft and vehicles.
- When scoring separation, the "best" value of the horizontal and vertical safety margins shall be taken into consideration.

More detailed guidance on scoring separation for aircraft with ground movement can be found in the **Appendix III Aircraft with Ground Movement.**

Only one aircraft

- For this type of occurrence this criterion evaluates the aircraft proximity to ground, areas or obstacles as a percentage of the safety margins.
- The separation refers to the achieved horizontal and vertical distances between the aircraft involved and ground, areas or obstacles.
- When scoring separation, the "best" value of the achieved horizontal and vertical safety margins shall be taken into consideration.

More detailed guidance on scoring separation (in case of Airspace Excursion) can be found in the **Appendix IV Only One Aircraft.**

2.2.1.2 Rate of Closure

The following generic guidelines for scoring the Rate of Closure should be taken into account:

- When scoring rate of closure sub-criterion, the "worst" value between horizontal and vertical closure rates shall be used. (Please see an example of how the "worst" value is calculated in the 'More than one aircraft' paragraph).
- The rate of closure should be measured at the moment the separation is infringed, not at the closest point of approach (CPA).
- If the separation is lost after the crossing point, the rate of closure will be scored 0 and the selected option should be 'None'.
- If there is positive evidence that both pilots, or pilot/driver have visual contact and would have been able to take independent action, the Rate of Closure score may be reduced by the moderation panel by one notch. This means that for example if the rate of closure "High" was scored, the default setting of 4 can be lowered to 3, which will result in the reduction of the severity.
- Should the members of the moderation panel not reach an agreement concerning the rate of closure of the aircraft/vehicles involved in the occurrence, the criterion should not be scored at all and the field should be left blank. This will be reflected in the value in the Reliability Factor.
- The comments field available next to each criterion allow the user to document the rationale behind the chosen score, for later reference.

More than one aircraft

- Example: The achieved horizontal rate of closure is 150 kts and the vertical one is 2500 ft/min. The user shall match these values against the ones defined in the RAT methodology. As such the horizontal rate could be matched against 'Medium' whereas the vertical rate is 'High'. The final rate of closure is then the worst of the two, in this case the vertical rate of closure, which will result in: 'High'.
- The RAT web-tool provides a rate of closure calculator (Figure 15, below) that could assist the user in the determination of both horizontal and vertical rates of closure and also the selection of the appropriate value to be considered. The user should ensure that in case of descending aircraft the ROD is negative and input adequately in the calculator (e.g. ROD = -1000 ft/min)
- In the case of an occurrence involving an airborne holding situation, the Rate of Closure score is based upon the vertical closure, as there is no lateral separation measure in such circumstances.

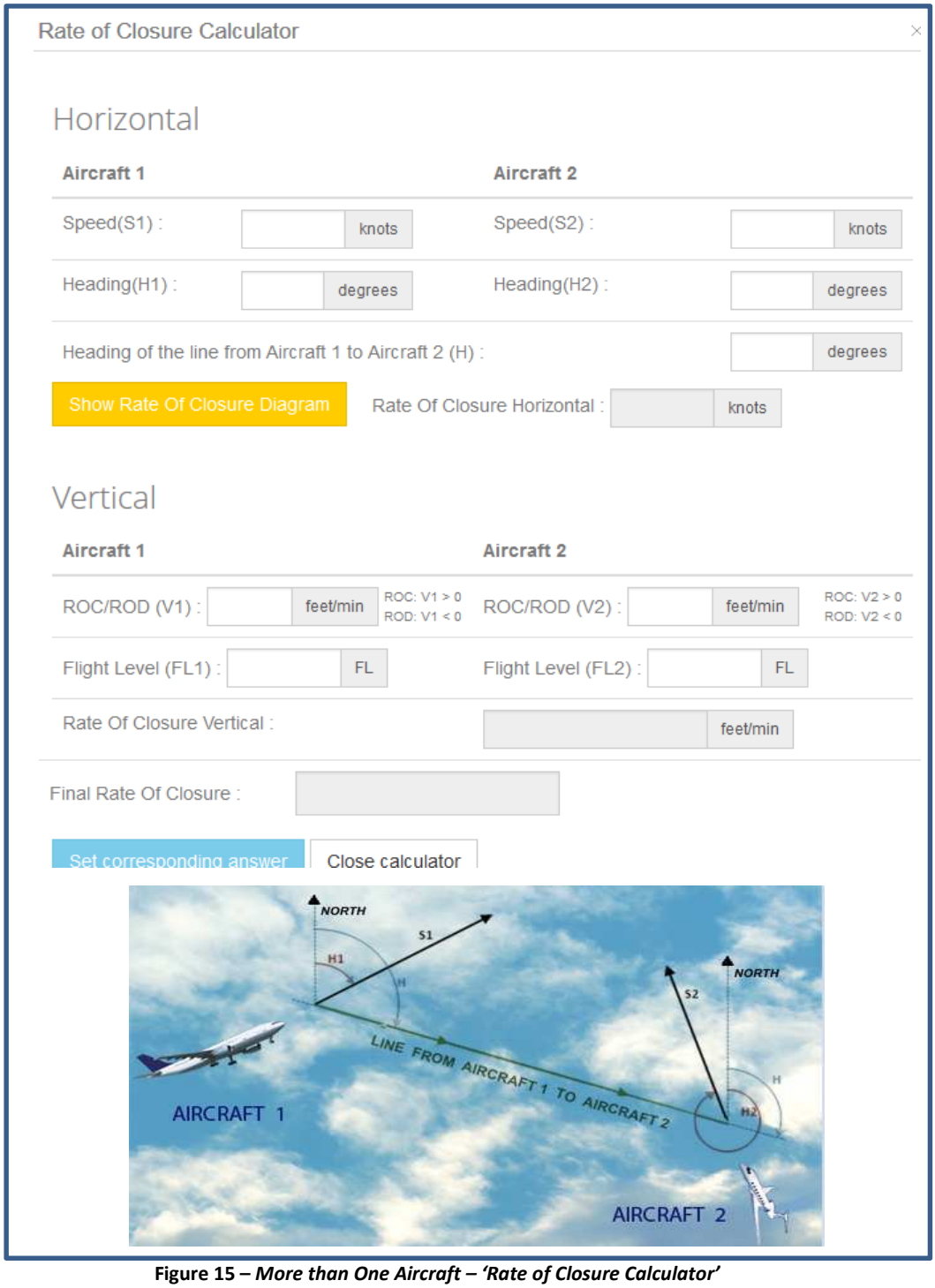

Figure 15 – *More than One Aircraft – 'Rate of Closure Calculator'*

Aircraft - aircraft tower

- The rate of closure should be measured at the moment the safety margin is infringed (not at the CPA). If the safety margin is infringed after the crossing point, the rate of closure will be scored 0 and the selected option should be 'None'.

Aircraft with ground movement

- The rate of closure should be measured at the moment the safety margin is infringed (not at the CPA). If the safety margin is infringed after the crossing point, the rate of closure will be scored 0 and the selected option should be 'None'.

Only one aircraft

- The rate of closure should be measured at the moment the safety margin is infringed.

More detailed guidance on scoring rate of closure can be found in the **Appendix IV Only One Aircraft.**

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2.2.2 Controllability

Controllability is the second major sub-criterion for assessing severity. It describes the "level of control" air traffic controllers and pilots, supported by safety nets, had over the situation.

- The risk induced by the ATM Ground and ATM Airborne segments has to be considered from the perspective of the amount of control actors exhibited over the situation.
- The purpose of this step is to balance positively or negatively the result of the proximity evaluation by taking into consideration the amount of luck or providence that "saved the day". The "logic" is that if there has been some control over the situation, even though the separation was tight, it was nevertheless achieved by the system. For this step it is proposed to follow the typical defence barriers as they apply chronologically.
- Other factors that could influence the controllability are:

  Available reaction time: Encounters that allow the pilot little time to react to avoid a collision are more severe than encounters in which the pilot has ample time to respond.

  Environmental conditions: Weather, visibility and surface conditions.

2.2.2.1 Potential Conflict Detection

Potential conflict detection refers to the ATM Ground detection and therefore this sub-criterion should be scored only on the ATM Ground column. This sub-criterion is not applicable for ATM Airborne (scores 0 points) and therefore the appropriate criterion in the RAT is inhibited. Consequently, the ATM Overall risk inherits the score of the ATM Ground.

- **'Potential conflict DETECTED'**

This criterion includes cases where the air traffic controller was aware of the situation as part of his/her normal scan of the traffic scenario.

This option should also be scored when detection was made with the support of a ground based safety net that gives sufficient time to the air traffic control staff to form a plan for solving the hazardous situation and also to implement it.

- **'Potential conflict detected LATE'**

This criterion should be scored if the conflict was detected late, eventually with the support of a current system warning, but there was still time to form a plan and execute it.

- **'Potential Conflict NOT detected'**

This criterion shall be scored when the air traffic control staff did not detect the potential conflict before the prescribed separation minima was infringed, or was

detected too late to avoid the loss of standard separation. Subsequently, the air traffic controller did not plan for any solution to solve the hazardous situation.

When potential conflict is not detected, **'Potential Conflict NOT detected'**, **'NO plan'** and **'NO execution'** options should be subsequently selected.

- **'Not applicable'**

In case of occurrences where pilots do not adhere to the ATM Ground's instructions (such as Level Bust, Runway Incursion and Airspace Infringement) potential conflict **Detection** is **'NOT applicable'**. Consequently the **Planning** and **Execution** sub-criteria are also **'NOT Applicable'** and 0 points should be scored.

Note: for airspace infringements, there can be occasions where ATM Ground had sufficient time, information and opportunity to prevent the incident, but did not do so; in such circumstances, it would be appropriate to score 'ATM Ground - Execution INADEQUATE'. Whether the controller had 'sufficient time, information and opportunity' is dependent on the specific circumstances of the incident - in particular, the controller's workload at the time.
E.g. an aircraft infringes controlled airspace whilst another aircraft is being vectored for an approach. There is sufficient time and distance between the aircraft for the controller, in the course of their normal scan, to become aware and prevent a confliction by observing the infringing aircraft and issuing appropriate resolution action to the aircraft being vectored. However, the controller does not do so and an incident occurs.

- **'Unknown'**

This option shall be selected in case there is no information concerning the potential conflict detection by the ATM Ground. In such cases the criterion will not be scored. However, this affects negatively the level of the Reliability Indicator.

Therefore, in case that information is not available, a user is always encouraged to return to the results of the investigation (or liaise with the investigator) and seek the missing data.

More than one aircraft

For a more detailed explanation of scoring the Conflict Detection, please refer to **Appendix I More Than One Aircraft.**

Aircraft - aircraft tower

For a more detailed explanation of scoring the Conflict Detection, please refer to **Appendix II Aircraft – Aircraft Tower.**

Aircraft with ground movement

For a more detailed explanation of scoring the Conflict Detection, please refer to **Appendix III Aircraft with Ground Movement.**

Only one aircraft

For a more detailed explanation of scoring the Conflict Detection, please refer to **Appendix IV Only One Aircraft.**

2.2.2.2 Plan

The planning sub-criterion refers to the ATM Ground plan to maintain prescribed separation minima or safety margins. As such, this criterion is 'not applicable' for the ATM Airborne column and consequently, scores 0 points. Therefore, ATM Overall will inherit the score of the ATM Ground.

The ATM Ground plan refers to the plan to maintain prescribed separation or safety margins. This plan may be amended tactically or by co-ordination. At this point in the risk assessment process a RAT user should evaluate this initial planning considered by the ATC. Any further actions taken after the prescribed separation minima or safety margins are infringed, are analysed and scored as part of the Recovery phase.

- **'Plan Correct'**

This option should be selected in case that the plan formed by the ATM Ground to solve the conflict is timely and correct. The adequacy of the planning is not depending on the achieving of the prescribed separation minima or safety margins.

- **'Plan INADEQUATE'**

This option should be scored when planning is either late or does not lead to a timely and effective resolution of the conflict (e.g. it may rely partly on chances or does not have an alternative course of action).

- **'No Plan'**

This option shall be automatically scored when **conflict** is **not detected**, although the ATM Ground is in charge with providing separation.

This option is also applicable to cases where, despite having detected the potential conflict, the ATM Ground has not considered any solution for its resolution.

- **'Not Applicable'**

This option shall be automatically selected for occurrences where the **conflict detection criterion** is **not applicable** (see paragraph above). The typical case refers to situations where the ATC is not in charge with providing separation.

More than one aircraft*- Not applicable*

Aircraft - aircraft tower*- Not applicable*

Aircraft with ground movement*- Not applicable*

Only one aircraft*- Not applicable*

2.2.2.3 Execution

The execution sub-criterion refers, in general, to ATM Ground execution in accordance with the plan developed in the previous phase. Therefore, the column ATM Overall will inherit the same score as ATM Ground, unless the pilot/driver has not complied with the instructions provided by the air traffic control staff.

Pilot's/Driver's execution should be scored in the ATM Airborne column. This criterion refers to the execution of the initial plan developed by the air traffic control staff to solve the detected hazardous situation before the system excursion of the safety envelope.

- **Execution CORRECT**

For ATM Ground, execution is correct in case that the plan made by the ATCO in the previous phase is implemented accordingly. When assessing execution, time and efficiency should be considered.

In respect of the ATM Airborne this criterion refers to the adherence to the instructions by the ATM Ground.

- **Execution INADEQUATE**

ATM Ground's execution is **inadequate** when it is neither timely nor effective. It refers to the execution of the plan developed in the 'Planning' criterion before the prescribed separation minima or safety margins would have been infringed. This option also includes cases where despite the fact that the planning developed by the air traffic control staff is good, implementation of the plan is not adequate.

When the plan is inadequate the execution should, in general, also be inadequate. There will be exceptions where a good execution could mitigate an inadequate plan. Documented rationale should be provided for the exception.

It is to be noted that pilot/driver's execution should be scored in the ATM Airborne column.

- **'NO execution'**

This option should be selected for cases when the ATM Ground has a plan for conflict resolution but has not implemented it at all.

The **'NO execution'** option shall be automatically scored when **conflict** is **not detected.**

The **'NO execution'** option shall be automatically scored when despite the fact the potential conflict was detected the plan for the conflict resolution is not at all implemented by the ATC.

- **'Not Applicable'**

This option shall be selected when execution is not applicable or in case of occurrences where the ATM Ground is not in charge of providing separation between the aircraft involved in the occurrence.

Whenever conflict Detection and Planning are **'NOT applicable'** (e.g. deviation from ATC clearance, runway incursion due to pilot deviation from ATC clearance) the **execution** criterion for ATM Ground is also **'NOT applicable'**. Consequently, the ATM airborne execution will be penalised.

More than one aircraft

More detailed scenarios of how to score Execution are given in the **Appendix I More Than One Aircraft.**

Aircraft - aircraft tower

More detailed scenarios of how to score Execution are given in the **Appendix II Aircraft – Aircraft Tower.**

Aircraft with ground movement*- Not applicable*

Only one aircraft*- Not applicable*

2.2.2.4 Airborne & Ground Safety Nets

- **Ground Safety Net Triggered**

This sub-criterion shall be scored when the controller failed to detect the conflict without the support of the safety nets and consequently failed to plan and execute a correct resolution (the conflict has been observed due to safety nets - useful safety nets warning).

In case of false/nuisance alerts this criterion is not applicable.

- **No Airborne / Ground Safety Net Triggered**

This option shall be selected when the conflict was not detected or detected late by the ATM Ground and the safety net (e.g. as appropriate STCA, A-SMGCA, RIMCAS, MSAW, APW) should have been triggered according to its implemented logic, but it failed to function. Hence the ground safety net barrier did not work.

When the conflict is detected by the air traffic control staff the criterion is not applicable and 0 points should be scored.

- **'Not Applicable'**

This option shall be selected when the criterion is not applicable (e.g. the ATC centre is not equipped with a ground safety net system).

More than one aircraft

STCA usage in the unit needs careful consideration when scoring this criterion. Only the trigger of the current STCA shall be scored under this criterion. The predictive STCA would inherently trigger nuisance alerts that are not in the scope of this criterion.

Aircraft - aircraft tower *- Not applicable*

Aircraft with ground movement *- Not applicable*

Only one aircraft *- Not applicable*

2.2.2.5 Recovery

Recovery from actual conflict is the phase requiring immediate action to restore the "equilibrium" or at least to confine the hazard. ATM Ground recovery should be scored in the ATM Ground column. Consequently pilot recovery is scored in the ATM Airborne column.

This sub-criterion refers both to the ATM Ground and ATM Airborne recovery. Therefore, the column ATM Overall will inherit the sum of both ATM Ground and ATM Airborne values.

Recovery starts when the ATCO or Pilot becomes aware that the separation/safety margins have been or are about to be breached.

- **'Recovery CORRECT'**

The recovery is correct when the actions taken by ATM (Ground and Airborne) have minimised the effect and mitigated the outcome of the occurrence.

- **'Recovery INADEQUATE'**

By selecting this option the user indicates that the ATM (Ground and Airborne) reaction, after the actual conflict is declared, was either not taken in a timely manner or was not the most effective course of action.

- **'NO recovery or the ATM Ground actions for recovery have worsened the situation or ATM Airborne has worsened the situation'**

When scoring 'NO recovery', consideration should be made as to whether Airborne safety nets (as appropriate TCAS, GPWS and pilot see and avoid action) were triggered or not.

It could be that the reason for not following the ATC instruction was due to an airborne safety net or a pilot 'see and avoid' action. In this case, there should be no penalty on the ATM Airborne part.

- **Not applicable**

When the aircraft tracks are diverging, then the Recovery should be scored as 'Not Applicable' and 0 points should be given.

When assessing the recovery the time and efficiency of that recovery should be considered.

For some occurrences, subject to the type of airspace where they occurred and to the services provided, recovery may be limited to providing traffic information or avoiding actions by the air traffic control staff. In such case, there should be no penalty on the ATM Ground part.

***More than one aircraft**- Not applicable*

***Aircraft - aircraft tower**- Not applicable*

***Aircraft with ground movement**- Not applicable*

***Only one aircraft**- Not applicable*

2.2.2.6 Airborne safety nets or Pilot initiative (see and avoid)

- **'TCAS or GPWS triggered (useful TCAS to be considered) or See and avoid pilot or driver decision (in the absence of TCAS or GPWS)'**

For cases where TCAS or GPWS has saved the day, 'TCAS triggered' or 'GPWS triggered' should be scored. Similarly, where the 'See and Avoid pilot or driver decision' had saved the day, this option should be scored.

The score will be assigned to the ATM Ground column to reflect that the ground barrier has failed. Selecting the same option for the ATM Airborne would not penalise the system any further, just ensure that the Reliability Factor is not negatively affected.

- **'NO TCAS RA' or 'GPWS Warning'**

This option should be selected when the geometry of the encounter would require a TCAS RA (based on ICAO TCAS logic) or GPWS warning and that did not occur. However, pilot actions taken based GPWS warning could have saved the day.

It should be scored both in the ATM Ground and ATM Airborne columns. In respect of the ATM Ground, choosing this option will ensure that the Reliability Factor is not negatively affected.

- **'Not Applicable'**

This option should be scored for occurrences where the 'see and avoid' barrier is not applicable (please see the next page, where some examples are provided); and for situations where the geometry of the encounter was such that it was not appropriate for a TCAS RA to be generated.

TCAS is considered to be an integrated component of ATM Airborne and ATM Overall. This option should be scored as not applicable (i.e. 0 points should be given) if adequate ATC instructions are issued before the pilot reaction due to TCAS RA.

Examples: –

1. *ATM Ground* issues effective resolution instructions which ATM Airborne starts to respond to; TCAS then triggers and ATM Airborne follows TCAS RA:
   Airborne Safety Nets Score – 'Not Applicable' because the ATM Ground barrier would still have been effective in the absence of TCAS.
2. *ATM Ground* issues resolution instructions which would have effectively resolved the risk of collision. However unbeknown to ATM Ground, TCAS RA also triggers and ATM Airborne correctly follows TCAS RA and disregards ATM Ground instructions.
   Airborne Safety Nets Score – 'Not Applicable' because the ATM Ground barrier would still have been effective in the absence of TCAS.
3. *ATM Ground* does not issue resolution instructions that would have effectively resolved the risk of collision in adequate time. TCAS RA triggers and resolves risk of collision.
   ATM Ground Recovery Score – No Recovery
   Airborne Safety Nets Score – 'TCAS or GPWS triggered'
   ***Note 1**: Events where pilots do not adhere to the ATM Ground's instructions (such as level busts or airspace infringements) can result in a loss of separation or erosion of safety margin which ATM Ground has no opportunity to identify prior to it occurring, TCAS may trigger and resolve the event so rapidly that ATM Ground has no opportunity to take recovery action. In such circumstances the ATM Ground Recovery should be scored as **NOT Applicable**.*
   ***Note 2**: Before scoring 'No Recovery' in combination with 'TCAS or GPWS triggered' all elements leading to the occurrence must be carefully considered before accumulating both scores.*
   ***Note 3:** For events scored in accordance with example 3 above, the cumulative ATM Ground score reflects the total failure of the ATM Ground recovery barrier. However, the RAT calculator functionality ensures the ATM Overall score takes into account the fact that TCAS has mitigated the effect of the ATM Ground barrier failure and consequently reflects the appropriate degree of severity in the event.*

More than one aircraft

The TCAS sub-criterion should be scored only for useful TCAS RAs (as per ICAO definitions).

***Aircraft - aircraft tower**- Not applicable*

***Aircraft with ground movement**- Not applicable*

***Only one aircraft**- Not applicable*

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2.2.2.7 Pilot / Driver Reaction

This criterion assesses the pilot/driver execution of 'see and avoid decision'. It should be scored on the ATM airborne column (in case of "more than one aircraft" or "only one aircraft", please see the specific details below). The following options are available for the user:

- '**Pilot/Driver took other effective action as a result of see and avoid decision**

This option should be selected in case that the pilot/driver took the most appropriate action based on the 'see and avoid' decision.

- '**Pilot/Driver took INSUFICIENT action as a result of see and avoid decision**

The user should select this option in case that the action taken by the pilot/driver as a result of the 'see and avoid' was insufficient.

- **Pilot/Driver INCORRECTLY took other action as a result of see and avoid decision**

This option should be selected in case that the pilot/driver took an incorrect action based on the 'see and avoid' decision.

The use of see and avoid refers to an 'alerted' see and avoid.

The following is an extract from the Australian Civil Aviation Safety Authority of what an alerted see-and-avoid concept is. "Pilots are alerted to the presence of another aircraft, usually by mutual contact (especially for GA pilots). They can then ensure that the aircraft is flown clear of conflicting traffic or can arrange mutual separation. Alerting devices must be guaranteed for the see and avoid to be a dependable line of defence. Also, there must be enough time for pilots to resolve situational awareness and establish alerted see-and-avoid."

More than one aircraft

Pilot execution of TCAS RA (or application of see and avoid where appropriate in cases where TCAS is not applicable) and recovery is a criterion to gather data on the overall ATM performance (including ATM Ground and ATM Airborne segments).

- **'Pilot(s) followed RA (or, in absence of RA, took other effective action, as a result of an alerted see and avoid decision)'**

By selecting this option we add no points as the system has been already penalised in the 'TCAS triggered' sub-criterion above;

- **'Pilot(s) INSUFFICIENTLY followed RA'**

The user should chose this selection when pilots are not reacting fully in accordance with the resolution advisory, but ATM Ground has enough controllability over the situation;

- **'Pilot(s) INCORRECTLY followed RA (or, in the absence of RA, took other inadequate action)'**

This option should be scored for ATM Overall whenever the pilot actions were either missing or contradictory (e.g. did not follow the RA). Another example here could be level bust cases where ATM Ground has NO margin to recover and to instruct accordingly and only providence saved the day. A contradictory reaction or non-reaction to a TCAS RA should be considered the worst case possible.

Aircraft - aircraft tower*- Not applicable*

Aircraft with ground movement*- Not applicable*

Only one aircraft

- **Pilot(s) followed GPWS (or, in absence of GPWS warning took other effective action- e.g. follow up see and avoid decision)**

This option should be selected in case that the pilot took the most appropriate action based on a GPWS warning or the 'see and avoid' decision.

- **Pilot(s) INSUFFICIENTLY followed GPWS**

The user should select this option in case that pilot insufficiently followed the GPWS warning.

- **Pilot(s) INCORRECTTLY followed GPWS (or, in absence of GPWS warning took other inadequate action)**

This option should be selected in case the pilot reacted incorrectly to the GPWS warning. It should be equally selected for occurrences where no GPWS warning is triggered but the pilot took other inadequate action that worsened the situation.

More detailed scenarios of how to score Pilot reaction are given in the **Appendix IV Only One Aircraft.**

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3 Methodology for ATM-Specific (Technical) Occurrences

3.1 Overview of the Methodology

This section provides guidance on how to use the 'ATM Specific Occurrences' sheet of the RAT. As indicated in Table 1 – *Types of Scoring Mark sheets* above this sheet should be used for technical occurrences affecting one's ability to provide safe ATM Services.

According to the RAT's methodology for ATM Specific Occurrences the severity and the overall risk of reoccurrence is determined based on a combination of criteria and their chosen options. For each criterion a number of options are available.

The combination of those options will provide the user with all the possible operational effects of the failure modes of a system that supports the provision of air traffic services. A predefined severity is available for each credible failure mode based on the input provided by national experts who participated in the RAT User Group (RUG) and taking into account the potential effect of the equipment's failure on the operational function supported (i.e. the effect on the work of ATCO or the pilot).

The complete list of the failure modes is further referenced in this document and is kept up to date by the group based on the users' feedback.

The user shall determine the severity of the event by selecting one of the available options for each criterion related to the system failure under analysis.

In order to ensure harmonisation in the determination of the severity of the ATM Specific Occurrences and the risk posed on the ATM System, the development of the RAT was made independently from any particular design of an ATM system.

Therefore the RAT does not consider the failure of a particular (sub-) system but of an "operational function". This is simply due to the fact that the failure of the same (sub)-system can have different effects on the ATCO's ability to provide services in different ANSPs due to the local aspects (e.g. system architecture etc).

The RAT for ATM Specific Occurrences was designed in a manner that ensures the same result irrespective whether the technical failure occurs during peak hours or, thanks to providence, at night when there are a very few aircraft in the sector. It is considered that the remedial actions to be taken in order to solve the failure should be the same. As such, the RAT only considers the worst credible outcome of the failure on the operations.

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3.2 Description

This section allows the user to record the administrative data related to the occurrence subject to risk assessment such as:

- Reference number: the unique national number associated to the occurrence.
- Date and time: the date and time when the occurrence took place. This information could be either selected from the drop down boxes or typed in manually.
- Description: the box to be used to record the description of the occurrence for future reference.

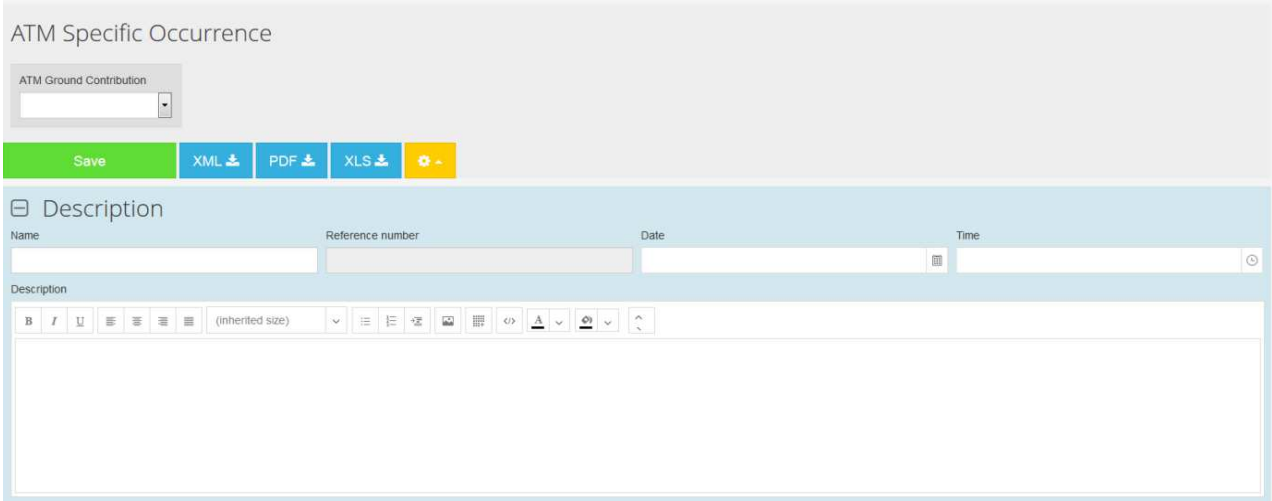

Figure 16 – *ATM Specific Occurrences– 'Description'*

3.3 Severity

This section provides guidance on scoring all the sub-criteria that finally derives the severity of the occurrence.

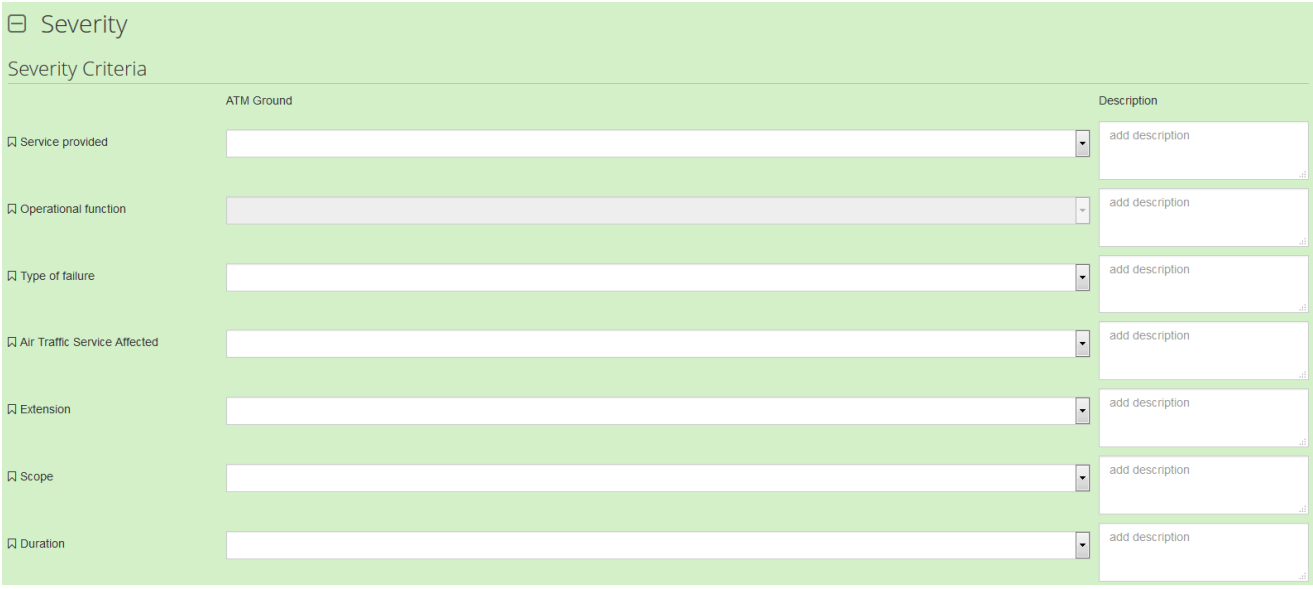

Figure 17 – *ATM Specific Occurrences– 'Severity'*

The following criteria are considered when determining the severity of an ATM Specific Occurrence:

- Entry Criteria
- Service provided
- Operational function
- Type of failure
- Service affected
- Extension
- Scope

3.3.1 Entry criteria

A RAT score must be applied when the event being scored has **Operational Consequences,** defined as when:

a) ATC or pilot has to apply mitigating measures in order to restore or maintain safe operations as a result of the ATM Specific Occurrence,

OR

b) it is determined that no such mitigating measures were available (i.e. no action possible);

OR

c) ATC or pilot concludes that mitigating measures were not required on this occasion due to the current operational conditions (e.g. favourable weather, low traffic levels etc);

OR

d) It is determined that ATC or pilot had been unknowingly operating with corrupt information.

There is no requirement to apply the RAT methodology for technical events where an operational function is not affected. However, in case an operational function is affected but the event does not have any operational consequences the severity shall automatically be 'E' – No safety effect and the RAT methodology is not applied any further.

If the service which failed was NOT used, it shall not be scored as an ATM Specific Occurrence.

The following flowchart shows how to determine whether a technical failure should be scored as an ATM Specific Event and severity classified using the RAT methodology under the provisions of the Performance Scheme Regulation.

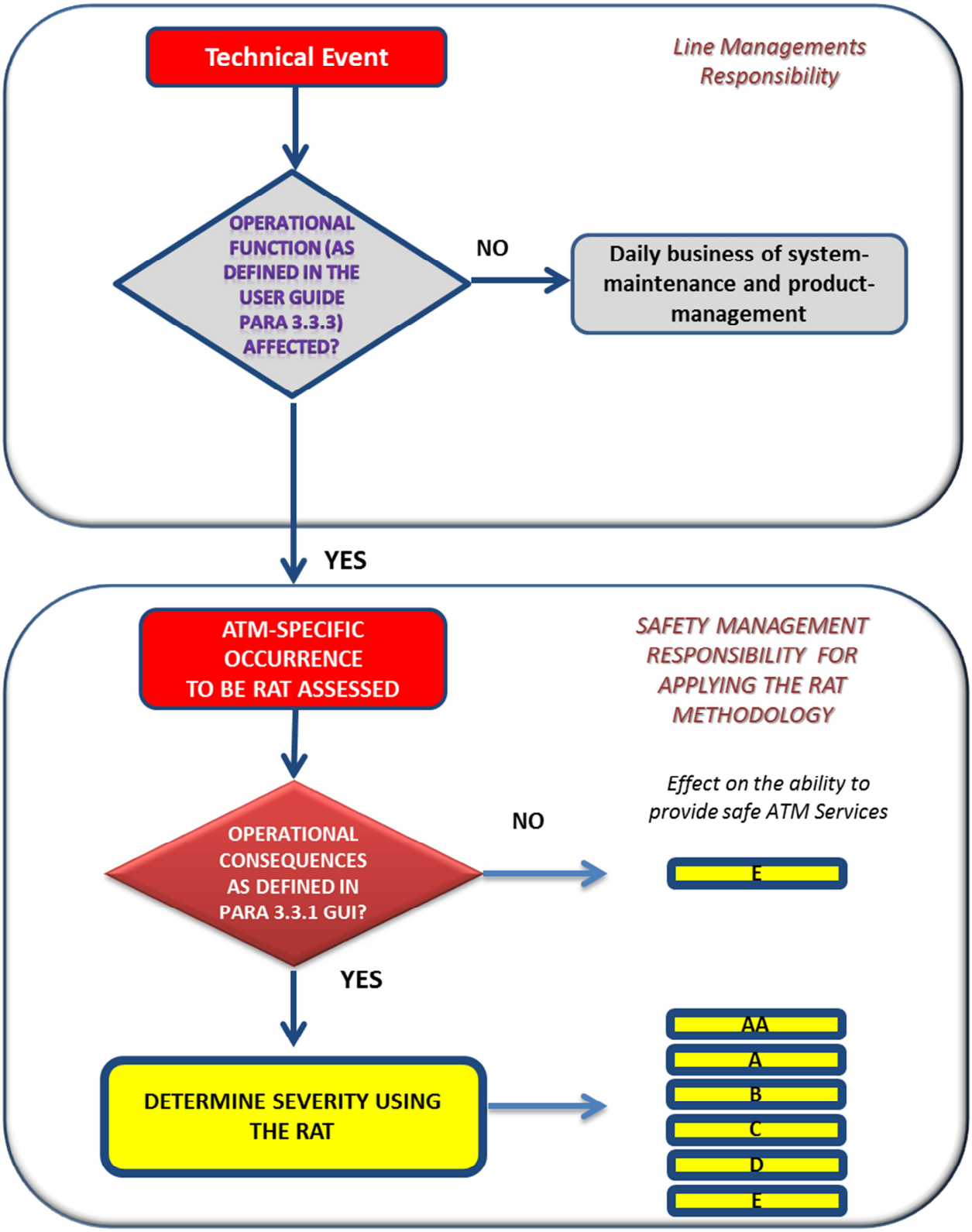

Figure 18 – ***ATM Specific Occurrences– Flowchart to determine RAT Applicability***

Graphical representation of Operational Consequences

The following four scenarios complemented by examples, illustrate the ATM ANS system both in a steady state and failure modes, in order to ease the understanding of Operational Consequences.

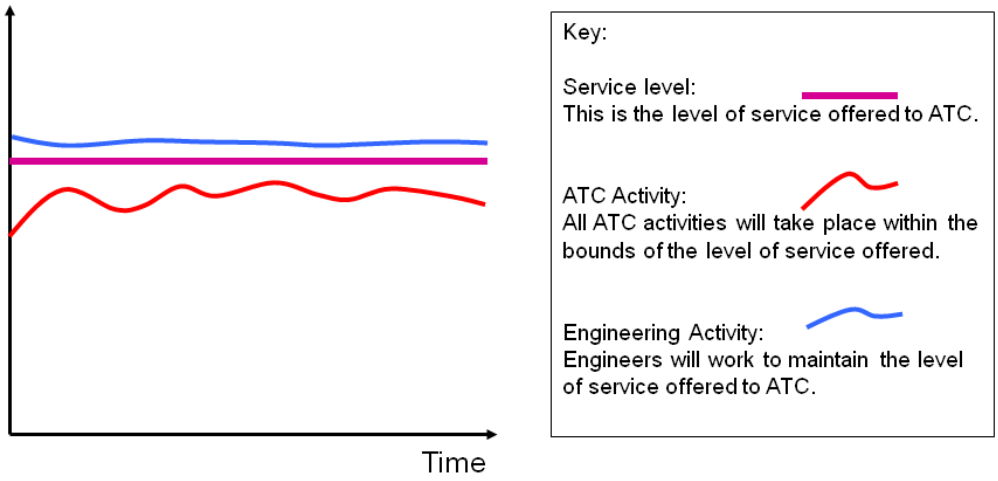

Figure 19 – *ATM Specific Occurrences – 'ATM System in a Steady State'*

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Scenario A) : "ATC or pilot has to apply mitigating measures in order to restore or maintain safe operations as a result of the ATM Specific Occurrence"

Example 1: Technical Event with an Immediate Operational Consequence

The chart below provides the occurrence timeline in case of a total failure of an operational function. In the given example the failure has an operational impact on the ability to provide ATM services (this could be the case in a total failure of the air-ground communication function, total failure of surveillance function).

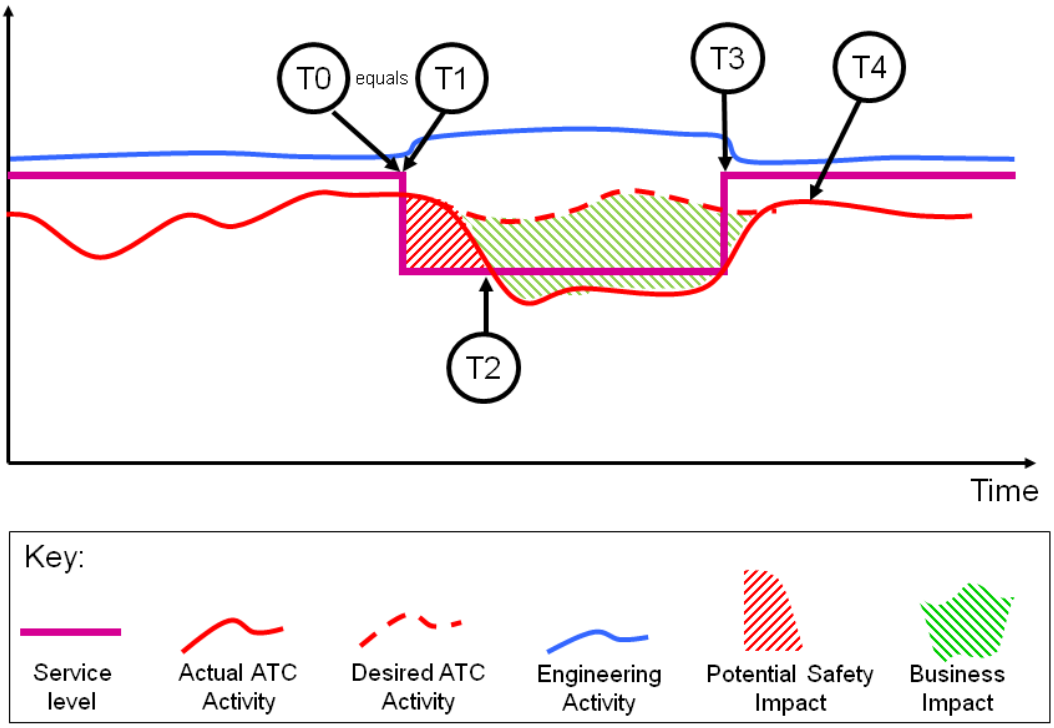

Figure 20– *ATM Specific Occurrences – 'Immediate Operational Consequence'*

The following moments are depicted on the time line of the occurrence:

T0	Technical Event commences. This could be a total or partial loss of service.
T1	Technical Event triggers operational consequences on ATC controller or pilot immediately and requires a RAT score.
T1 to T2	Potential safety impact on ATC or pilot
T2	ATC or pilot now is operating with reduced but safe level of service
T3	The Technical Event finishes
T2 to T4	Business effect on ATC or Pilot (e.g. regulations applied)
T4	ATC / Pilot returns to the desired level of activity

Example 2: Technical Event with a Delayed Operational Consequence

The chart below provides the occurrence timeline in case of a failure which, after a period of time results in an operational consequence.

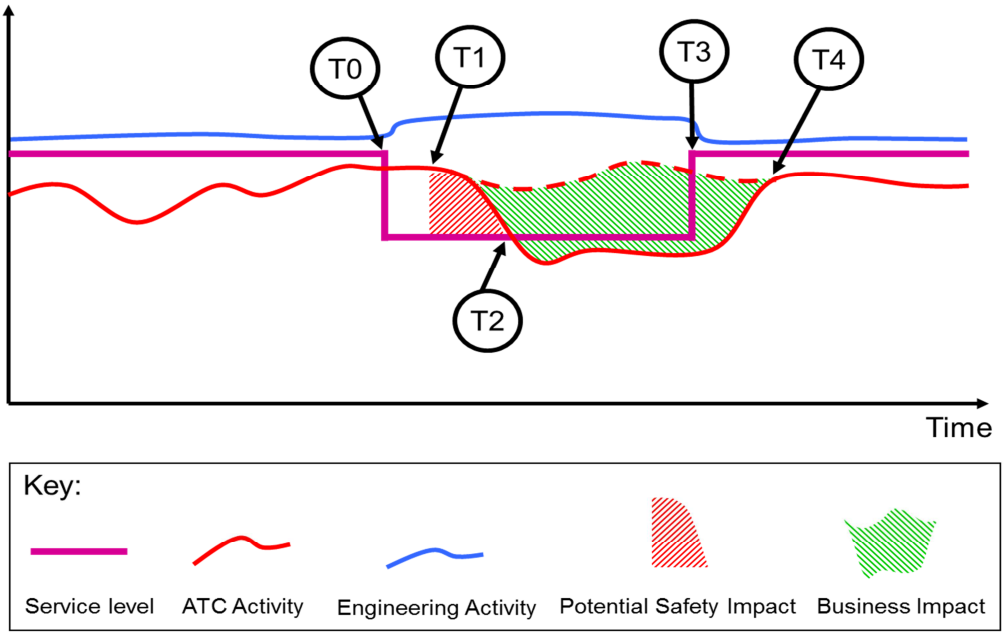

Figure 21– *ATM Specific Occurrences – Delayed Operational Consequence*

The following moments are depicted on the time line of the occurrence:

T0	Technical Event commences. This could be a total or partial loss of service.
T0 to T1	ATC or Pilot have no visibility of the event or deal with it with no operational consequences.
T1	ATC or pilot can no longer tolerate the technical event. Operational Consequences commence. At this point the event becomes an ATM specific occurrence and requires a RAT score.
T1 to T2	Potential safety impact on ATC or pilot
T2	ATC or pilot now is operating with reduced but safe level of service
T3	The Technical Event finishes
T1 to T4	Business effect on ATC or Pilot (e.g. regulations applied)
T4	ATC returns to the desired level of activity

Scenario B): "it is determined that no such mitigating measures were available (i.e. no action possible)"

Example 3: Technical event has Operational Consequences, but ATC or Pilot have no mitigation available.

The chart below illustrates a technical event which Engineering, ATC and Pilot are aware of but are unable to mitigate.

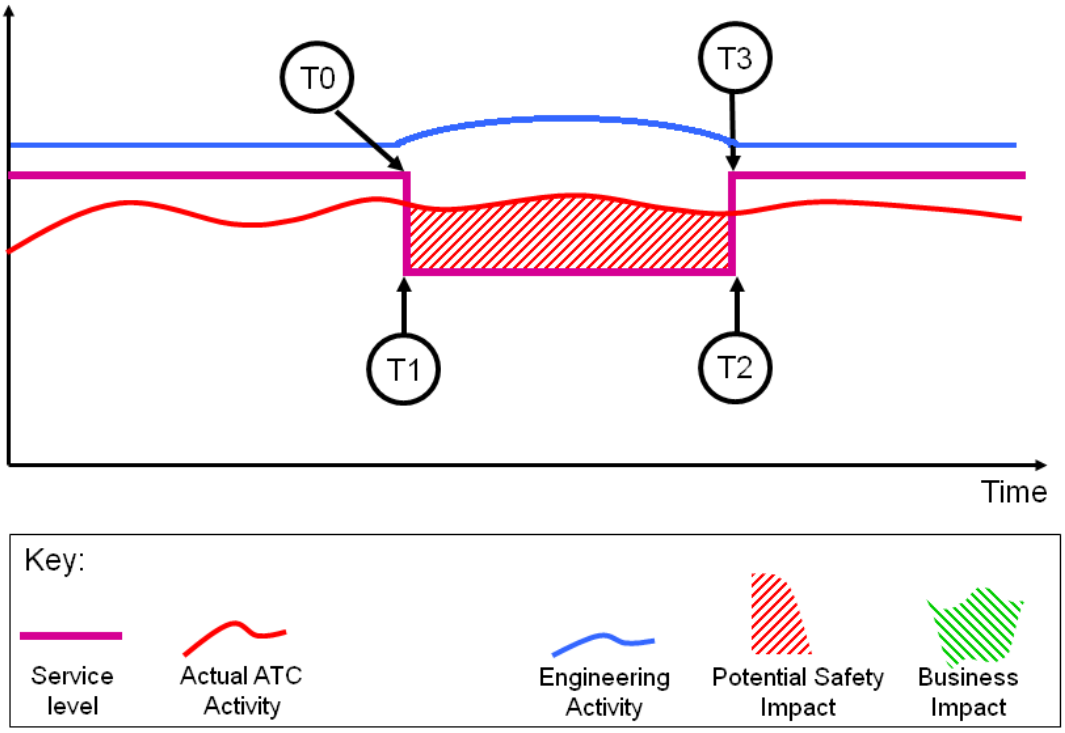

Figure 22– ATM Specific Occurrences – Operational Consequences with no mitigation

The following moments are depicted on the time line of the occurrence:

T0	Technical Event commences.
T1	ATC and Pilot operate with no mitigation. A RAT score is required.
T1 to T2	Potential safety impact on ATC or pilot
T3	The ATM Specific Technical Event finishes

Scenario C) : ATC or pilot concludes that mitigating measures were not required on this occasion due to the current operational conditions (e.g. favourable weather, low traffic levels etc);

Example 4: Failure with no Operational Consequence at the time

The chart below illustrates the occurrence timeline in the case of a Failure where ATC or pilot concludes that mitigating measures were not required on this occasion due to the current operational conditions (e.g. favourable weather, low traffic levels etc);

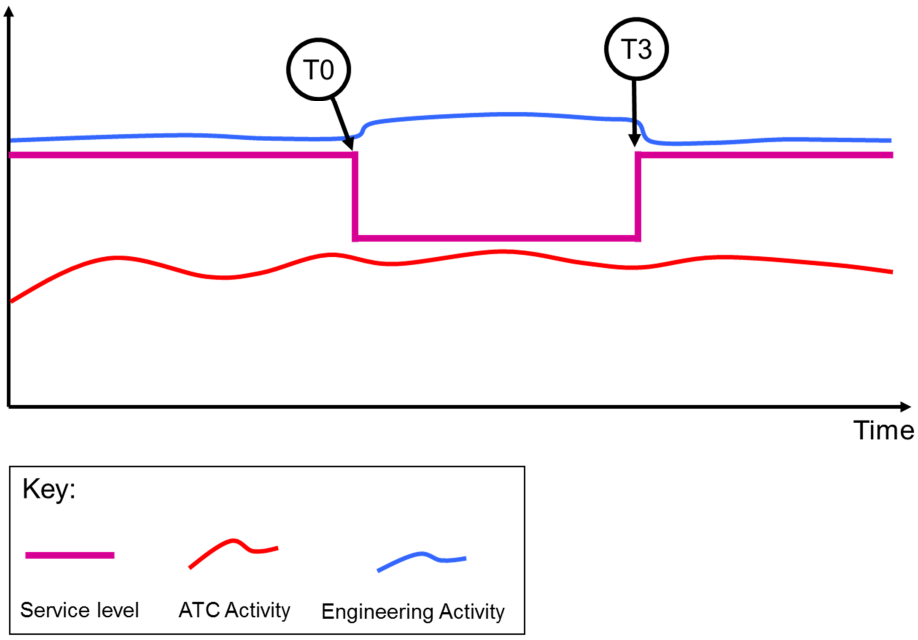

Figure 23– *ATM Specific Occurrences – 'Failure with no Operational Consequence at the time*

The following moments are depicted on the time line of the occurrence:

T0	Technical Event commences.
T1	Does not take place because the desired level of activity can be maintained.
T2	Does not take place.
T0 to T3	Although Technical Event has no Operational Consequence at the time, a RAT score is required because there would be consequences under other operational conditions.
T3	Technical Occurrence finishes.
T4	Does not take place.

Scenario D) : It is determined that ATC or pilot had been unknowingly operating with corrupt information.

Example 5: Technical event provides misleading information

The chart below illustrates a technical event which is at the time unknown to Engineering, ATC or Pilot and provides corrupt information to ATC or Pilot which they believe to be correct.

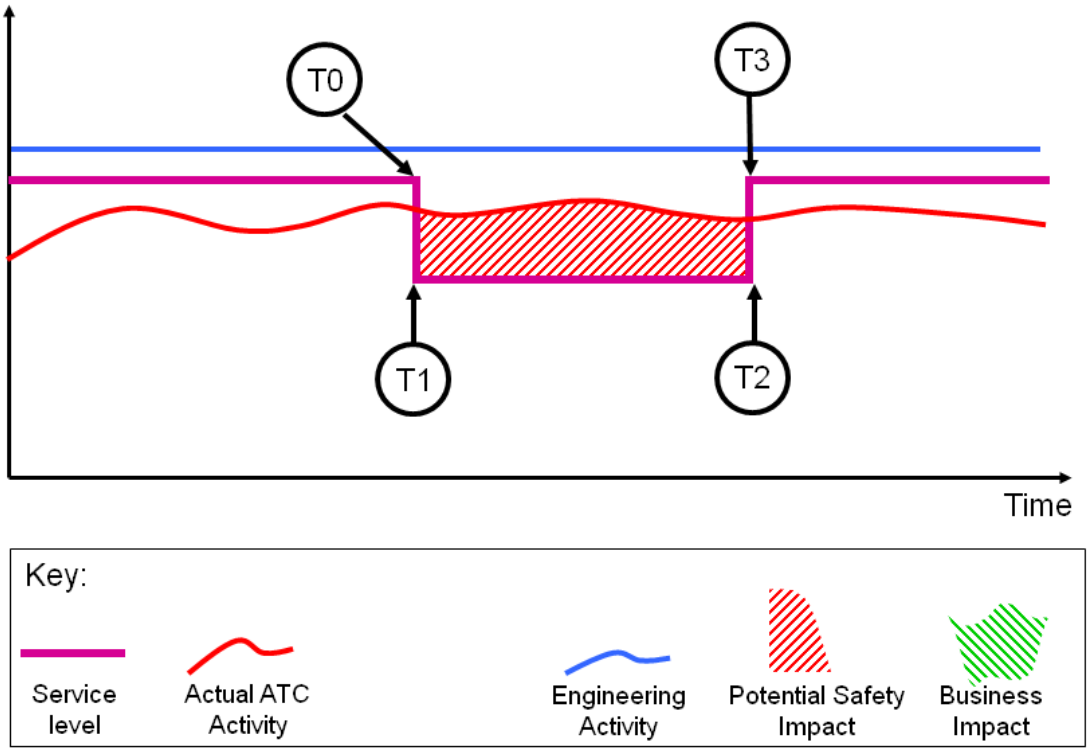

Figure 24– ATM Specific Occurrences – 'operating with corrupt information'

The following moments are depicted on the time line of the occurrence:

T0	Technical Event commences.
T1	ATC or Pilot operate, unaware of the misleading information being provided. A RAT score is required.
T1 to T2	Potential safety impact on ATC or pilot
T3	The ATM Specific Technical Event finishes

3.3.2 Service Provided

Each ATM Specific Occurrence shall be classified in one of the following ATM/ANS functions or services, based on the type of service that the system is providing or supporting:

- **Communication**

Aeronautical fixed and mobile services to enable ground-to-ground and air-to-ground communications for ATC purposes;

- **Navigation Services**

Those facilities and services that provide aircraft with positioning and timing information;

- **Surveillance Services**

Those facilities and services used to determine the respective positions of aircraft to allow safe separation;

- **ATC Automation**

The various flight information services, alerting services, air traffic advisory services and ATC services (area, approach and aerodrome control services);

- **Airspace Management**

A planning function with the primary objective of maximising the utilisation of available airspace by dynamic time-sharing and, at times, the segregation of airspace among various categories of airspace users on the basis of short-term needs;

- **Air Traffic Flow and Capacity Management**

Function established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilised to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate air traffic service providers.

- **Information Services**

A service established within the defined area of coverage responsible for the provision of aeronautical information and data necessary for the safety, regularity and efficiency of air navigation.

3.3.3 Operational Function

Each ATM Specific Occurrence shall be further classified, for each type of service provided, in one of the air traffic controller (ATCO) or pilot operational functions supported by the system:

- **Communication Services**
  - ➔ ***Air/Ground Communication Function***

    Two-way communication between aircraft and stations or locations on the surface of the Earth.

  - ➔ ***Ground/Ground Communication Function***

    Two-way communication between stations or locations on the surface of the Earth.

- **Navigation Services**
  - ➔ **Instrument Navigation**

    Utilizes various electronic systems that radiate radio frequency signals in space to aircraft avionic systems that provide pilots with information about the flight situation of their aircraft, such as bearing and distance as well as aircraft timing and vertical and horizontal positioning information. This functionality affords pilots the ability to navigate in any type of weather conditions.

  - ➔ **Satellite Navigation**

    Satellite navigation systems utilize autonomous geo-spatial positioning from a system of satellites providing small electronic GPS, WAAS or LAAS receivers to determine their location to high precision using time signals transmitted along a line of sight by radio from satellites.

  - ➔ **Visual Navigation**

    Airport runway lighting systems provide pilots with runway extended centerline, runway end identification or visual vertical guidance to a single runway.

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- **Surveillance Services**

  ➔ ***Air Surveillance***

  Those facilities and services used to determine the respective positions of aircraft in the air.

  ➔ ***Ground Surveillance***

  Those facilities and services used to determine the respective positions of aircraft and vehicles on the ground. *Remark: Ground surveillance may also cover airborne aircraft.*

- **ATC Automation**

  ➔ ***Flight and Surveillance Processing***

  Specified information provided to air traffic service units, relative to an intended flight or portion of a flight of an aircraft.

  ➔ ***Surface Movement Guidance and Control (SMGC)***

  The SMGC function provides routing, guidance and surveillance for the control of aircraft and vehicles. This function enables the maintenance of the declared surface movement rate under all weather conditions within the aerodrome visibility operational level (AVOL) while maintaining the required level of safety.

  ➔ ***Operations Room Management***

  This function enables the user to combine or split sectors and assign different roles on a controller working position (CWP).

  ➔ ***Decision Making Support***

  The following tools have been considered, inter-alia as a decision making aid to the air traffic controller:

  – Medium Term Conflict Detection (MTCD)
  – Arrival/Departure Manager (A/D-MAN)
  – Airport Collaborative Decision Making (A-CDM)

  ➔ ***Safety Nets***

  A ground based safety net denominates a functionality of the ATM system related to the ANSP with the sole purpose of monitoring the environment of operations in order to provide timely alerts of an increased risk to flight safety which may include resolution advisories.

- **Airspace Management**

  ➔ ***Real Time Airspace Environment***

  The display on the executive air traffic controller position of all the airspace configuration at the time (e.g. restricted/ danger areas).

- **Air Traffic Flow and Capacity Management**

  ➔ ***Tactical and Real Time***

  The function that provides traffic prediction, flow monitoring and alerting.

- **Information Services**

  ➔ ***Aeronautical Information***

  This operational function is related to the provision of aeronautical information and data necessary for the safety, regularity and efficiency of air navigation

  ➔ ***Meteorological Information***

  The meteorological information consists of reports, analysis, forecasts, and any other statements relating to existing or expected meteorological conditions.

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3.3.4 Type of Failure

The RAT user should chose the most appropriate type of failure for the ATM Specific Occurrence under assessment, from the following choices:

- **Total Loss of Function**

The function is not available to the controller or pilot.

- **Partial Loss of Function**

Not all the elements of the function are available to the ATC or Pilot (e.g. loss of one or several sub-functions).

- **Redundancy Reduction**

It represents a loss of a technical back-up.

- **Undetected Corruption of Function**

Data presented is incorrect but is not detected and used as being correct. If the corruption is detected it means the function will have to be removed totally (total loss of function) or partially (partial loss of function).

- **Loss of Supervision**[1]

The function cannot be monitored or controlled. In case that the loss of supervision leads to the removal of the main function the ATM Specific Occurrence shall be scored as a 'total loss' of the function.

- **Corruption of Supervision**[1]

The undetected corruption of supervision has no actual or potential operational impact unless a second failure occurs, or in case of lack of action when needed. In case of action taken based on an erroneous indication the user of the RAT should score the failure incurred by the respective action

The Figure 25 below illustrates the concepts of **Total Loss of function** and **Redundancy Reduction** for the **failure of Air-Ground Communication function**

[1] These types of failures shall not be scored in the framework of the Performance Scheme Regulation and not reported via the Annual Summary Template.

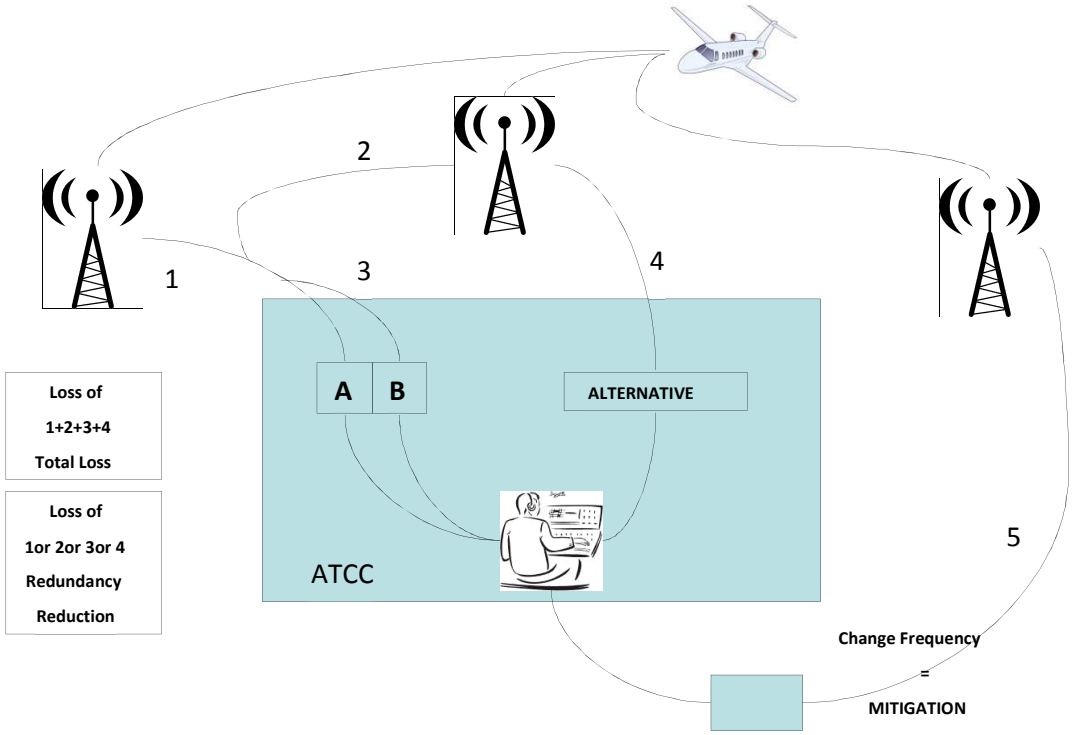

Figure 25– ***ATM Specific Occurrences – 'Total Loss and Redundancy Reduction - Failure of Air-Ground Communication'***

3.3.5 Air Traffic Services Affected

The effect of the system failure will be assigned to one of the following services:

- **(Upper) Area Control Centre**

ATC service for controlled flights in a block of airspace

- **Approach Control Service**

ATC service provided to arriving and departing traffic

- **Aerodrome Control**

ATC service provided to aerodrome traffic

- **Oceanic Control**

ATC service provided to flights over the high seas

- **Flight Information Service**

Service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.

3.3.6 Extension

The physical extension of the failure will be categorised as:

- **Controller Working Position (CWP)**

One Controller Working Position.

- **Sector Suite**

A set of CWPs which work together to control a sector(s).

- **Multiple Suites**

Self-explanatory.

- **Unit**

The unit represents the entire ACC/UAC/APP/TWR's operations room as applicable

The picture below illustrates the different options available in the Extension criterion: CWP, Sector and Unit.

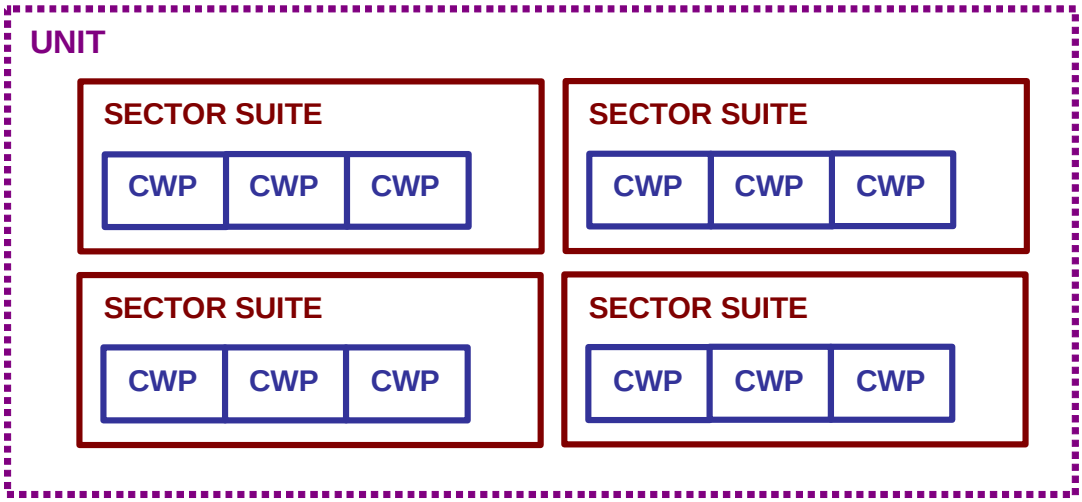

Figure 26 – ***ATM Specific Occurrences – 'Extension of the failure in an ATC Unit'***

If a **Sector** is made of a **single CWP**, **Extension** should be scored as **Sector**. Equally if the **Unit** is made of a **single Sector** the **Extension** should be scored as **Unit**.

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3.3.7 Scope

The operational scope of the effect of the technical failure is classified as one of the following options:

- **One**

One frequency, one aircraft as applicable.

- **Some**

More than one frequency, more than one aircraft as applicable and less than all.

- **All**

All ATCO / Pilot communications.

This criterion defines the scope based on what the operational function is expected to deliver.

The table below gives an indication of what one/some/all represents for different operational functions.

Services	Operational functions	Scope (how many … were impacted)
Communication	Air/Ground Communication	Communication(s) ATCO/Pilot
Communication	Ground/Ground Communication	Communication(s) ATCO/ ATCO
Navigation	Navigation	Pilots(s)
Surveillance	Air Surveillance	Displayed Radar Track(s)
Surveillance	Ground Surveillance	Displayed Radar Track(s)
Surveillance	Surface Movement Guidance and Control	Aircraft(s)/Vehicle(s)
ATC Automation	Flight and Surveillance Processing	Flight Plans(s)
ATC Automation	OPS Room Management	N/A (extension should be sufficient)
ATC Automation	Decision Making Support	Flight(s)
ATC Automation	Safety Nets	Conflict(s)
ATC Automation	Real Time Airspace Environment	Route(s), Area(s), …
Air Traffic Flow Capacity Management	Tactical and Real Time	Flight(s)
Information Services	Aeronautical Information	Information Type(s)
Information Services	Meteorological Information	Information Type(s)

Table 2– *ATM Specific Occurrences – 'Sample of the Technical Failure scope'*

3.3.8 Determination of Severity

Following the classification of the occurrence for all criteria described above, the severity for that occurrence is determined by identifying the appropriate combination in the **look-up table** and retrieval of the **pre-determined severity in column "Severity"**.

The look-up table contains, as far as possible, all the realistic combination of the criteria described in this section.

An occurrence code is uniquely assigned to each combination of failure modes listed in the look-up table.

A severity is predefined for each of the identified realistic combinations of the above criteria. The predefined severity was determined by the members of the RUG based on the experience gained at national level in investigating these types of system failures.

Code	Service Affected	Services	Operational functions	Type of Failure	Extension	Scope	uratio	T1	Severity
AR-AGC/000	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	Unit	All	> T1		AA
AR-AGC/001	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	Unit	Some	> T1		AA
AR-AGC/002	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	Unit	One	> T1		A
AR-AGC/010	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	Multiple Suites	All	> T1		AA
AR-AGC/011	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	Multiple Suites	Some	> T1		A
AR-AGC/012	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	Multiple Suites	One	> T1		A
AR-AGC/020	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	Sector Suite	All	> T1		X
AR-AGC/021	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	Sector Suite	Some	> T1		X
AR-AGC/022	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	Sector Suite	One	> T1		B
AR-AGC/030	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	CWP	All	> T1		X
AR-AGC/031	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	CWP	Some	> T1		B
AR-AGC/032	Area control services	Communication	Air/Ground Communication	Undetected Corruption of function	CWP	One	> T1		B
AR-AGC/100	Area control services	Communication	Air/Ground Communication	Total Loss of function	Unit	All	> T1		AA
AR-AGC/101	Area control services	Communication	Air/Ground Communication	Total Loss of function	Unit	Some	> T1		AA
AR-AGC/102	Area control services	Communication	Air/Ground Communication	Total Loss of function	Unit	One	> T1		A
AR-AGC/110	Area control services	Communication	Air/Ground Communication	Total Loss of function	Multiple Suites	All	> T1		AA
AR-AGC/111	Area control services	Communication	Air/Ground Communication	Total Loss of function	Multiple Suites	Some	> T1		A
AR-AGC/112	Area control services	Communication	Air/Ground Communication	Total Loss of function	Multiple Suites	One	> T1		A
AR-AGC/120	Area control services	Communication	Air/Ground Communication	Total Loss of function	Sector Suite	All	> T1		A
AR-AGC/121	Area control services	Communication	Air/Ground Communication	Total Loss of function	Sector Suite	Some	> T1		A
AR-AGC/122	Area control services	Communication	Air/Ground Communication	Total Loss of function	Sector Suite	One	> T1		A
AR-AGC/130	Area control services	Communication	Air/Ground Communication	Total Loss of function	CWP	All	> T1		B
AR-AGC/131	Area control services	Communication	Air/Ground Communication	Total Loss of function	CWP	Some	> T1		B
AR-AGC/132	Area control services	Communication	Air/Ground Communication	Total Loss of function	CWP	One	> T1		B
AR-AGC/200	Area control services	Communication	Air/Ground Communication	Partial Loss of function	Unit	All	> T1		C
AR-AGC/201	Area control services	Communication	Air/Ground Communication	Partial Loss of function	Unit	Some	> T1		C
AR-AGC/202	Area control services	Communication	Air/Ground Communication	Partial Loss of function	Unit	One	> T1		C

Table 3 – ***ATM Specific Occurrences – 'Sample of the Look-Up Table'***

3.3.9 Severity Classes

Consequently, the following severity classes have been defined for scoring the ATM Specific Occurrence:

- **AA – Total inability to provide safe ATM Services**

An occurrence associated with the total inability to provide any degree of ATM Services in compliance with applicable Safety Regulatory Requirements, where:

– there is a sudden and non-managed total loss of ATM service or situation awareness;

– There is a totally corrupted ATM service or corrupted information provided to ATS personnel.

- **A – Serious inability to provide safe ATM Services**

An occurrence associated with almost a total and sudden inability to provide any degree of ATM Services in compliance with applicable Safety Regulatory Requirements. It involves circumstances indicating that the ability to provide ATM services is severely compromised and has the potential to impact many aircraft safe operations over a significant period of time.

- **B – Partial inability to provide safe ATM Services**

An occurrence associated with the sudden and partial inability to provide ATM Services in compliance with applicable Safety Regulatory Requirements.

- **C – Ability to provide safe but degraded ATM Services**

An occurrence involving circumstances indicating that a total, serious or partial inability to provide safe and non-degraded ATM Services could have occurred, if the risk had not been managed / controlled by ATS personnel within Safety Regulatory Requirements, even if this implied limitations in the provision of ATM Services.

- **E – No effect on ATM Services**

Occurrences which have no effect on the ability to provide safe and non-degraded ATM Services.

- **D – Not determined**

Insufficient information was available to determine the risk involved or inconclusive or conflicting evidence precluded such determination.

It is to be noted that in case of combination of criteria that are not realistic the severity is marked 'X' in the look-up table.

3.3.10 User Interface RAT web version

A drop-down menu is available listing the available options for each criterion. Once all the criteria are answered (i.e. one of the options is selected) the severity is retrieved from the 'Look-up' table and displayed. At the same time the unique code for the respective combination is also retrieved (see column 1 in the Look-up Table 3 – *ATM Specific Occurrences – 'Sample of the Look-Up Table'*).

- **Entry Criteria**

The T1 value for the identified failure mode is displayed to the extent to which this value has been established and stored in the web-tool by the user.

The definition of T1 for each failure mode is a prerogative of each service provider that implemented the RAT methodology, taking into account the particularities of its own system. However this task is not compulsory and depends on the user's available resources. As such a user should consider that the entry criteria for the application of the RAT methodology, as defined in paragraph 3.3.1, are satisfied when an event lasts longer than the defined T1.

- **Range of Severities**

Once the user selects the service that failed the range of possible severities is displayed in the appropriate box on the left hand side. Therefore, the user would be able to identify the lowest and highest severity for the failure under scrutiny very early in the risk assessment process.

- **Failure Combination Code**

Once the other criteria are selected, the range of severities is reduced to a unique failure mode. A failure combination code is also displayed for further reference.

- **Examples**

This feature allows the user to record a technical failure of the services provided that took place in the past without having to insert, yet again all the criteria.

To this end, once the identification of the service failure is completed, the user could click on the 'Examples' button (see screen shot Figure 27– *ATM Specific Occurrences – 'Web-Tool Features'*) for the list of previous failures of that service that have been recorded into the RAT web-tool.

In case that an identical failure is already recorded the user should select the appropriate example from the pop-up list and click the 'OK' button. As such, all the criteria of the failure are automatically filled-in together with the associated severity.

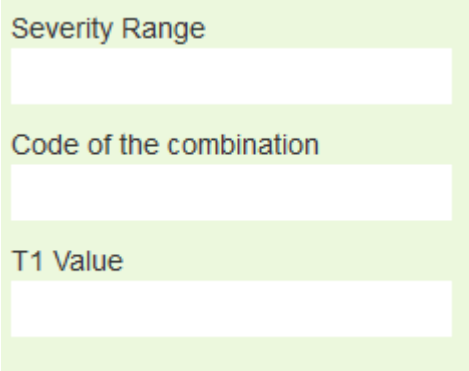

Figure 27– *ATM Specific Occurrences – 'Web-Tool Features'*

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4 Repeatability

The repeatability part of the RAT scheme aims at assessing the likelihood of recurrence. Therefore, the severity of incident is not at all affected by this analysis.

The system for assessing the likelihood of recurrence of an ATM Specific Occurrence is based on a scoring system, and therefore totally different from the severity assessment mechanism.

4.1 Systemic Issues

This sub-criterion refers to absent or failed defences, including the systems, conditions, equipment, situations, procedures, counter measures or behaviours which normally prevent this type of events to occur. Systemic issues refer also to the organisational latent conditions that were present in the system before the incident, and may have contributed to the occurrence.

'System' is understood in the RAT framework to be the aggregation of people, equipment and procedures.

4.1.1 Procedures

The following options are available to assess the contribution of the operational procedures to the event and, therefore their impact on the likelihood of reoccurrence. These sub-criteria should be scored both for ATM Ground or ATM Airborne, as applicable.

- **Procedures – DESIGN**

This option should be selected when the applicable procedures are badly designed and therefore inducing safety issues. Cases involving overloads could be scored here (e.g. for design of the detection of overloads).

- **Procedures – IMPLEMENTATION**

This should reflect issues related to the implementation of a procedure, especially situation where implementation is not done as per design.

Cases involving overloads could be scored here (e.g. for implementation issues).

All the human aspects that impact on the implementation (lack of training or violation of procedures) shall NOT be scored here but in the Human Resources Management issues below.

- **Procedures LACK OF**

This covers the situation when procedures are needed but have not been developed. As such the absence of procedures was identified as a contributory cause to the occurrence.

Cases involving overloads could be scored here (e.g. lack of means to detect overloads).

4.1.2 Equipment

The same logic used for Procedures is to be followed for Equipment.

4.1.3 Human Resources Management

- **Human Resources Management (staff planning, assignment, training) DESIGN**

This refers to that part of the system which concerns 'people'. Therefore, it covers all related issues such as recruitment, training, competency checks as well as staff planning, operational room management etc.

The Human Resources Management design causes can range from the manpower planning up to shift roster and design of training etc. Those systemic causes should be retrievable amongst the occurrence causes.

ATM Airborne and ATM Ground columns are differentiated as one relates to aircraft and the other to the ground system, with the global ATM picture being given by the total sum of the two.

- **Human Resources Management IMPLEMENTATION**

This criterion refers to identified issues regarding: implementation of training; adherence to manpower policies; adherence to the rules of rostering, sector manning etc.

- **Human Resources Management LACK OF**

Human resource management is needed. Absence of human resources management was identified as a contributory cause to the assessed occurrence.

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4.2 Non-Systemic / Human Involvement Issues

4.2.1 Other Contributing Factors

- **Non-Systemic /Human Involvement Issues with Contextual Conditions**

Contextual conditions, as described in the EAM2/GUI 8[2], refer to the circumstances that exist at the time of the safety occurrence. Originally described by Reason (1990, 1991)[3] as "Psychological precursors of Unsafe Acts", they have also been variously described as preconditions for unsafe acts, task and environmental conditions, situational factors, conditions, or performance shaping factors.

In the occurrence investigation process, contextual conditions can be identified by asking "What were the conditions in place at the time of the safety occurrence that help explain why a person acted as they did?"

Therefore in order to identify a contextual condition an investigator shall ask the question whether the item describes an aspect of the workplace, local organisational climate, or a person's attitudes, personality, performance limitations, physiological or emotional state that helps explain their action?

Therefore there are five categories of contextual conditions that can be identified:

- Workplace conditions;
- Organisational climate;
- Attitudes and personality;
- Human performance limitations;
- Physiological and emotional factors

- **Non-Systemic /Human Involvement Issues <u>without</u> Contextual Conditions**

Other issues include human involvement (Human Factors) and active failures that are not necessarily identified as systemic issues but are contributing factors that led to the occurrence.

- Issues such as hear-back, read-back errors, all the physiological and psychological errors can be included in this category.
- It is sometimes difficult to identify a contributing factor as a systemic issue, even when 'substitution' test techniques are applied. However, investigators will consider it worth retaining it for subsequent trend analysis.

[2] Guidelines on the Systemic Occurrence Analysis Methodology (SOAM)

[3] Reason, J. (1990). *Human error.* New York: Cambridge University Press.

Reason, J. (1991). Identifying the latent causes of aircraft accidents before and after the event. *Proceedings of the 22ndISASI Annual Air Safety Seminar, Canberra, Australia.* Sterling, VA: ISASI.

4.3 Window of Opportunity

This criterion refers to the possibility of such a situation (traffic, weather and other elements) to exist in the future in conjunction with the working methods in use at the time of occurrence.

Methods or techniques either normal, degraded mode or exceptional are roughly linked to the type of situation.

This criterion should capture the circumstances in conjunction with the methods/techniques to be applied. It concerns the categories of 'emergency/unusual' and 'workload peak' where there is not necessarily an obvious link with the techniques to be applied.

The 'Emergency/unusual' category should be selected if at the time of the occurrence, there were already emergency or unusual situations being handled by the ATM Ground (e.g. aircraft hijack, radio communication failure, bomb threat, engine failure etc.)

- **Normal**

The ATM Unit operations under its normal conditions without any degraded modes or contingencies in place.

- **Degraded Mode**:

The ATM unit is working at a reduced level of service induced by equipment outage or malfunctions, staff shortage or procedures are becoming inadequate as a knock-on effect of one or several deficient system elements.

- **Contingency**

At the time of the occurrence, the ATM unit is operating under exceptional conditions that called for the introduction of contingency measures (e.g. industrial action, pandemics, closure of airspace for major military exercises or war operations etc).

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5 Acronyms

A-SMGCS	Advanced Surface Movement Guidance and Control System
ANSP	Air Navigation Service Provider
APW	Area Proximity Warning
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATS	Air Traffic Services
CAS	Controlled Airspace
CFIT	Controlled Flight Into Terrain
CPA	Closest Point of Approach
ESARR	EUROCONTROL Safety Regulatory Requirement
EUROCONTROL	European Organisation for the Safety of Air Navigation
GA	General Aviation
GPWS	Ground Proximity Warning System
HEIDI	Harmonisation of European Incident Definition Initiative for ATM
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IMC	Instrumental Meteorological Conditions
MSAW	Minimum Safe Altitude Warning
RA	Resolution Advisory
RF	Reliability Factor
RF_R	Reliability Factor for Repeatability
RF_S	Reliability Factor for Severity
RIMCAS	Runway Incursion Monitoring and Conflict Alerting System
ROC	Rate of Climb
ROD	Rate of Descent
R/T	Radio Telephony
SAFREP	Safety Data Reporting and Data Flow Task Force
SNETS	Safety Nets
SOAM	Systemic Occurrence Analysis Methodology

SOFIA	Sequentially Outlining and Follow-up Integrated Analysis
STCA	Short Term Conflict Alert
TCAS	Traffic alert and Collision Avoidance System
TAWS	Terrain Awareness Warning System
TWR	Tower
VFR	Visual Flight Rules

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6 References

COMMISSION REGULATION (EU) No 691/2010, 29 July 2010, laying down a performance scheme for air navigation services and network functions and amending Regulation (EC) No 2096/2005 laying down common requirements for the provision of air navigation services.

COMMISSION IMPLEMENTING REGULATION (EU) No 390/2013, 3 May 2013, laying down a performance scheme for air navigation services and network functions.

EATMP SOFIA Reference Manual (Edition 1.0, 22 October 2002), EUROCONTROL , Brussels.

EUROCONTROL ESARR 2: Reporting and Assessment of Safety Occurrences in ATM (Edition 3.0, 02.12.2009), EUROCONTROL, Brussels.

ICAO Doc 4444; Procedures for Air Navigation Services, Air Traffic Management, (Edition 15, 2007), Montreal, Canada.

RAT web tool:
http://www.srvs.nm.eurocontrol.int/rat/

7 List of Appendices

Appendix I More Than One Aircraft

This appendix provides more details and guidance on scoring possibilities for the following Controllability items:

- Conflict Detection
- Execution

Conflict Detection

– **Potential Conflict detected late (score 1)**

The air traffic controller became aware of the situation late, *on his own initiative* and before a loss of separation had occurred.

– **Potential conflict detected late (score 2)**

The air traffic controller became aware of the situation late, before a loss of separation occurred, but after being prompted either by another air traffic controller, pilot, STCA or other system warning.

– **Potential Conflict detected late (score 3)**

The conflict was detected by the ATM ground before a loss of separation occurred. However, the detection and resolution was done by a different air traffic controller from the one that was involved in the creation of the situation (e.g. aircraft transferred to another sector in an unsafe situation and the new sector controller detects the potential conflict).

– **Potential Conflict detected late (score 4)**

The potential conflict was only detected after the prescribed separation minima between the potential conflicting aircraft had been lost. The air traffic controller however was able to take effective collision avoidance.

Execution

Some more details of how the Execution can be scored are shown below:

Consider how many errors contributed towards the event, up to a maximum of 4. This is however not a rule but guidance as to how to approach this area.

Read back errors should be counted as one point on the air traffic control side and one point on the airborne side. Failure to note an incorrect pilot call is one point.

The scenarios below provide detailed guidance on scoring the pilot's execution for several types of occurrences:

- **Airspace Infringements**

Aware of Airspace – pilot knows where boundary is but infringed it due to poor navigation, monitoring of ground features or poor height keeping.

Please use the lateral or vertical scale as appropriate to the error:

Pilot Execution	*Score*
Aware of airspace boundary and infringement up to 1 Nm or up to 400ft	1
Aware of airspace boundary and infringement up to 2 Nm or up to 600ft	2
Aware of airspace boundary and infringement up to 3 Nm or up to 800ft	3
Aware of airspace boundary and infringement up to 4 Nm or up to 1000ft	4
Misread Chart / Planning Info and therefore believed outside of Controlled Airspace (CAS).	5
* No information available	5
Pilot temporarily uncertain of position and takes own resolution to clear airspace	6
Pilot Lost requiring ATC assistance to leave airspace	7
Regardless of above – any Infringement of MORE than 4 Nm or more than 1000ft	7
Unaware of the airspace	8-9
Deliberate Non-Conformance	10

*Investigators should apply local knowledge to common routes that are known to be used by aircraft to go around or under CAS. If the investigator is satisfied, from the evidence, that there is a high probability that the pilot was attempting to follow a known common route then it may be considered that the pilot was aware of the airspace boundary.

Additional points can be added for other errors.

- Level Bust

Pilot Execution	*Score*
Up to 400ft and self-correcting or pilot check of cleared level	1
Up to 600ft and self-correcting or pilot check of cleared level	2
Up to 800ft and self-correcting or pilot check of cleared level	3
Up to 1000ft and self-correcting or pilot check of cleared level	4
More than 1000ft and self-correcting or pilot check of cleared level	5
No information available	5
Recovery due ATC, up to 500ft from cleared level	5
Recovery by ATC, more than 500ft and up to 1000ft from	6

Pilot Execution	*Score*
cleared level	
Recovery by ATC, more than 1000ft from cleared level	7
Recovery by ATC, more than 1000ft and up to 2000ft from cleared level	8
Unaware of any cleared level	9
Deliberate Non-Conformance	10

Additional points can be added for other errors

- Level Bust due to Emergency or Weather

Pilot Execution	*Score*
Left assigned level due to an emergency (score dependent on subsequent actions)	0-2
Left assigned level due to technical/weather problem (score dependent on subsequent actions)	1-3

Additional points can be added for other errors

- Speed Control

Pilot Execution	*Score*
Less than 20kts from the instructed speed or slow to reduce to instructed speed	1-2
20kts to 30kts from the instructed speed	3
More than 30kts up to 40 kts from instructed speed	5
More than 40kts from instructed speed	7

Additional points can be added for other errors.

- Incorrect entry into Oceanic Airspace

Pilot Execution	*Score*
Did not enter Oceanic airspace at assigned level/track/time, En-route to assigned level/track, not more than 500ft/2mins/15 miles deviation	1-2
Did not enter Oceanic airspace at assigned level/track/time, En-route to assigned level/track, more than 500ft/2mins/15 miles but less than 1000ft/4mins/30miles deviation	3-4
Did not enter Oceanic airspace at assigned level/track/time, En-route to assigned level/track, more than 1000ft/4mins/30miles deviation but less than 2000ft/6mins/45 miles deviation	5-6
Did not enter Oceanic airspace at assigned level/track/time, En-route to assigned level/track by more than 2000ft/6mins/45 miles deviation	7-8
Entered Oceanic airspace without a clearance	8

Pilot Execution	*Score*
Entered Oceanic airspace without a clearance and without ATC Communications for at least 5 minutes or by next system warning?	9
Entered Oceanic airspace without a clearance and with intentional non- conformance	10

- Deviation from clearance within Oceanic airspace due to mitigating contextual reasons such as an emergency, technical problem or weather-related problem

Pilot Execution	*Score*
Due to an emergency, technical or weather related problem the pilot requested a deviation from clearance from ATC first and there being no ATC clearance available, complied with Contingency procedures (or better)	0
Due to an emergency, pilot deviated from clearance without informing ATC first. Unable to maintain level but took some mitigating action	0
Due to an emergency, pilot deviated from clearance without informing ATC first. Unable to maintain level but did not take any mitigating action	1
Due to an emergency, pilot deviated from clearance without informing ATC first, but did comply with Contingency procedures (or better)	1
Due to a technical or weather related problem, pilot deviated from clearance without informing ATC first, but complied with Contingency procedures (or better)	2
The pilot requested a deviation from clearance from ATC first, and there being no ATC clearance available, did not comply with Contingency procedures	4
The pilot deviated from clearance without informing ATC first, did not comply with contingency procedures, but did take some mitigating action	5 - 7
Did not comply with contingency procedures and did not inform ATC or take any known mitigating action	8

- Deviation from clearance within Oceanic airspace with no mitigating contextual factors e.g. GNE

Pilot Execution	*Score*
Deviated from assigned level/track, not more than 500ft/2mins/15 miles	1 - 2
Deviated from assigned level/track, more than 500ft /2mins/15 miles, but not more than 1000ft/4mins/30 miles	3 - 4

Pilot Execution	*Score*
Deviated from assigned level/track, more than 1000ft/4 mins/30 miles, but not more than 2000ft/6mins/45 miles	5 - 6
Deviated from assigned level/track by more 2000ft/6 mins/45 miles	7 -9
Intentional non- conformance	10

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Appendix II Aircraft – Aircraft Tower

This appendix provides more details and guidance on scoring possibilities for the following Severity and Controllability items:

- Separation
- Conflict Detection
- Execution

Please note that the ICAO definition is used when referring to runway strip; "the runway strip is a defined area including the runway and stopway."

Separation

– Aircraft lands without clearance

- **Safety Margin Infringed Critical**

This option should be scored if the landing aircraft collides with or passes an aircraft/vehicle on the runway strip with no possibility of stopping. No collision avoidance action is taken OR the action taken was so late that there was a high chance of collision. (score 10).

- **Safety Margin Infringed Significant**

When the landing aircraft crosses the threshold there is another aircraft/vehicle on the runway strip and in the first half of the runway but one or both of the parties is able to stop or turn off (score 7-9 depending on the minimum distance achieved).

- **Safety Margin Infringed Medium**

When the landing aircraft crosses the threshold there is another aircraft/vehicle on the runway strip beyond the first half of the runway but one or both of the parties is able to stop or turn off (score 4-6 depending on the minimum distance achieved).

- **Safety Margin Infringed Minor**

When the landing aircraft crosses the runway threshold there is another aircraft/vehicle within the protected area but clear of the runway strip (score 1-3 depending on the minimum distance achieved).

- **Safety Margin Achieved at CPA**

This option should be selected if there is no other aircraft/vehicle within the protected area when the landing aircraft crosses the threshold (score 0).

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– Aircraft takes off without clearance

- **Safety Margin Infringed Critical**

The departing aircraft collides with or passes an aircraft /vehicle on the runway strip without the possibility of stopping. No collision avoidance action is taken OR the action taken was so late that there was a high chance of collision (score 10).

- **Safety Margin Infringed Significant**

When the aircraft commences takes-off there is another aircraft /vehicle on the runway strip in the first half of the runway, but one or both of the parties is able to stop or turn off (score 7-9 depending on the minimum distance achieved).

- **Safety Margin Infringed Medium**

When the aircraft commences take-off there is another aircraft /vehicle on the runway strip but beyond the first half of the runway. One or both of the parties is able to stop or turn off (score 4-6 depending on the minimum distance achieved).

- **Safety Margin Infringed Minor**

When the aircraft commences take-off there is another aircraft/vehicle within the protected area but clear of the runway strip (score 1-3 depending on the minimum distance achieved).

- **Safety Margin Achieved at CPA**

This option should be selected if there is no other aircraft /vehicle within the protected area at the time the aircraft commences take-off (score 0).

– ATC incorrectly clears an aircraft to land or take off

- **Safety Margin Infringed Critical**

ATM Ground incorrectly cleared an aircraft to land or take-off. That aircraft collides with or passes an aircraft/vehicle on the runway strip with no possibility of stopping. No collision avoidance action is taken or the action taken was so late that there was a high chance of collision (score 10).

- **Safety Margin Infringed Significant**

ATM Ground incorrectly cleared an aircraft to land or take-off. When the landing aircraft crossed the runway threshold or the departing aircraft commenced its take-off, there is another aircraft /vehicle on the runway strip in the first half of the runway. One or both of the parties is able to stop or turn off (score 7-9 depending on the minimum distance achieved).

- **Safety Margin Infringed Medium**

ATM Ground incorrectly cleared an aircraft to land or take-off. When the landing aircraft crossed the threshold or the departing aircraft commenced its take-off, there is another aircraft /vehicle on the runway strip but beyond the first half of the runway. One or both of the parties is able to stop or turn off.

OR

Go-arounds from less than 1 Nm from the runway threshold.

(score 4-6 depending on the minimum distance achieved)

- **Safety Margin Infringed Minor**

ATM Ground incorrectly cleared an aircraft to land or take-off. When the landing aircraft crossed the threshold or the departing aircraft commenced its take-off there was another aircraft /vehicle within the protected area but clear of the runway strip.

OR

Go-arounds and cancellation of landing clearance between 4Nm and 1Nm from the threshold

OR

The aircraft that has been cleared for take-off does not commence its roll; or ATC cancels the take-off clearance (score 1-3 depending on minimum distance and the time between clearance and cancellation of the clearance).

- **Safety Margin Achieved at CPA**

When the landing or departing aircraft passed abeam potentially conflicting traffic, that traffic is not within the protected area (Score 0).

– **Incorrect entry onto a runway with or without an ATC clearance. It includes incorrect action by an aircraft/vehicle/person or by ATC.**

- **Safety Margin Infringed Critical**

An aircraft/vehicle/person entered the runway incorrectly with or without clearance. It collided with, or passed another aircraft /vehicle without the possibility of stopping. No collision avoidance action is taken.

OR the action taken was so late that there was a high chance of collision (score 10).

- **Safety Margin Infringed Significant**

An aircraft/vehicle/person entered the runway incorrectly with or without clearance. There was another aircraft /vehicle on the runway strip, in unsafe proximity such that immediate recovery action is required to prevent a collision (score 7-9 depending on the minimum distance achieved).

- **Safety Margin Infringed Medium**

An aircraft/vehicle/person entered the runway incorrectly with or without clearance. There was another aircraft /vehicle moving on the runway strip, but not in unsafe proximity, such that no immediate recovery is required to resolve a collision. However, action is required to remove the conflict and regain safety requirements.

OR

Go-arounds due to an incorrect presence on the runway from less than 1 Nm from the runway threshold.

OR

Cancellation of a take-off clearance where the incorrect aircraft/vehicle is in a position on the runway strip, relative to the departing aircraft, such that a collision is unlikely. (score 4-6 depending on the minimum distance achieved).

- **Safety Margin Infringed Minor**

An aircraft/vehicle/person entered the runway incorrectly with or without clearance. There was another aircraft/vehicle on the runway strip but, even if no resolution action is taken by any party, there is no risk of collision.

OR

An aircraft/vehicle/person enters the protected area of the runway incorrectly with or without clearance, but remains clear of the runway edge.

OR

Go-arounds and cancellation of landing clearance due to an incorrect presence on the runway, between 4Nm and 1Nm from the runway threshold.

OR

Cancellation of take-off clearance where the incorrect aircraft/vehicle is in a position on the protected area of the runway, relative to the departing aircraft, such that a collision is unlikely.

(score 1-3 depending on minimum distance achieved)

- **Safety Margin Achieved at CPA**

An aircraft/vehicle/person incorrectly entered the protected area of the runway with or without clearance but when it passed

OR

was passed abeam by potentially conflicting traffic that traffic was not within the protected area.

Includes go-arounds or cancellation of landing clearance when inbound is more than 4Nm from the runway threshold (Score 0).

Conflict Detection

– **Potential conflict detected late (score 1)**

The air traffic controller became aware of the situation late, *on his own initiative* and before a loss of separation had occurred.

– **Potential conflict detected late (score 2)**

The air traffic controller became aware of the situation late, before a loss of separation occurred, but after being prompted either by another air traffic controller, pilot, STCA or other system warning.

– **Potential Conflict detected late (score 3)**

The conflict was detected by the ATM ground before a loss of safety margins occurred. However, the detection and resolution was done by a different air traffic controller from the one that was involved in the creation of the situation (e.g. aircraft transferred to another sector in an unsafe situation and the new sector controller detects the potential conflict).

– **Potential Conflict detected late (score 4)**

The potential conflict was only detected after safety margins had been eroded. The air traffic controller however was able to take effective collision avoidance.

Execution

Some more details of how the Execution can be scored are showed below:

Consider how many errors contributed towards the event, up to a maximum of 4. This is however not a rule but guidance as to how to approach this area.

Read back errors should be counted as one point on the air traffic control side and one point on the airborne side. Failure to note an incorrect pilot call is one point.

The scenarios below provide detailed guidance on scoring the pilot's execution for several types of occurrences:

- Runway Incursion

	Pilot/Driver Execution	Score
	Inadequate execution of the plan whilst taxying, infringing the protected area of for the runway (Cat 1 or Cat 3 holding point) and stops with no intention of entering the runway	1-2
	Inadequate execution of the plan in receipt of a clearance to enter the runway at correct intersection (crossing stop bars, out of sequence, etc)	3-4

	Pilot/Driver Execution	Score
	Inadequate execution of the plan whilst taxying, infringing the protected area for the runway (Cat 1 or Cat 3 holding point) and stopped by ATC/Pilot query	5
	Incorrect execution of the plan in receipt of a clearance to enter a runway enters at incorrect intersection or incorrect runway (depending on pilot's interpretation of ATC plan/read back etc).	5 - 7
	Incorrect execution of the plan – no clearance to enter but then entered/crossed the runway.	5 – 7
	No execution of the plan – take-off or landing without clearance, but with contextual factors (e.g expectation/ given a departure clearance when lined up/be ready immediate or landing in unusual/emergency circumstances).	7-8
	No execution of the plan – take-off or landing without clearance. No contextual factors	9
	Take-off or landing without a clearance including deliberate non-conformance.	10

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Appendix III Aircraft with Ground Movement

This appendix provides more details and guidance on scoring possibilities for the following Controllability items:

- Separation
- Conflict Detection

Separation

The following options are available:

- Safety margin achieved (score 0)
- Safety margin infringed minor (score 1)
- Safety margin infringed medium (score 4)
- Safety margin infringed medium (score 7)
- Safety margin infringed critical (score 10)

Users of the RAT methodology may choose to adjust the score as they see fit.

Conflict Detection

– **Potential conflict detected late (score 1)**

The air traffic controller became aware of the situation late, *on his own initiative* and before an erosion of the safety margins had occurred.

– **Potential conflict detected late (score 2)**

The air traffic controller became aware of the situation late, before an erosion of the safety margins occurred, but after being prompted either by another air traffic controller, pilot or a system warning.

– **Potential Conflict detected late (score 3)**

The conflict was detected by the ATM ground before a loss of separation occurred. However, the detection and resolution was done by a different air traffic controller from the one that was involved in the creation of the situation (e.g. aircraft transferred to another sector in an unsafe situation and the new sector controller detects the potential conflict).

– **Potential Conflict detected late (score 4)**

The potential conflict was only detected after the safety margins between the encounters had been eroded. The air traffic controller however was able to take effective collision avoidance.

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Appendix IV Only One Aircraft

This appendix provides more details and guidance on scoring possibilities for the following Severity and Controllability items:

- Separation
- Rate of Closure
- Conflict Detection
- Pilot Reaction

Separation

The table below provides more guidance on scoring proximity for the following type of occurrence:

- Airspace Excursion

Pilot Execution	Score
Excursion by up to half of standard separation (e.g. not more than1.5nm laterally or 500 ft vertically)	1
Excursion by more than half of standard separation, up to standard separation (e.g. more than 1.5nm and not more than 3nm or more than 500 ft and not more than 1000ft). Score depends on the time that the aircraft was outside the controlled/segregated airspace.	2-4
More than standard separation criteria e.g. more than 3nm or more than 1000 ft. Score depends on the time that the aircraft was outside the controlled/segregated airspace.	5-7
More than double standard separation criteria e.g. more than 6nm or more than 2000 ft.	8-10

Rate of Closure

The table below provides more guidance on scoring the rate of closure based on the aircraft ground speed or rate of climb/descent.

Pilot Execution	Score
up to 120 kts or up to 1000ft/min	1
between 120 kts and 200kts or between 1000ft/min up to 2000ft/min	3
between 200kts and 400kts or between	4

Pilot Execution	Score
2000ft/min and 4000ft/min	
more than 400kts or more than 4000ft/min	5

Conflict Detection

– **Potential Conflict detected late (score 1)**

The air traffic controller became aware of the situation late, *on his own initiative* and before a loss of separation had occurred.

– **Potential conflict detected late (score 2)**

The air traffic controller became aware of the situation late, before a loss of separation occurred, but after being prompted either by another air traffic controller, pilot or a system warning.

– **Potential Conflict detected late (score 3)**

The conflict was detected by the ATM ground before a loss of separation occurred. However, the detection and resolution was done by a different air traffic controller from the one that was involved in the creation of the situation (e.g. aircraft transferred to another sector in an unsafe situation and the new sector controller detects the potential conflict).

– **Potential Conflict detected late (score 4)**

The potential conflict was only detected after the prescribed separation minima between an aircraft and ground/area/obstacle had been lost. The air traffic controller however was able to take effective collision avoidance.

Pilot Execution

The scenarios below provide detailed guidance on scoring the pilot's execution for several types of occurrences:

- **Airspace Infringements**

Aware of Airspace – pilot knows where boundary is but infringed due to poor navigation, monitoring of ground features or poor height keeping.

Please use the lateral or vertical scale as appropriate to the error:

Pilot Execution	*Score*
Aware of airspace boundary and infringement up to 1 Nm or up to 400ft	1
Aware of airspace boundary and infringement up to 2 Nm or up to 600ft	2
Aware of airspace boundary and infringement up to 3	3

Pilot Execution	*Score*
Nm or up to 800ft	
Aware of airspace boundary and infringement up to 4 Nm or up to 1000ft	4
Misread Chart / Planning Info and therefore believed outside of CAS	5
* No information available	5
Pilot temporarily uncertain of position and takes own resolution to clear airspace	6
Pilot Lost requiring ATC assistance to leave airspace	7
Regardless of above – any Infringement of MORE than 4 Nm or more than 1000ft	7
Unaware of the airspace	8-9
Deliberate Non-Conformance	10

* Investigators should apply local knowledge to common routes that are known to be used by aircraft to go around or under CAS. If the investigator is satisfied, from the evidence, that there is a high probability that the pilot was attempting follow a known common route then it may be considered that the pilot was aware of the airspace boundary.

Additional points can be added for other errors.

- Level Bust

Pilot Execution	*Score*
Up to 400ft and self-correcting or pilot check of cleared level	1
Up to 600ft and self-correcting or pilot check of cleared level	2
Up to 800ft and self-correcting or pilot check of cleared level	3
Up to 1000ft and self-correcting or pilot check of cleared level	4
More than 1000ft and self-correcting or pilot check of cleared level	5
No information available	5
Recovery due ATC, up to 500ft from cleared level	5
Recovery by ATC, more than 500ft and up to 1000ft from cleared level	6
Recovery by ATC, more than 1000ft from cleared level	7
Recovery by ATC, more than 1000ft and up to 2000ft from cleared level	8

Pilot Execution	*Score*
Unaware of any cleared level	9
Deliberate Non-Conformance	10

Additional points can be added for other errors

- Level Bust due to Emergency or Weather

Pilot Execution	*Score*
Left assigned level due to an emergency (score dependent on subsequent actions)	0-2
Left assigned level due to technical/weather problem (score dependent on subsequent actions)	1-3

Additional points can be added for other errors

- Speed Control

Pilot Execution	*Score*
Less than 20kts from the instructed speed or slow to reduce to instructed speed	1-2
20kts to 30kts from the instructed speed	3
More than 30kts up to 40 kts from instructed speed	5
More than 40kts from instructed speed	7

Additional points can be added for other errors.

- Incorrect entry into Oceanic Airspace

Pilot Execution	*Score*
Did not enter Oceanic airspace at assigned level/track/time, En-route to assigned level/track, not more than 500ft/2mins/15 miles deviation	1
Did not enter Oceanic airspace at assigned level/track/time, En-route to assigned level/track, not more than 900ft/4mins/25 miles deviation	2
Did not enter Oceanic airspace at assigned level/track/time, En-route to assigned level/track, not more than 1000ft/5mins/26 miles deviation	4
Did not enter Oceanic airspace at assigned level/track And not en-route to that level/track	6
Entered Oceanic airspace without a clearance	8
Entered Oceanic airspace without a clearance and without	9

Pilot Execution	*Score*
ATC Communications for at least 5 minutes or by next system warning?	
Entered Oceanic airspace without a clearance and with intentional non- conformance	10

Additional points can be added for other errors.

- Deviation from clearance into Oceanic Airspace

Pilot Execution	*Score*
Due to an **emergency**, **technical** or **weather** related problem the pilot requested a deviation from clearance from ATC first and there being no ATC clearance available, complied with Contingency procedures (or better)	0
Due to an **emergency,** pilot deviated from clearance without informing ATC first. Unable to maintain level but took some mitigating action	0
Due to an **emergency,** pilot deviated from clearance without informing ATC first. Unable to maintain level but did not take any mitigating action.	1
Due to an emergency, pilot deviated from clearance without informing ATC first, but did comply with Contingency procedures (or better)	1
Due to a technical or weather related problem, pilot deviated from clearance without informing ATC first, but complied with Contingency procedures (or better)	2
The pilot requested a deviation from clearance from ATC first, and there being no ATC clearance available, did not comply with Contingency procedures	4
The pilot deviated from clearance without informing ATC first, did not comply with contingency procedures, but did take some mitigating action	5-7
Did not comply with contingency procedures and did not inform ATC or take any known mitigating action	8

Additional points can be added for other errors.

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