EUROCONTROL

RISK ANALYSIS TOOL

Guidance Material

1. Summary

Risk is a factor that exists in every human endeavour, including operations involving aircraft – whether in the air or on the ground. Each movement of aircraft involves some level of risk because the system, being human-based, is fallible. Identifying and mitigating risk is critical to increasing the level of safety. The Risk Analysis Tool (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 tool 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 tool 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 give guidance on how to use the severity and risk marksheets developed by EUROCONTROL

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

Consequently, it contains components and information that should be appropriate to score severity and risk of recurrence for safety occurrences as required by the Commission Regulation (EU) No 691/2010 on the performance scheme for air navigation services and network functions *(Performance Scheme Regulation)* and also by ESARR2 – Reporting and Assessment of Safety Occurrences in ATM.

The present version has been developed by the RAT User Group. This document is complemented by the Excel Qualitative marksheets.

The screen shots used on this guidance material are taken from the RAT web-tool developed by EUROCONTROL as they convey better the meaning than the Excel sheets.

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

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

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

2. Legal Basis

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 (Technical) Occurrences

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.

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3. Key Terms and Concepts

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 Risk Assessment Tool (RAT) based on the available safety data related to a given occurrence.

The interrelationships of these definitions are expressed in *Figure 1* below:

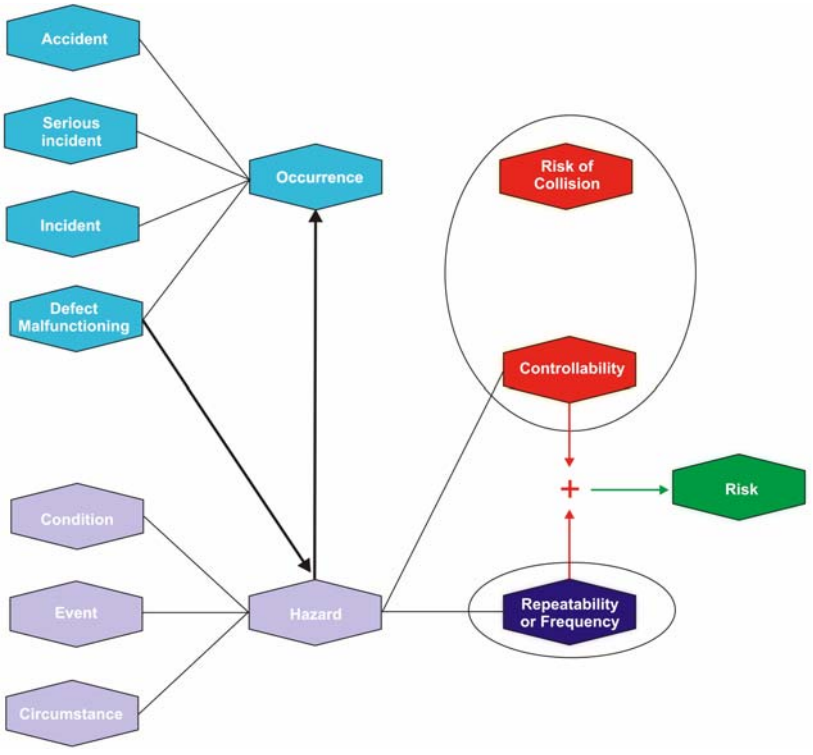

Figure 1 – *Schematic Representation of Definitions*

4. Scoring System

4.1. Overview of the scoring system

Within the RAT methodology, the assessment of 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 judgement which is easy to use.

The severity of the ATM Specific (Technical) events is established based on the use of a 'look-up' table that contains pre-defined severities for all the possible failure combinations. The likelihood of reoccurrence 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 to be used based on the number of aircraft involved or the type of occurrence under assessment (see Table 2 below).

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 for the conduct of the investigation of occurrence should normally be sufficient for the use of RAT. Otherwise, a RAT user shall reverse to the investigation process in the attempt to collect the missing data. In this respect it is acknowledge 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).

4.2. 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.

5. Risk Assessment

5.1. Overview of the Process

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 number of aircraft involved in the event, type of occurrence and also the associate guidance provided for each scenario (see Table 2 below).

Although by using the RAT a user (or a group of users) would considerably increase the objectivity of the risk assessment, it should be noted that the tool 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 later 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 tool 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.

Number of aircraft involved	Marksheet to be used Section Reference in this document	Purpose
More than one aircraft	3.2.1	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	3.2.2	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	3.2.3	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	3.2.4	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	3.1.5	To be applied in the cases of technical occurrences affecting one's capability to provide safe ATM services.

Table 2 – *Types of Scoring Mark sheets*

5.2. RAT Structure

RAT is built around the set of marksheets listed in the Table 2 above. A user should select the most appropriate one to be used, 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.

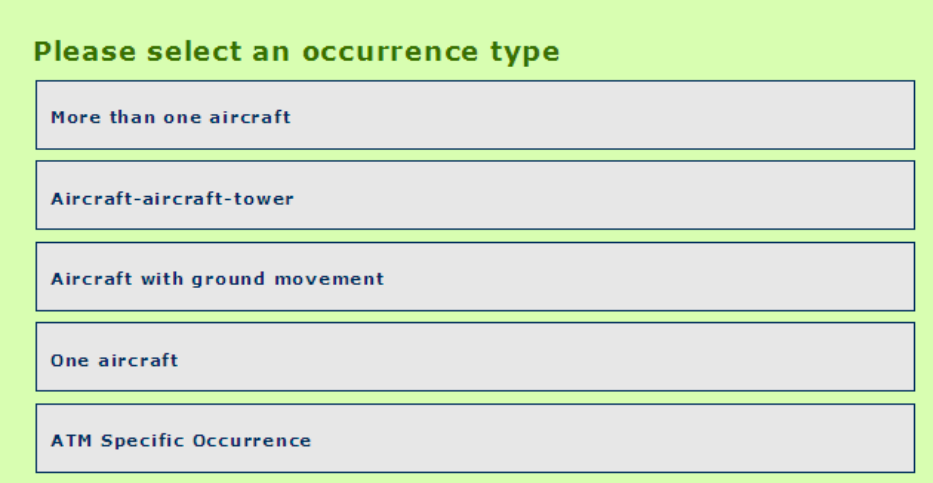

Figure 3 – *RAT Structure*

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 and Risk ATM Ground boxes should be used to record the final risk values as modified by the panel. It is to be noted that 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 administrative data related to each occurrence (i.e. national occurrence number, date, time) and also the description of the events

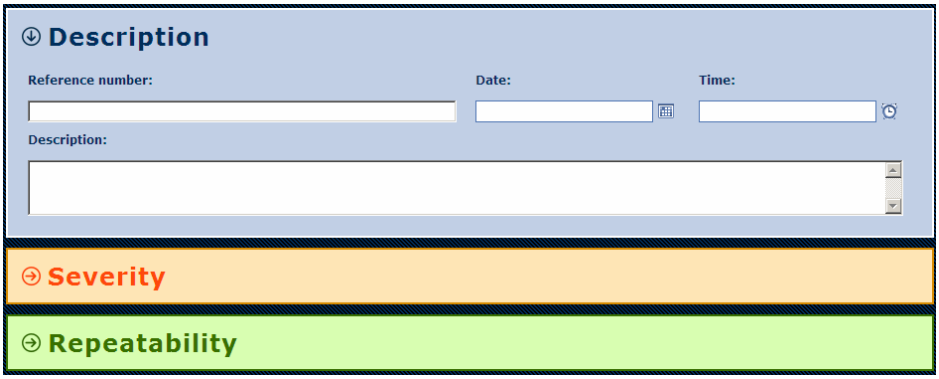

Figure 4 – *Marksheets' Structure*

The appropriate fields of the ATM Ground and ATM Airborne columns are available for the user to score all the criteria listed under severity and repeatability sections. The values for the 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.

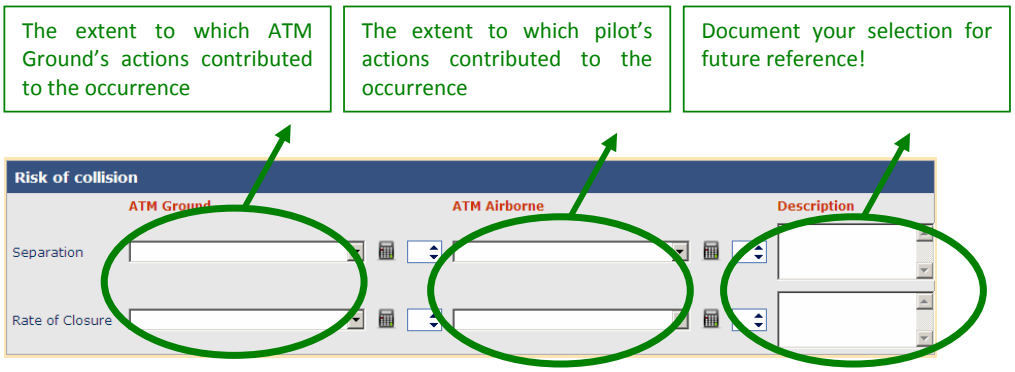

Figure 5 – *Risk of Collision*

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

At the top of each marksheet a dynamic view of how the severity and risk of reocurrence 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 computes potentially values for all ATM segments (Ground and ATM Overall). In addition to the ESARR2 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 occurrence.

The determination of the overall ATM risk is normally a regulatory task that takes into account the combined ground and airborne contribution. This value should be made available to the public through the Annual Summary Template (AST) as required by ESARR2.

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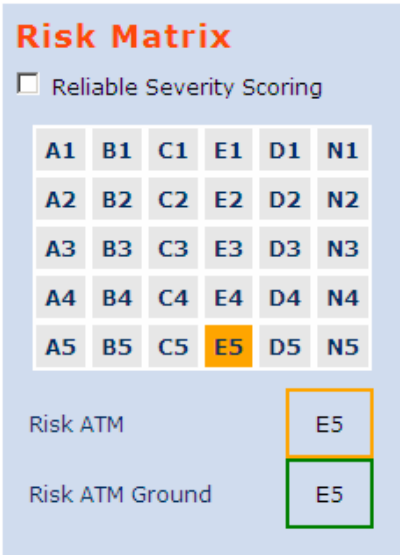

Figure 6 – *Risk Matrix Operational Occurrences*

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 a certain category of occurrences). As part of the reporting exercise the States would have to indicate, at the level of occurrence, whether RAT was used for deriving the risk and whether the value is either associated with ATM Ground or ATM Overall segments.

It is to be noted that the RAT offers the possibility to a user to set the ATM Ground Contribution to highlight the ATM Ground (i.e. ANSP provider) contribution to the occurrence under scrutiny. This value is particularly important to highlight the performance of the ground component, particularly in case of complex events involving several ANS providers. 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.

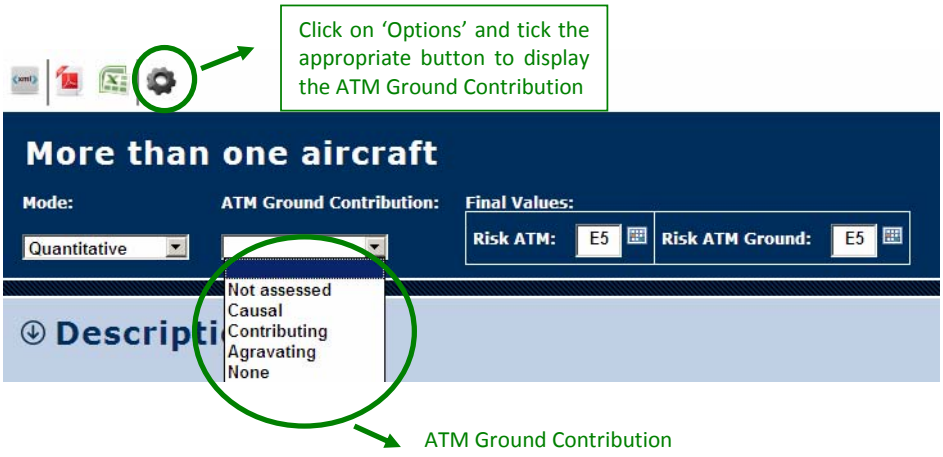

Figure 7 – *ATM Ground Contribution*

The tool 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 8 below).

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

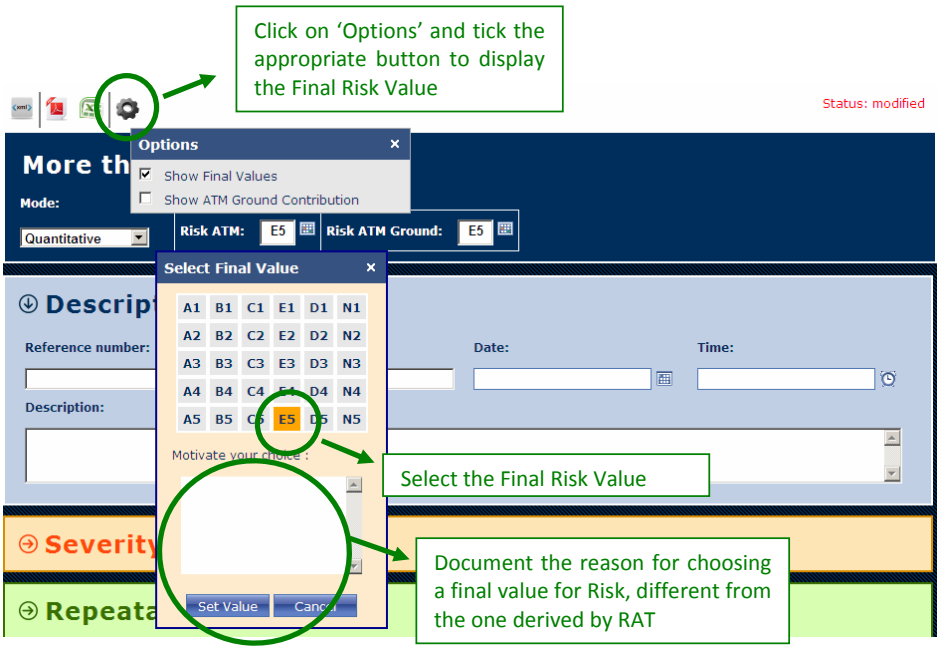

Figure 8 – *Final Risk Value*

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6. More than One Aircraft

This section provides guidance on how to use the 'More than One Aircraft' sheet of the RAT.

6.1. 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.

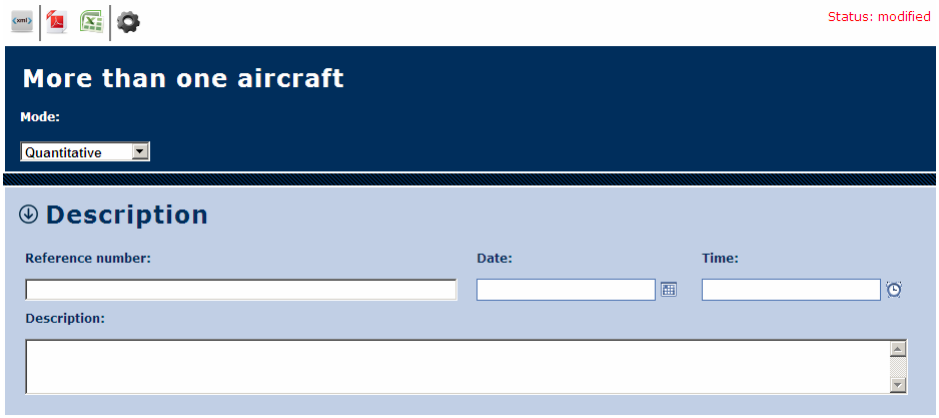

Figure 9 – *More than One Aircraft – 'Description'*

6.2. Severity

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

It is to be noted that in the context of the EC Regulation No.691/210 – Performance Scheme Regulation, the second KPI for safety only concerns the use of RAT for the severity assessment of certain types of occurrences for the first reference period 2012-2014.

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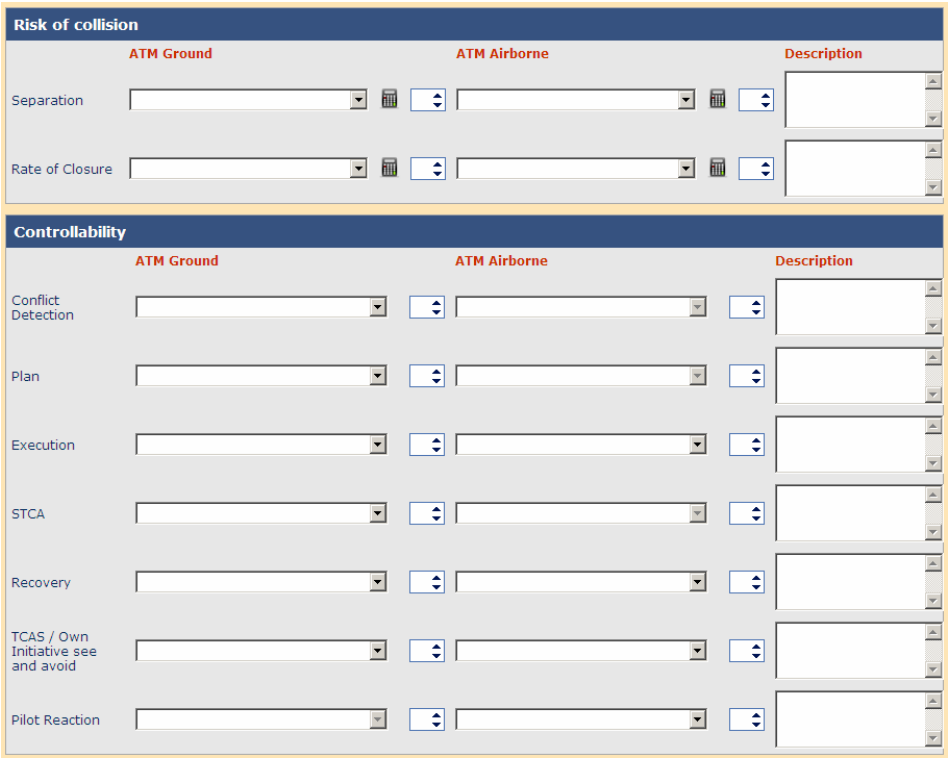

Figure 10 – *More than One Aircraft – 'Severity*

6.2.1. 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**.

6.2.1.1. 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.

- 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).
- The separation refers to the achieved horizontal and vertical distances between aircraft.
- When scoring separation, the "best" value of the infringed horizontal and vertical separation shall be taken into consideration.
- If there is no defined separation minimum, 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.

6.2.1.2. Rate of Closure

- When scoring rate of closure sub-criterion, the "worst" value between horizontal and vertical will be taken into consideration.
- RAT provides a rate of closure calculator 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)

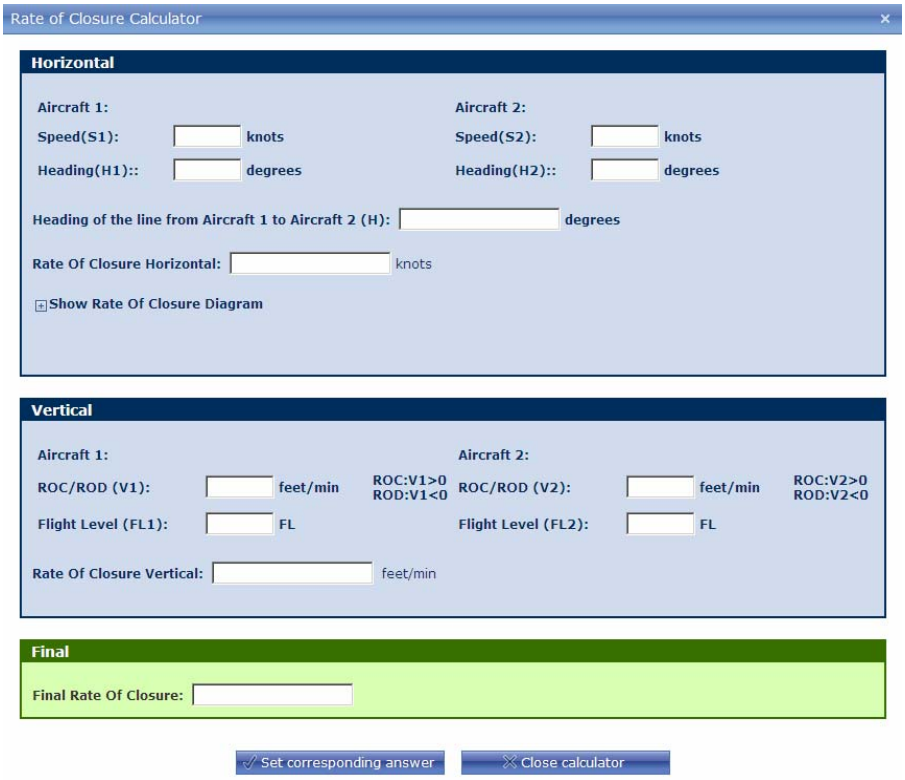

Figure 11 – *More than One Aircraft – 'Rate of Closure Calculator'*

- The rate of closure should be measured at the moment the separation is infringed (not at the closest point of approach).
- If the separation is lost after the crossing point, the rate of closure will be scored 0 and the selected option should be 'None'.
- Should the members of the moderation panel can not reach an agreement concerning the rate of closure of the aircraft 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 allows the user to document the rationale behind the chosen score, for later reference.
- If there is positive evidence that both pilots 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**.

6.2.2. Controllability

Controllability is the second major sub-criterion for assessing severity that 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.

6.2.2.1. 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 box of the RAT web-tool is deemed. 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 includes procedures such as Standing Agreements where conflict detection between specific aircraft is not required, just compliance with the procedure.

  This option should also be scored when detection was made with the support of a predictive STCA (Short Term Conflict Alert) warning 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 should NOT be scored automatically whenever the prescribed separation minima between the aircraft involved in the occurrence is infringed. Due consideration shall be given to the circumstances associated to the event.

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

- **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.

- **'Potential Conflict NOT detected'**

  This criterion shall be scored when the air traffic control staff did not detect the potential conflict before the closest point of approach or was detected too late to enable effective collision avoidance. 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) potential conflict **Detection** is **'NOT applicable'**. Consequently the **Planning** and **Execution** sub-criteria are also **'NOT Applicable'** and a 0 points should be scored.

- **'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 lease with the investigator) and seeks the missing data.

6.2.2.2. Plan

Planning sub-criterion refers to the ATM Ground plan to maintain prescribed separation or safety margins between the aircraft involved. 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 developed by the air traffic control staff to solve the detected hazardous situation before the separation minima between the aircraft involved would have been infringed. 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 between is infringed are analysed and scored as part of the Recovery phase.

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- **'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 between the aircraft involved in the occurrence.

- **'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 chance or do not have an alternative course of action) .

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- **'No Plan'**

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

  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 between the aircraft involved in the conflict.

6.2.2.3. Execution

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 has not complied with the instructions provided by the air traffic control staff.

Pilot'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**

  When assessing execution, time and efficiency of that execution should be considered.

- **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 between the aircraft

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involved in the occurrence 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.

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

- **'NO execution'**

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

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

  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 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 (see above paragraph) or in case of occurrences where the ATM ground is not in charge of providing separation between the aircraft involved in the occurrence.

6.2.2.4. STCA

- **Current STCA 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 Current STCA Alarm Triggered**

  This option shall be selected when the conflict was not detected or detected late by the ATM Ground and STCA 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.

  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.

6.2.2.5. 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 Airborne values.

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

- **'Recovery INADEQUATE'**

  By selecting this option the user indicates that the ATM (Ground and Airborne) reaction, after the actual conflict is declared, had not improved the situation.

- **'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 a TCAS/pilot see and avoid action was triggered or not. It could be that the reason for not following the ATC instruction was a TCAS RA/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.

The table below provides some guidance on how to score recovery:

Scenario	**Score**
tracks are diverging when separation lost, no recovery action is required. This is true even if there is a small closing speed, going behind	**0**
Deliberate inaction (not in unsafe proximity) and tracks converging	**1-2**
Deliberate inaction (not in unsafe proximity) **and tracks reciprocal**	**3-4**
Deliberate inaction when acft are in unsafe proximity is an inadequate recovery	**At least 5**
If recovery action is by ATC having been alerted to the conflict by a pilot/vehicle, score it under "see and avoid decision"	**5**

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Deleted: Recovery starts when the separation/safety margins have been breached (potentially due to the fact that the plan for solving the hazardous situation was inadequate or totally missing). From this step onwards, the plan to restore the 'equilibrium' is a new one, different from the first plan established in the detection/planning phase, seeking to bring the system back within its safety envelope (such as re-establishment of the separation minima).

Deleted: The Recovery step starts when the safety margins have been breached (potentially due to the fact that the plan for solving the hazardous situation was inadequate or totally missing).From this step onwards, the plan to restore the 'equilibrium' is a new one, different from the first plan established in the detection/planning phase, seeking to bring the system back within its safety envelope (such as re-establishment of the separation minima).

6.2.2.6. TCAS/Own Initiative see and avoid

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

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

  For cases where TCAS has saved the day, 'TCAS triggered' 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'**

  This option should be selected when the geometry of the encounter would require a TCAS RA (based on ICAO TCAS logic) and that did not occur. 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'**

  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.

6.2.2.7. Pilot reaction

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 some of the level bust cases where ATM Ground has NO margin to recover and to instruct accordingly and it is only

providence that saved the day. A contradictory reaction or non-reaction to a TCAS RA should be considered the worst case possible.

The comments field added to the form allows the user to document the rationale behind the chosen score for later reference.

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."

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6.3. 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.

According to the current plans, it is only for the second reference period (2015-2019) when the repeatability is to be considered for the risk assessment of separation minima infringements, runway incursions and ATM Specific (Technical) occurrences in accordance with the provisions of the EC Regulation No.691/210 – Performance Scheme Regulation.

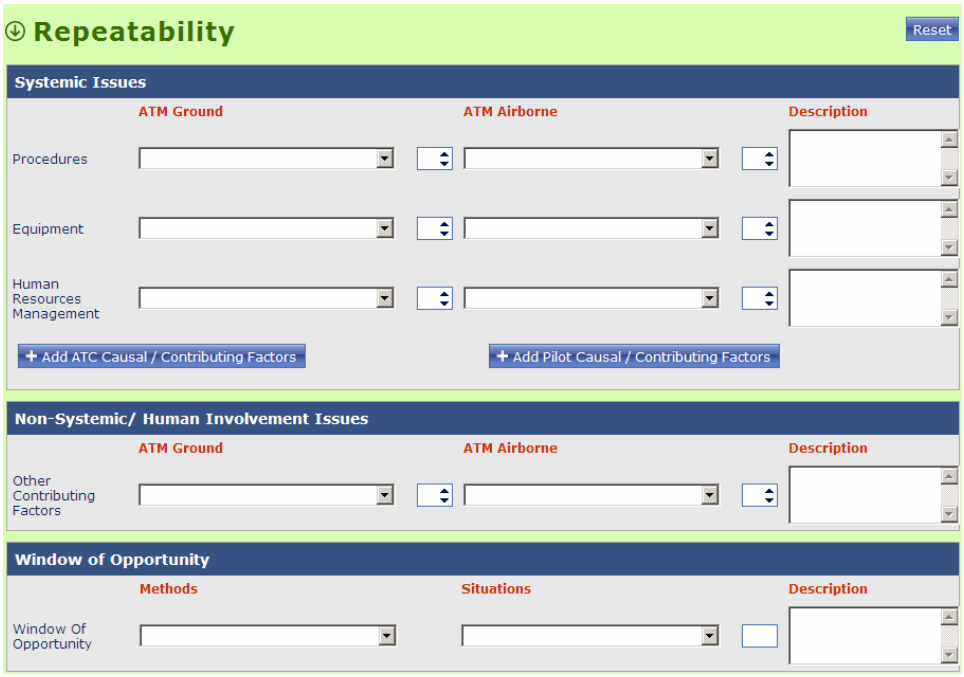

Figure 12 – *More than One Aircraft – 'Repeatability'*

6.3.1. 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**.

6.3.1.1. 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).

6.3.1.2. Equipment

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

6.3.1.3. Human Resource 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.

6.3.1.4. ATC/Pilot Causal/Contributing Factors

- Systemic/Contributing Factors to an occurrence are predefined and related both to the ATC and Pilot actions

Deleted: within HEIDI taxonomy

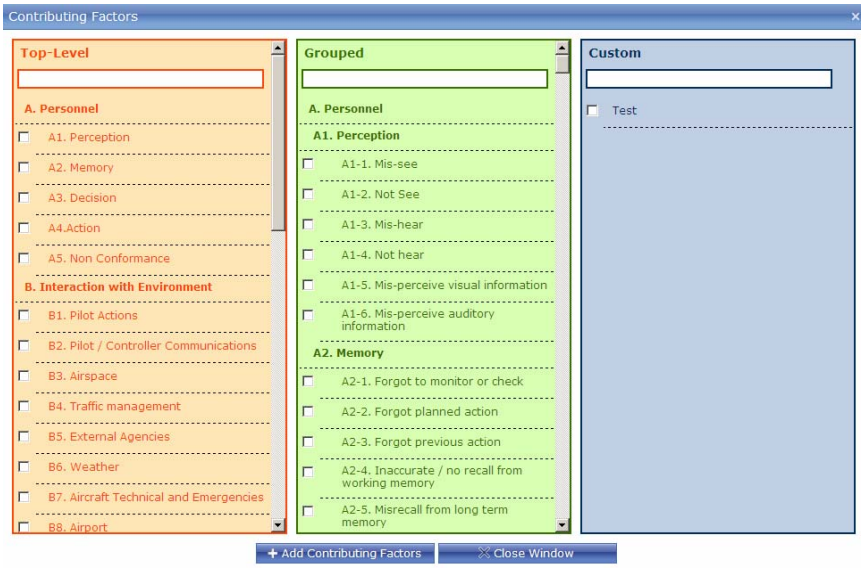

Figure 13 – *More than One Aircraft – 'Contributing Factors'*

A user of the RAT web tool can select several causes for each occurrence both related the actors involved in the events.

Customised causes can be defined by the user and added to the web tool. It is to be noted that more than one cause can be selected by ticking the relevant boxes.

Irrespective of whether they are systemic or not, all contributing factors are part of the Repeatability criteria and will influence the likelihood of reoccurrence and NOT the Severity part.

6.3.2. Non Systemic Human Involvement Issues

6.3.2.1. Other Contributing Factors

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

  Contextual conditions, as described in the EAM2/GUI8[1], refer to the circumstances that exist at the time of the safety occurrence. Originally described by Reason (1990, 1991)[2] 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.

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

[2] 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.

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 helped 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.

6.3.3. 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.

However, what is aimed at being captured here are the circumstances in conjunction with the methods/techniques to be applied. This would concern more the medium categories of 'emergency/unusual' and 'workload peak' where there is not necessarily an obvious link with the techniques to be applied.

Types of situations that fall under the 'Emergency/unusual' category are those that, at the time of the occurrence, there are already emergency or unusual situations being handled by the position involved, 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**

  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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6.4. Examples of Scored Occurrences

6.4.1. Example 1

Risk Analisys Tool Report

EUROCONTROL

Reference number:
Occurrence type: More than one aircraft
Description: Tiger21 (F16) left the area assigned to its mission (Res-Roz-Sintra / A1192) without coordination, flying towards
descending traffic approaching **XXXX**. ABC602 was turned by ATCO to avoid Tiger21. The achieved separation between the two aircraft was 2 Nm of horizontal separation at the same altitude. DEF24M was instructed to stop descending at FL120 in order to avoid another separation infringement with the Tiger21.
Occurrence date: 19/04/20 **XX**
Occurrence time:

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%
ATM GROUND: 50%
ATM GROUND SEVERITY: 100%
ATM GROUND REPEATABILITY: 0%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	26-50%	7	N/A		7	(1)
Rate of Closure	High (>205 and <=700 knots, >2000 and <=4000 ft/mn)	4	N/A		4	(2)
Controllability						
Conflict Detection	Not applicable	0	N/A		0	(3)
Plan	Not applicable	0	N/A		0	(4)
Execution	Execution CORRECT	0	Execution INADEQUATE	5	5	(5)
STCA	Not applicable	0	N/A		0	(6)
Recovery	Recovery CORRECT	0	NO recovery or the ATM ground actions for recovery have worsened the situation or ATM airborne has worsened the situation	10	10	(7)
TCAS / Own Initiative see and avoid	Not applicable	0	Not applicable	0	0	(8)
Pilot Reaction	N/A		Not applicable	0	0	(9)
Total		11		15	26	

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Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures	N/A		N/A			(10)
Equipment	N/A		N/A			(11)
Human Resources Management	N/A		N/A			(12)
Non-systemic / Human Involvment Issues						
Other Contributing Factors	N/A		N/A			(13)
Window of Opportunity						
Method	N/A					
Situation	N/A					(14)
Total		**0**		**0**	**0**	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation: Achieved separation 2Nm horizontally and 0 ft vertically.

(2) Rate of Closure:

(3) Conflict Detection:

(4) Plan:

(5) Execution:

(6) STCA:

(7) Recovery:

(8) TCAS / Own Initiative see and avoid:

(9) Pilot Reaction:

(10) Procedures:

(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors:

(14) Window Of Opportunity:

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6.4.2. Example 2

Risk Analisys Tool Report

EUROCONTROL

Reference number:
Occurrence type: More than one aircraft
Description: GAT traffic (Cruzer) flying VFR departed from a non-controlled aerodrome close to **YYYY** TMA. ATCO saw the target flying westbound and assumed that will stay below the controlled airspace. On this basis a departure from the **ZZZZ** military air base (E145) was cleared to take-off. The GAT traffic came close to the extended centerline of the **ZZZZ** RWY04 enabling the Mode C. It was only then when the ATCO realized that the separation with the GAT traffic is going to be infringed.
Occurrence date: 19/04/20 **XX**
Occurrence time:

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%
ATM GROUND: 50%
ATM GROUND SEVERITY: 100%
ATM GROUND REPEATABILITY: 0%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	75-99%	1	N/A		1	(1)
Rate of Closure	Medium (>85 and <=205 knots, >1000 and <=2000 ft/mn)	2	N/A		2	(2)
Controllability						
Conflict Detection	Not applicable	0	N/A		0	(3)
Plan	Not applicable	0	N/A		0	(4)
Execution	Execution CORRECT	0	NO execution	10	10	(5)
STCA	Not applicable	0	N/A		0	(6)
Recovery	Recovery CORRECT	0	Recovery CORRECT	0	0	(7)
TCAS / Own Initiative see and avoid	Not applicable	0	Not applicable	0	0	(8)
Pilot Reaction	N/A		Not applicable	0	0	(9)
Total		**3**		**10**	**13**	

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Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures	N/A		N/A			(10)
Equipment	N/A		N/A			(11)
Human Resources Management	N/A		N/A			(12)
Non-systemic / Human Involvment Issues						
Other Contributing Factors	N/A		N/A			(13)
Window of Opportunity						
Method	N/A					
Situation	N/A					(14)
Total		0		0	0	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation: Achieved horizontal separation of 4NM.

The ultralight a/c (ABCD) was not equipped with a mode C transponder.

(2) Rate of Closure:

(3) Conflict Detection:

(4) Plan:

(5) Execution: ABCD - ultra light a/c infringes the airspace and infringes separation with EFG9151, a departure from Alverca air base.

(6) STCA:

(7) Recovery: ABCD flight is instructed to fly to the North due to traffic which is correctly executed.

(8) TCAS / Own Initiative see and avoid:

(9) Pilot Reaction:

(10) Procedures:

(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors:

(14) Window Of Opportunity:

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6.4.3. Example 3

Risk Analisys Tool Report

EUROCONTROL

Reference number:
Occurrence type: More than one aircraft
Description: Synopsis: ABC50G inbound ZZZZ @FL320 – needs to descend to FL260; DEF456 requesting FL350, authorised to climb to FL290.
@7:55 – ABC50G was cleared to descend to FL300 on present heading. Instruction was acknowledged correctly.
@7:55 – DEF456 instructed to turn right 10 degrees and cleared to climb to FL350. DEF456 reads back turn left 10 degrees and climb to FL350.
@7:55:50 the STCA is triggered. At that time the distance between the two aircraft was 29NM with a predicted separation of 4NM.
@7:56:10 DEF456 initially turns right. STCA is stopped.
@7:56:30 DEF456 turns left and STCA is triggered again. The ATCO asks CSN456 to confirm the left turn of 10 degrees.
@7:56:30 DEF456 (climbing through FL304) is asked to stop climb and return to FL300. DEF456's pilot asks confirmation of the clearance.
@7:56:50 ABC50G cleared to climb to FL320 which is not acknowledged.
@7:56:50 ABC50G acknowledges the clearance to stop climbing @FL320. At that time the STCA shows 11NM between the conflicting aircraft with a predicted minimum separation of 1.4Nm.
@7:57:10 ABC50G cleared heading North. ABC50G reports TCAS RA.
@7:57:30 traffic information passed to ABC50G. The closest separation between the two aircraft was of 4.7 Nm and 200ft.
Occurrence date: 19/04/20 xx
Occurrence time:

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%
ATM GROUND: 50%
ATM GROUND SEVERITY: 100%
ATM GROUND REPEATABILITY: 0%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	75-99%	1	N/A		1	(1)
Rate of Closure	Very High (>700knots, >4000ft/mn)	5	N/A		5	(2)
Controllability						
Conflict Detection	Potential Conflict detected	0	N/A		0	(3)
Plan	Plan CORRECT	0	N/A		0	(4)
Execution	Execution INADEQUATE	3	Execution INADEQUATE	5	8	(5)
STCA	Not applicable	0	N/A		0	(6)
Recovery	Recovery INADEQUATE	5	Recovery CORRECT	0	5	(7)
TCAS / Own Initiative see and avoid	TCAS triggered (useful RAs only to be considered) or see and avoid pilot decision (in the absence of TCAS)	10	TCAS triggered (useful RAs only to be considered) or see and avoid pilot decision (in the absence of TCAS)	0	0	(8)
Pilot Reaction	N/A		Pilot(s) followed RA (or, in absence of RA, took other effective action, as a result of see and avoid decision)	0	0	(9)
Total		24		-5	19	

Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures	N/A		N/A			(10)
Equipment	N/A		N/A			(11)
Human Resources Management	N/A		N/A			(12)
Non-systemic / Human Involvment Issues						
Other Contributing Factors	N/A		N/A			(13)
Window of Opportunity						
Method	N/A					
Situation	N/A					(14)
Total		**0**		**0**	**0**	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation: Achieved minimum separation: 4Nm and 625ft.

(2) Rate of Closure:

(3) Conflict Detection: KLM50G locked on heading as the conflict with CSN456 is detected.

(4) Plan:

(5) Execution: CSN456 id cleared to turn right. However the wrong read-back is not spot by the ATCO.

(6) STCA: Maastricht UAC is equipped with a predictive STCA.

(7) Recovery: Wrong traffic information is sent to KLM50G, as the conflicting traffic is at 1 o'clock instead of 11 o'clock.

(8) TCAS / Own Initiative see and avoid:

(9) Pilot Reaction:

(10) Procedures:

(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors:

(14) Window Of Opportunity:

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6.4.4. Example 4

Risk Analysis Tool Report

Reference number: Parallel approaches
Occurrence type: More than one aircraft
Description: ABC3217 on approach to runway 33L from XXXX from YYYYY,crosses the two locators and loses the prescribed separation minima with DEF6333 who was in LLZ 33R. GHI5316, aircraft who was preceeding ABC3217 had the wake turbulence category "heavy".
Occurrence date: 23/06/2009
Occurrence time: 10:38:00

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 75%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 50%
ATM GROUND: 90%
ATM GROUND SEVERITY: 100%
ATM GROUND REPEATABILITY: 80%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	26-50%	7			7	(1)
Rate of Closure	Low (<=85knots, <=1000ft/mn)	1			1	(2)
Controllability						
Conflict Detection	Potential Conflict detected	0			0	(3)
Plan	Plan CORRECT	0			0	(4)
Execution	Execution INADEQUATE	3	Execution INADEQUATE	5	8	(5)
STCA	Not applicable	0			0	(6)
Recovery	Recovery CORRECT	0	Recovery CORRECT	0	0	(7)
TCAS / Own Initiative see and avoid	Not applicable	0	Not applicable	0	0	(8)
Pilot Reaction			Not applicable	0	0	(9)
Total		11		5	16	

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Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures	Procedures IMPLEMENTATION	8			8	(10)
Equipment	Not applicable	0			0	(11)
Human Resources Management	Not applicable	0			0	(12)
Non-Systemic/ Human Involvement Issues						
Other Contributing Factors						(13)
Window of Opportunity						
Method	Normal					
Situation	Daily Routine	7			7	(14)
Total		**15**		**0**	**15**	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation: Achieved separation 1.5NM and 500 ft.

(2) Rate of Closure:

(3) Conflict Detection:

(4) Plan:

(5) Execution: AIN Sector has not provided the final vector to the aircraft ABC3217to proceed to the LLZ RWY 33L or, if his intention was that the aircraft crossed ABC3217 locators of RWY 33R's / L, did not inform them of the situation.

DEF6333 started its descent from 6000 ft to 5000 ft a minute after the clearence was issued by the ATC.

(6) STCA:

(7) Recovery: Traffic information was provided to the a/c involved.

(8) TCAS / Own Initiative see and avoid:

(9) Pilot Reaction:

(10) Procedures: Excessive traffic scheduled for landing on RWY33L in comparison with traffic for RWY33R.

(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors:

(14) Window Of Opportunity: Normal operating conditions.

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7. Aircraft – Aircraft Tower

This section provides guidance on how to use the 'Aircraft – Aircraft Tower' sheet of the RAT.

As indicated in Table 2 above this sheet is to 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.

7.1. Description

Figure 14 –*Aircraft-Aircraft-Tower – '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.

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7.2. Severity

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

It is to be noted that in the context of the EC Regulation No.691/210 – Performance Scheme Regulation, the second KPI for safety only concerns the use of RAT for the severity assessment of certain types of occurrences for the first reference period 2012-2014.

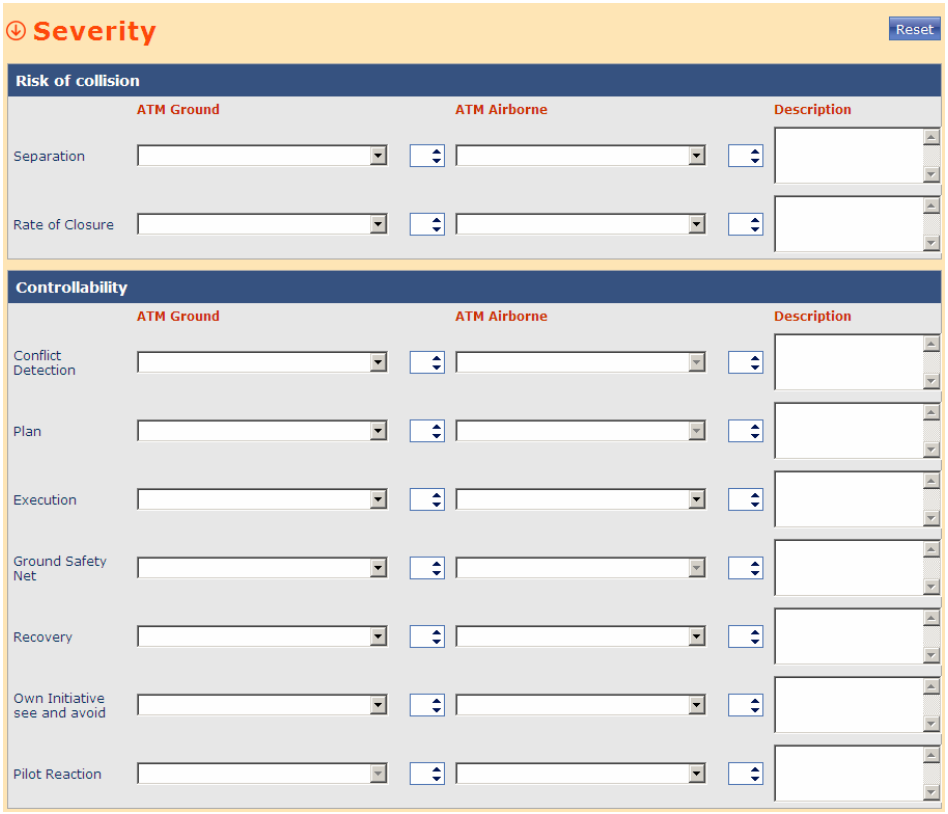

Figure 15 –*Aircraft-Aircraft-Tower – 'Severity*

7.2.1. 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.

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.

'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. The protected area is defined by CAT 1 or CAT3 holding points.

7.2.1.1. Separation

In order to facilitate scoring the *separation sub-criterion* the following guidance is provided to the user taking into account the identified types of occurrences:

– 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).

– 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).

Deleted: Aircraft, vehicle or pedestrian enters runway without clearance

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 acft/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)

7.2.1.2. Rate of Closure

- 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).
- 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.
- When scoring rate of closure sub-criterion, the "worst" value between horizontal and vertical will be taken into consideration.
- 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'.
- Should the members of the moderation panel can 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 allows the user to document the rationale behind the chosen score, for later reference.
- If there is positive evidence that both pilots 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.

7.2.2. Controllability

Controllability is the second major sub-criterion for assessing severity that describes the "level of control" air traffic controllers and pilots/drivers 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 safety margin 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.

7.2.2.1. 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 box of the RAT web-tool is deemed. 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 includes procedures such as Standing Agreements where conflict detection between specific aircraft is not required, just compliance with the procedure.

  This option should also be scored when detection was made with the support of a predictive system warning 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 should NOT be scored automatically whenever the prescribed separation minima between the aircraft involved in the occurrence is infringed. Due consideration shall be given to the circumstances associated to the event.

  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 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.

- **'Potential Conflict NOT detected'**

  This criterion shall be scored when the air traffic control staff did not detect the potential conflict before the closest point of approach or was detected too late to enable effective collision avoidance. 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 Runway Incursion) potential conflict **Detection** is **'NOT applicable'**. Consequently the **Planning** and **Execution** sub-criteria are also **'NOT Applicable'** and a 0 points should be scored.

- **'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 lease with the investigator) and seeks the missing data.

7.2.2.2. Plan

Planning sub-criterion refers to the ATM Ground plan to maintain prescribed separation or safety margins between the aircraft involved. 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.

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The ATM Ground plan refers to the plan developed by the air traffic control staff to solve the detected hazardous situation before the safety margins between the aircraft/vehicles involved would have been infringed. At this point in the risk assessment process a RAT user should evaluate this planning considered by the

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ATC. Any further actions taken after the safety margins are infringed should be 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 safety margins between the aircraft/vehicles involved in the occurrence.

- **'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 chance or do not have an alternative course of action).

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- **'No Plan'**

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

  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 between the aircraft/vehicles involved in the conflict.

7.2.2.3. Execution

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

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- **Execution CORRECT**

  When assessing execution, time and efficiency of that execution should be considered.

- **Execution INADEQUATE**

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  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 safety margins between the aircraft/vehicles involved in the occurrence would have been infringed. This option also includes cases where despite the fact that the initial planning developed by the air traffic control staff is good, implementation of the plan is not adequate.

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  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 also for cases when the ATM Ground has a plan to for the conflict resolution but it had not been implemented at all.

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

  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 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 (see above paragraph) or in case of occurrences where the ATM ground is not in charge of providing separation between the aircraft involved in the occurrence.

  The table below provides a higher granularity concerning the scoring of 'Aircraft – Aircraft Tower' type of events.

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Scenario	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
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/readback 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

Scenario	Score
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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7.2.2.4. 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 Ground Safety Net Triggered**

  This option shall be selected when the conflict was not detected or detected late by the ATM Ground and the ground safety net (A-SMGCA, RIMCAS) 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 execution is not applicable (see above paragraph) or in case that the airport is not equipped with a ground safety net system.

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

Deleted: Recovery starts when the separation/safety margins have been breached (potentially due to the fact that the plan for solving the hazardous situation was inadequate or totally missing). ' From this step onwards, the plan to restore the 'equilibrium' is a new one, different from the first plan established in the detection/planning phase, seeking to bring the system back within its safety envelope (such as re-establishment of the separation minima).

- **'Recovery INADEQUATE'**

  By selecting this option the user indicates that the ATM (Ground and Airborne) reaction, after the actual conflict is declared, had not improved the situation.

- **'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 a TCAS/pilot see and avoid action was triggered or not. It could be that the

reason for not following the ATC instruction was a TCAS RA/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 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.

7.2.2.6. Own Initiative See and Avoid

- **'See and avoid pilot decision'**

  This option should be selected for cases where the 'See and avoid pilot decision' had saved the day

  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 RF is not negatively affected.

- **'NO See and avoid possible'**

  This option should be selected when the pilots could not see each other due to the conditions at the time of occurrence (e.g. weather – IMC conditions, low visibility, time of day etc). However, a pilot actions taken based on see and avoid principles could have saved the day. This option should be scored on the ATM Airborne column.

  In respect of the ATM Ground, choosing this option will ensure that the RF is not negatively affected.

- **'Not Applicable'**

  This option should be scored for occurrences where the 'see and avoid' barrier is not applicable.

7.2.2.7. Pilot reaction

This criterion assesses the pilot/driver execution of 'see and avoid decision'. It should be scored on the ATM airborne column. 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 comments field added to the form allows the user to document the rationale behind the chosen score for later reference.

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."

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7.3. 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.

According to the current plans, it is only for the second reference period (2015-2019) when the repeatability is to be considered for the risk assessment of separation minima infringements, runway incursions and ATM Specific (Technical) occurrences in accordance with the provisions of the EC Regulation No.691/210 – Performance Scheme Regulation.

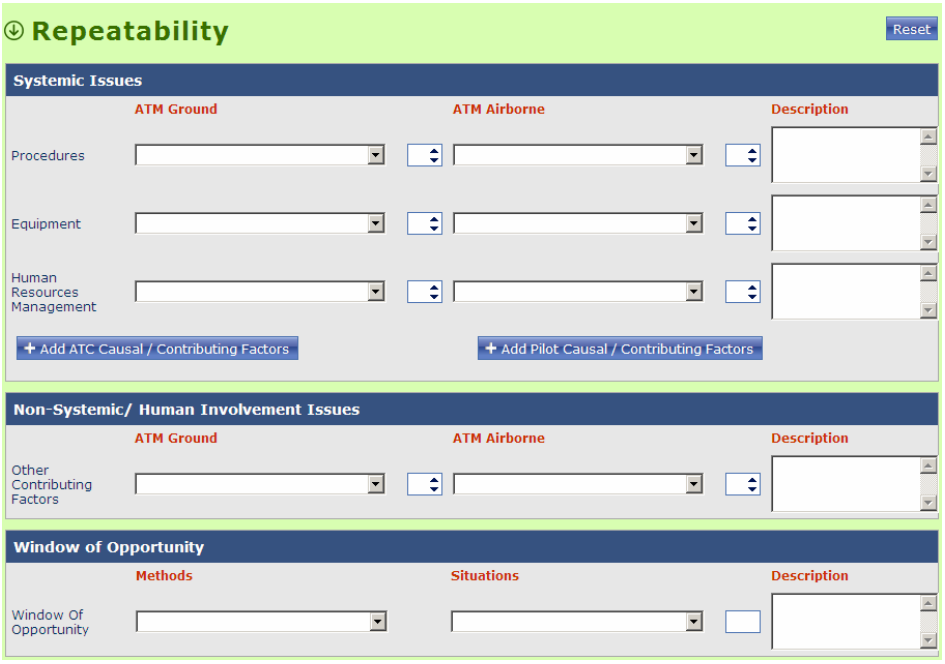

Figure 16 –*Aircraft-Aircraft-Tower – 'Repeatability*

7.3.1. 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.

7.3.1.1. 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).

7.3.1.2. Equipment

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

7.3.1.3. 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.

7.3.1.4. ATC /Pilot Causal/Contributing Factors

- Systemic/Contributing Factors to an occurrence are predefined and related both to the ATC and Pilot actions

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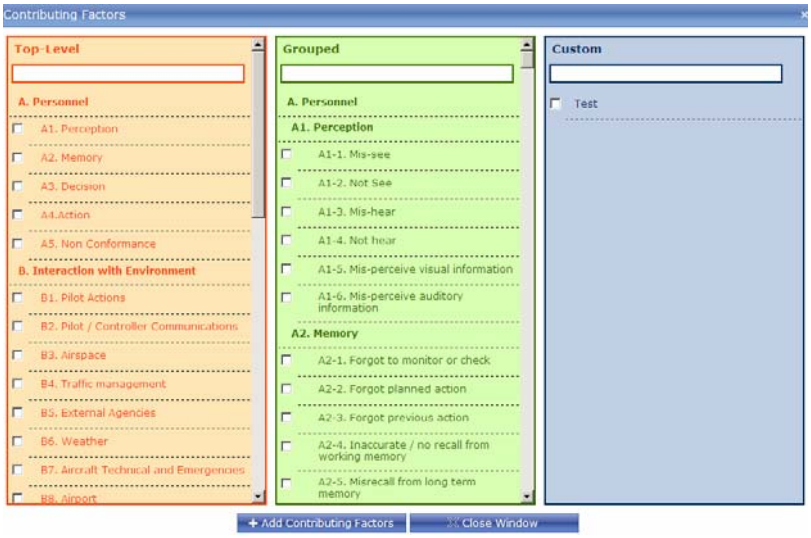

Figure 17 *–Aircraft-Aircraft-Tower – 'Contributing Factors'*

A user of the RAT web tool can select several causes for each occurrence both related the actors involved in the events.

Customised causes can be defined by the user and added to the web tool. It is to be noted that more than one cause can be selected by ticking the relevant boxes.

Irrespective of whether they are systemic or not, all contributing factors are part of the repeatability criteria and will influence the likelihood of reoccurrence and NOT the severity part.

7.3.2. Non-Systemic / Human Involvement Issues

7.3.2.1. Other Contributing Factors

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

  Contextual conditions, as described in the EAM2/GUI 8[3], refer to the circumstances that exist at the time of the safety occurrence. Originally described by Reason (1990, 1991)[4] 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?"

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

[4] 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.

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.

7.3.3. 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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7.4. Examples of Scored Occurrences

7.4.1. Example 1

Risk Analisys Tool Report

EUROCONTROL

Reference number: Event
Occurrence type: Aircraft-aircraft-tower
Description: RYR05P cleared to land whilst a runway inspection was in progress. The driver of the Ranger vehicle heard the transmission and vacated the runway of his own accord; RYR05P was at 4.5DME at this time.
Occurrence date:
Occurrence time:

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%
ATM GROUND: 50%
ATM GROUND SEVERITY: 100%
ATM GROUND REPEATABILITY: 0%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	Safety margin achieved	0	N/A		0	(1)
Rate of Closure	None	0	N/A		0	(2)
Controllability						
Conflict Detection	Potential Conflict detected	0	N/A		0	(3)
Plan	Plan CORRECT	0	N/A		0	(4)
Execution	NO execution	5	Execution CORRECT	0	5	(5)
Ground Safety Net	Not applicable	0	N/A		0	(6)
Recovery	NO recovery or the ATM ground actions for recovery have worsened the situation or ATM airborne has worsened the situation	10	Recovery CORRECT	0	10	(7)
Own Initiative see and avoid	See and avoid pilot decision	10	See and avoid pilot decision	0	0	(8)
Pilot Reaction	N/A		Pilot took other effective action, as a result of see and avoid decision	0	0	(9)
Total		25		-10	15	

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Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures	N/A		N/A			(10)
Equipment	N/A		N/A			(11)
Human Resources Management	N/A		N/A			(12)
Non-systemic / Human Involvment Issues						
Other Contributing Factors	N/A		N/A			(13)
Window of Opportunity						
Method	N/A					
Situation	N/A					(14)
Total		**0**		**0**	**0**	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation: The service car was outside the stop bars.

(2) Rate of Closure: The service car was not on the active RWY

(3) Conflict Detection:

(4) Plan:

(5) Execution: The ATCO did not instruct the service car driver to clear the RWY.

(6) Ground Safety Net:

(7) Recovery:

(8) Own Initiative see and avoid: The service car driver's initiative!

(9) Pilot Reaction:

(10) Procedures:

(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors:

(14) Window Of Opportunity:

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7.4.2. Example 2

Risk Analisys Tool Report

EUROCONTROL

Reference number: Event
Occurrence type: Aircraft-aircraft-tower
Description: B752 outbound from **XXXX** to **YYYY** was in the process of positioning along taxying Juliet when the crew called the controller (runway 23R). On first contact the crew informed the controller that they were taxying to holding point JA1. This was their clearance limit and is a stopbar associated with a runway entry point. The controller acknowledged this information and advised the crew that after departure the en-route frequency would be non-standard. All read back from the crew of B752 were correct.

Shortly after B752 had reached the stopbar the driver of Leader 6 (MaPlc Ops vehicle) called the controller and informed him that the B752 had actually crossed the stopbar at JA1. On hearing this, the controller visually checked the position of B752 (with the aid of binoculars) and immediately realised that the aircraft had indeed crossed the stopbar and thus incurred on runway 23R. As a result of the incursion the controller instructed the crew of B763 to carry out a missed approach; the aircraft was at approximately 3Nm from touch down when the missed approach was issued.
B752 then departed shortly afterwards without further incident.
Occurrence date: 19/04/20 **XX**
Occurrence time:

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%
ATM GROUND: 35%
ATM GROUND SEVERITY: 70%
ATM GROUND REPEATABILITY: 0%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	N/A		Safety margin infringed minor	1	1	(1)
Rate of Closure	N/A		High (>100 and <=250 knots, >1000 and <=2000 ft/mn)	4	4	(2)
Controllability						
Conflict Detection	Potential Conflict detected	0	N/A		0	(3)
Plan	Plan CORRECT	0	N/A		0	(4)
Execution	Execution CORRECT	0	Execution INADEQUATE	5	5	(5)
Ground Safety Net	Not applicable	0	N/A		0	(6)
Recovery	Recovery CORRECT	0	Recovery CORRECT	0	0	(7)
Own Initiative see and avoid	Not applicable	0	Not applicable	0	0	(8)
Pilot Reaction	N/A		Not applicable	0	0	(9)
Total		**0**		**10**	**10**	

Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures	N/A		N/A			(10)
Equipment	N/A		N/A			(11)
Human Resources Management	N/A		N/A			(12)
Non-systemic / Human Involvment Issues						
Other Contributing Factors	N/A		N/A			(13)
Window of Opportunity						
Method	N/A					
Situation	N/A					(14)
Total		**0**		**0**	**0**	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation:

(2) Rate of Closure:

(3) Conflict Detection:

(4) Plan:

(5) Execution: the crew of **B752** did not see the stopbar at JA1 as they approached it. The event was then further aggravated by the fact that the crew then mis-perceived the position of the "old stop bar" (which was obviously, from the crews response, clearly visible to them) as their clearance limit.

(6) Ground Safety Net:

(7) Recovery: **B763** approaching RWY23R was instructed by the ATC to GO AROUND as the **B752** has entered the active runway.

(8) Own Initiative see and avoid:

(9) Pilot Reaction:

(10) Procedures:

(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors:

(14) Window Of Opportunity:

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7.4.3. Example 3

Risk Analisys Tool Report

EUROCONTROL

Reference number:
Occurrence type: Aircraft-aircraft-tower
Description: ABC2715 was authorised to land on RWY03. DEF1158 calls on the tower frequency ready to takeoff. Tower clears DEF1158 to line-up behind landing traffic on RWY03. The clearance is not acknowledged by DEF1158. The tower controller gets in contact with DEF1158 only when the aircraft is on the RWY. TWR instructs AEA1158 to vacate the runway via the N2 taxiway and cancels the landing clearance for ABC2715
Without leaving the runway DEF1158 had questioned whether or not authorized to line-up. TWR gives instruction to Go Around ABC2715 to 1902. AEA1158 states that have only heard that the line up clearance and the rest of the communication have been cut out. DEF1158 takes off at 19.07 whilst ABC2715 lands at 19.13.
Occurrence date:
Occurrence time:

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%
ATM GROUND: 50%
ATM GROUND SEVERITY: 100%
ATM GROUND REPEATABILITY: 0%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	Safety margin infringed minor	1	N/A		1	(1)
Rate of Closure	High (>100 and <=250 knots, >1000 and <=2000 ft/mn)	4	N/A		4	(2)
Controllability						
Conflict Detection	Potential Conflict detected	0	N/A		0	(3)
Plan	Plan CORRECT	0	N/A		0	(4)
Execution	Execution INADEQUATE	3	Execution INADEQUATE	5	8	(5)
Ground Safety Net	Not applicable	0	N/A		0	(6)
Recovery	Recovery CORRECT	0	Recovery CORRECT	0	0	(7)
Own Initiative see and avoid	Not applicable	0	Not applicable	0	0	(8)
Pilot Reaction	N/A		Not applicable	0	0	(9)
Total		8		5	13	

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Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures	N/A		N/A			(10)
Equipment	N/A		N/A			(11)
Human Resources Management	N/A		N/A			(12)
Non-systemic / Human Involvment Issues						
Other Contributing Factors	N/A		N/A			(13)
Window of Opportunity						
Method	N/A					
Situation	N/A					(14)
Total		**0**		**0**	**0**	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation:

(2) Rate of Closure:

(3) Conflict Detection:

(4) Plan:

(5) Execution:

(6) Ground Safety Net:

(7) Recovery:

(8) Own Initiative see and avoid:

(9) Pilot Reaction:

(10) Procedures:

(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors:

(14) Window Of Opportunity:

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7.4.4. Example 4

Risk Analisys Tool Report

EUROCONTROL

Reference number:
Occurrence type: Aircraft-aircraft-tower
Description: ABC123 was cleared to land on RWY25R and vacate via the B9 exit. DEF456 was holding short of the RWY25R ready for immediate take off. A third flight GHI789 was approaching RWY25R on approach speed (5NM).After landing ABC123 gets confused and exits via B8. When realizing the wrong exit, despite the ATCO instruction to continue at 'good speed' At that moment the GHI789 was at 3NM. The DEF456 is cleared for immediate take off with reasonable assurance that RWY is clear. At that time the ABC123 stops suddenly and blocks the active RWY with its tail. GHI789 executes a GO Arround!
Occurrence date: 19/04/20 **XX**
Occurrence time:

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%
ATM GROUND: 50%
ATM GROUND SEVERITY: 100%
ATM GROUND REPEATABILITY: 0%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	Safety margin infringed significant	7	N/A		7	(1)
Rate of Closure	High (>100 and <=250 knots, >1000 and <=2000 ft/mn)	4	N/A		4	(2)
Controllability						
Conflict Detection	Potential Conflict detected	0	N/A		0	(3)
Plan	Plan CORRECT	0	N/A		0	(4)
Execution	Execution INADEQUATE	3	Execution INADEQUATE	5	8	(5)
Ground Safety Net	Not applicable	0	N/A		0	(6)
Recovery	Recovery INADEQUATE	5	Recovery INADEQUATE	6	11	(7)
Own Initiative see and avoid	Not applicable	0	Not applicable	0	0	(8)
Pilot Reaction	N/A		Not applicable	0	0	(9)
Total		19		11	30	

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Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures	N/A		N/A			(10)
Equipment	N/A		N/A			(11)
Human Resources Management	N/A		N/A			(12)
Non-systemic / Human Involvment Issues						
Other Contributing Factors	N/A		N/A			(13)
Window of Opportunity						
Method	N/A					
Situation	N/A					(14)
Total		**0**		**0**	**0**	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation:

(2) Rate of Closure:

(3) Conflict Detection: The potential conflict is spotted by the ATCO.

(4) Plan: Planning of the landing and take-off sequencess is correct

(5) Execution: ABC123 exits the RWY on the wrong taxi way.

(6) Ground Safety Net:

(7) Recovery: ABC123 stops after exiting on B8 despite the ATCO instruction to continue.
The ATM Ground cleares the DEF456 for immediate takeoff despite there was no assurance that the RWY was clear.

(8) Own Initiative see and avoid:

(9) Pilot Reaction:

(10) Procedures:

(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors:

(14) Window Of Opportunity:

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7.4.5. Example 5

Risk Analysis Tool Report

EUROCONTROL

Reference number: RWY INC
Occurrence type: Aircraft-aircraft-tower
Description: The incident took place on the runway 27L at XXX airport. It occurred between an A330 crossing the runway 27L and an E190 taking off this runway. The low visibility procedures were in progress. The A330 stopped taxiing while still on the runway. The E190 was taking off.

Controllers involved: Tower and Ground controllers.`
Workload: Standard for both controllers
No training on the positions

Occurrence date: 10/08/20 **XX**
Occurrence time:

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 95%
OVERALL SEVERITY: 90%
OVERALL REPEATABILITY: 100%
ATM GROUND: 100%
ATM GROUND SEVERITY: 100%
ATM GROUND REPEATABILITY: 100%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	Safety margin infringed minor	1			1	(1)
Rate of Closure	Very High (>250knots, >2000ft/mn)	5			5	(2)
Controllability						
Conflict Detection	Potential Conflict detected	0			0	(3)
Plan	Plan CORRECT	0			0	(4)
Execution	Execution INADEQUATE	3			3	(5)
Ground Safety Net	Ground Safety Net triggered (e.g. A-SMGCS Level2, RIMCAS)	0			0	(6)
Recovery	Recovery INADEQUATE	5			5	(7)
Own Initiative see and avoid	Not applicable	0	Not applicable	0	0	(8)
Pilot Reaction			Not applicable	0	0	(9)
Total		14		0	14	

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Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures	Procedures IMPLEMENTATION	8	Not applicable	0	8	(10)
Equipment	Not applicable	0	Not applicable	0	0	(11)
Human Resources Management	Not applicable	0	Not applicable	0	0	(12)
Non-Systemic/ Human Involvement Issues						
Other Contributing Factors	Non-Systemic/ Human Involvement issues with Contextual Conditions	4	Not applicable	0	4	(13)
Window of Opportunity						
Method	Normal					
Situation	Daily Routine	7			7	(14)
Total		**19**		**0**	**19**	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation: A330 has nearly totally vacated the runway

(2) Rate of Closure:

(3) Conflict Detection:

(4) Plan:

(5) Execution: The A330 stopped taxiing, which was not spotted by the controller.

(6) Ground Safety Net:

(7) Recovery: The tower controller did not cancel the take off of E190.
The Ground controller asked the A330 to expedite the vacation of the RWY while the other a/c was rolling.

(8) Own Initiative see and avoid:

(9) Pilot Reaction:

(10) Procedures: No verification of of the fact that that the runway is clear and no reaction when the ground radar triggers.

(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors: Complexity of the taxiways of that particular airport.

(14) Window Of Opportunity: Normal operating conditions.

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7.4.6. Example 6

Risk Analysis Tool Report

EUROCONTROL

Reference number: RWY INC
Occurrence type: Aircraft-aircraft-tower
Description:
The incident took place on the runway 08L at YYY airport. It occurred between a B763 crossing the runway 08L and a B738 taking off this runway. The B763 stopped taxiing while still on the runway. The B738 was at take off.

Controllers involved: Tower controller with a coordinator and South ground controller
Work load:Tower controller: Standard
Ground controller: sustain
The coordinator was not close to the tower controller
Occurrence date: 13/08/2011
Occurrence time:

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 100%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 100%
ATM GROUND: 100%
ATM GROUND SEVERITY: 100%
ATM GROUND REPEATABILITY: 100%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	Safety margin infringed significant	7			7	(1)
Rate of Closure	Very High (>250knots, >2000ft/mn)	5			5	(2)
Controllability						
Conflict Detection	Potential Conflict detected	0			0	(3)
Plan	Plan CORRECT	0			0	(4)
Execution	Execution INADEQUATE	3	Execution CORRECT	0	3	(5)
Ground Safety Net	Not applicable	0			0	(6)
Recovery	NO recovery or the ATM ground actions for recovery have worsened the situation or ATM airborne has worsened the situation	7	Recovery CORRECT	0	7	(7)
Own Initiative see and avoid	Not applicable	0	No see and avoid action possible	10	10	(8)
Pilot Reaction			Not applicable	0	0	(9)
Total		22		10	32	

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Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures	Procedures IMPLEMENTATION	8	Not applicable	0	8	(10)
Equipment	Not applicable	0	Not applicable	0	0	(11)
Human Resources Management	Human resources management IMPLEMENTATION	4	Not applicable	0	4	(12)
Non-Systemic/ Human Involvement Issues						
Other Contributing Factors	Non-Systemic/ Human Involvement issues without Contextual Conditions	6	Not applicable	0	6	(13)
Window of Opportunity						
Method	Normal					
Situation	Daily Routine	7			7	(14)
Total		**25**		**0**	**25**	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation: due to the position of B763 during the take off.

(2) Rate of Closure:

(3) Conflict Detection:

(4) Plan:

(5) Execution: The take off clearance was given to B763 before the runway was vacated.

(6) Ground Safety Net:

(7) Recovery: No recovery from the tower controller and late recovery of the ground controller

(8) Own Initiative see and avoid: The UPS couldn't The B763 could not move forward because of the traffic in front.

(9) Pilot Reaction:

(10) Procedures: No verification of the fact that the runway is vacated and late reaction when the radar triggers.

(11) Equipment:

(12) Human Resources Management: Co-ordinator controller was far from the position.

(13) Other Contributing Factors: the ground frequencies were not splitted while the traffic load was sustain

(14) Window Of Opportunity: Normal operating conditions.

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8. Aircraft with Ground Movement

This section provides guidance on how to use the 'Aircraft with ground movement sheet of the RAT. As indicated in Table 2 above this sheet is to 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 could either be on the ground or airborne.

8.1. 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 18 –*Aircraft with ground movement – 'Description'*

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8.2. Severity

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

It is to be noted that in the context of the EC Regulation No.691/210 – Performance Scheme Regulation, the second KPI for safety only concerns the use of RAT for the severity assessment of certain types of occurrences for the first reference period 2012-2014.

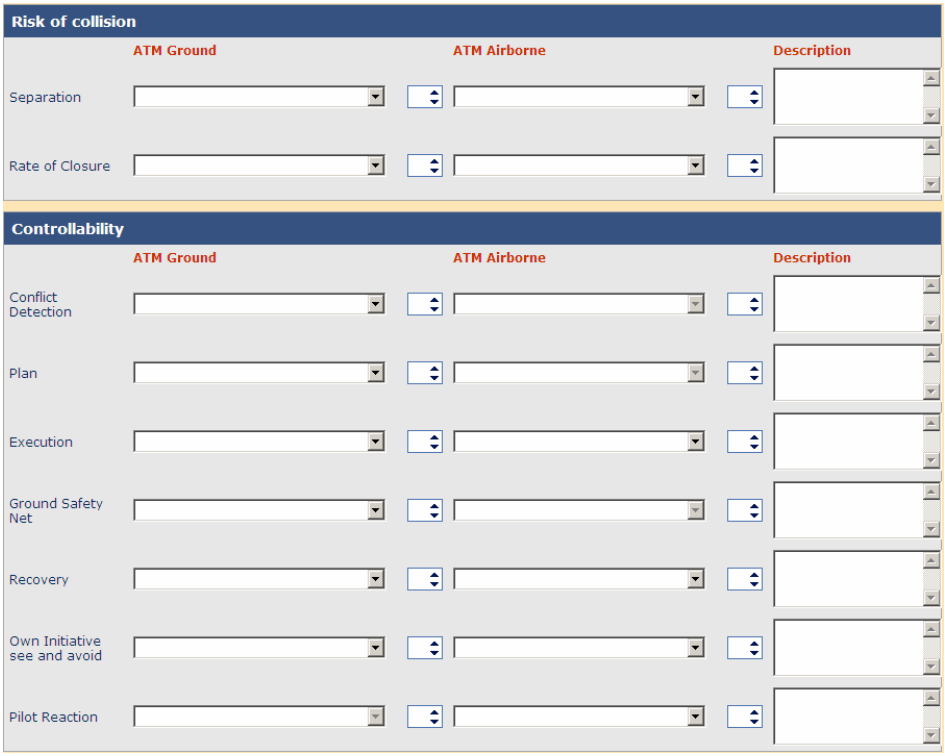

Figure 19 –*Aircraft with ground movement – 'Severity'*

8.2.1. 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.

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.

'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. The protected area is defined by CAT 1 or CAT3 holding points.

8.2.1.1. Separation

- 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.

Deleted: the following guidance is provided to the user taking into account the identified types of occurrences:¶

- 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.

8.2.1.2. Rate of Closure

- 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).
- 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.
- When scoring rate of closure sub-criterion, the "worst" value between horizontal and vertical will be taken into consideration.
- The rate of closure should be measured at the moment the safety margin is infringed (not at the closest point of approach). 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'.
- Should the members of the moderation panel can 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 allows the user to document the rationale behind the chosen score, for later reference.
- If there is positive evidence that both pilots 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.

8.2.2. Controllability

Controllability is the second major sub-criterion for assessing severity that describes the "level of control" air traffic controllers and pilots/drivers 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 safety margin 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.

8.2.2.1. 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 box of the RAT web-tool is deemed. 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 includes procedures such as Standing Agreements where conflict detection between specific aircraft is not required, just compliance with the procedure.

  This option should also be scored when detection was made with the support of a predictive system warning 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 should NOT be scored automatically whenever the safety margins between the aircraft and vehicle(s) involved in the occurrence had been eroded. Due consideration shall be given to the circumstances associated to the event.

  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 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 afety 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.

- **'Potential Conflict NOT detected'**

  This criterion shall be scored when the air traffic control staff did not detect the potential conflict or was detected too late to enable effective collision avoidance. 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 and drivers do not adhere to the ATM Ground's instructions (such as Runway Incursion) potential conflict **Detection** is **'NOT applicable'**. Consequently, **Planning** and **Execution** sub-criteria are also **'NOT Applicable'** and 0 points should be scored.

- **'Unknown'**

  This option shall be selected in case there is no information available to the members of the panel/investigators concerning the potential conflict detection by the ATM Ground. In such cases the criterion will not be scored. This would negatively affect the Reliability Indicator. Therefore, in case that information is not available, a user of the RAT methodology is always encouraged to return to the results of the investigation (or lease with the investigator) and seeks the missing data.

8.2.2.2. Plan

Planning sub-criterion refers to the ATM Ground plan to maintain 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 developed by the air traffic control staff to solve the detected hazardous situation before the safety margins between the aircraft/vehicles involved had been eroded. 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 safety margins are infringed should be 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 safety margins between the aircraft/vehicles involved in the occurrence.

- **'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 chance or do 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 between the aircraft/vehicles involved.

  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 between the aircraft/vehicles involved in the conflict.

8.2.2.3. Execution

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

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- **Execution CORRECT**

  When assessing execution, time and efficiency of that execution should be considered.

- **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 safety margins between the aircraft/vehicles involved in the occurrence would had been eroded. This option also includes cases where despite the fact that the initial planning developed by the air traffic control staff is good, implementation of the plan is not adequate.

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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 also for cases when the ATM Ground has a plan to for the conflict resolution but it had not been implemented at all.

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

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  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 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 (see above paragraph) or in case of occurrences where the ATM Ground is not in charge of providing separation between the aircraft involved in the occurrence.

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8.2.2.4. 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 Ground Safety Net Triggered**

  This option shall be selected when the conflict was not detected or detected late by the ATM Ground and the ground safety net (A-SMGCA, RIMCAS) 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 execution is not applicable (see above paragraph) or in case that the airport is not equipped with a ground safety net system.

8.2.2.5. 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 Airborne values.

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

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- **'Recovery INADEQUATE'**

  By selecting this option the user indicates that the ATM (Ground and Airborne) reaction, after the actual conflict is declared, had not improved the situation.

- **'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 a TCAS/pilot see and avoid action was triggered or not. It could be that the reason for not following the ATC instruction was a TCAS RA/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 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.

8.2.2.6. Own Initiative See and Avoid

- **'See and avoid pilot or driver decision'**

  This option should be selected for cases where the 'See and avoid pilot or driver decision' had saved the day

  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 RF is not negatively affected.

- **'NO See and avoid possible'**

  This option should be selected when the pilots and drivers could not see each other due to the conditions at the time of occurrence (e.g. weather – IMC conditions, low visibility, time of day etc). However, a pilot or driver actions taken based on see and avoid principles could have saved the day. This option should be scored on the ATM Airborne column.

In respect of the ATM Ground, choosing this option will ensure that the RF is not negatively affected.

- **'Not Applicable'**

  This option should be scored for occurrences where the 'see and avoid' barrier is not applicable.

8.2.2.7. Pilot reaction

This criterion assesses the pilot/driver execution of 'see and avoid decision'. It should be scored on the ATM airborne column. 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 comments field added to the form allows the user to document the rationale behind the chosen score for later reference.

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."

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8.3. 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.

According to the current plans, it is only for the second reference period (2015-2019) when the repeatability is to be considered for the risk assessment of separation minima infringements, runway incursions and ATM Specific (Technical) occurrences in accordance with the provisions of the EC Regulation No.691/210 – Performance Scheme Regulation.

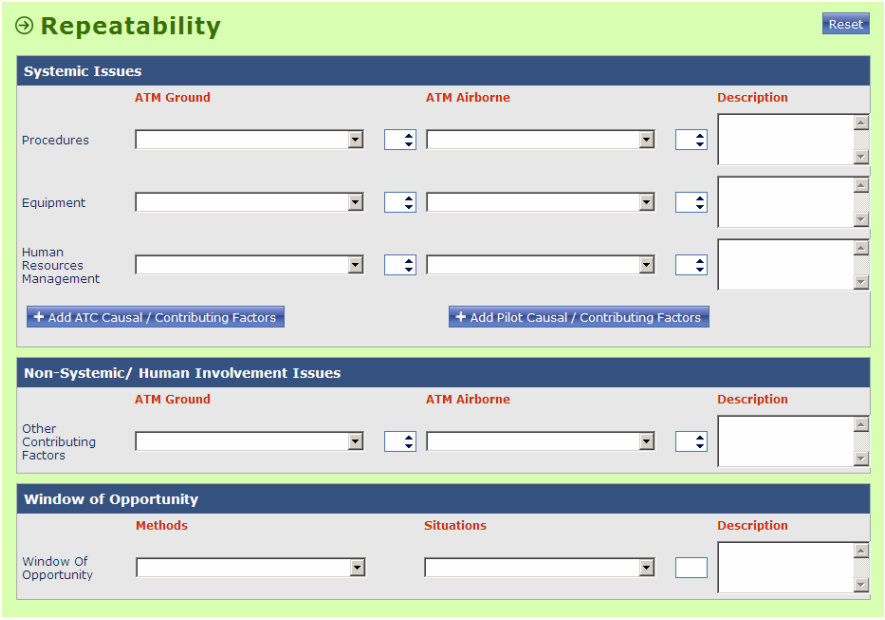

Figure 20 –*Aircraft with ground movement – 'Repeatability*

8.3.1. 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.

8.3.1.1. 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).

8.3.1.2. Equipment

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

8.3.1.3. 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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8.3.1.4. ATC /Pilot Causal/Contributing Factors

- Systemic/Contributing Factors to an occurrence are predefined and related both to the ATC and Pilot actions

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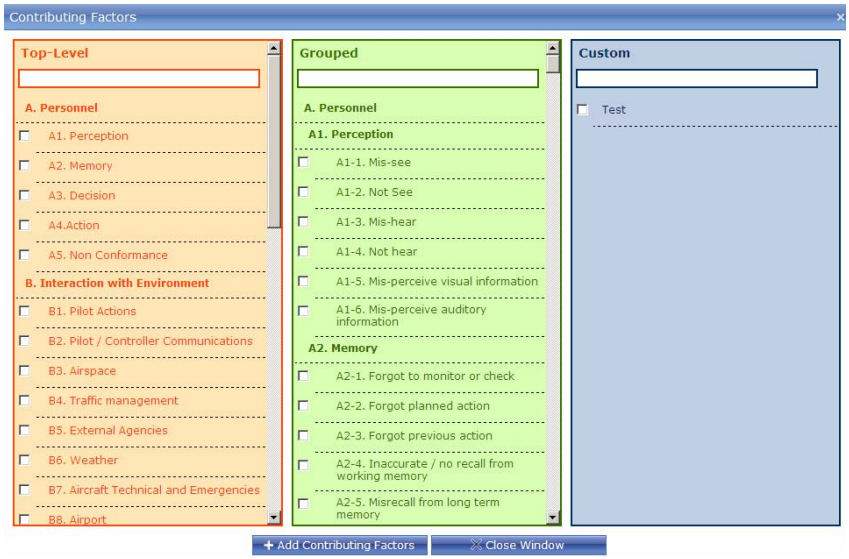

Figure 21 – *Aircraft with ground movement – 'Contributing Factors'*

A user of the RAT web tool can select several causes for each occurrence both related the actors involved in the events.

Customised causes can be defined by the user and added to the web tool. It is to be noted that more than one cause can be selected by ticking the relevant boxes.

Irrespective of whether they are systemic or not, all contributing factors are part of the repeatability criteria and will influence the likelihood of reoccurrence and NOT the severity part.

8.3.2. Non-Systemic/ Human Involvement Issues

8.3.2.1. Other Contributing Factors

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

  Contextual conditions, as described in the EAM2/GUI 8[5], refer to the circumstances that exist at the time of the safety occurrence. Originally described by Reason (1990, 1991)[6] 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

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

[6] 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.

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.

8.3.3. 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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8.4. Examples of Scored Occurrences

Risk Analysis Tool Report

EUROCONTROL

Reference number: RAT#11-OPS04
Occurrence type: Aircraft with ground movement
Description: A Surface Proximity Event occurred between an A346 and an A332 on the intersection of taxiways A5 and G4 on the manoeuvring area. Both aircraft were taxiing towards the holding point of Runway 21R for departure. The situation was resolved by the pilot of the A346 bringing his aircraft to a rapid stop to avoid taxing onto taxiway A5 in front of the A332.
At the time of occurrence ATCO was working 4 operational positions in accordance with the approved roster for the nightshift. The situation at the time of the event was complex as the ATCO was working both parallel runways 21R and 21L as well as the entire manoeuvring area of the airport at night.
At the time of the event a runway inspection by a fire tender was in progress on runway 21L and all arriving and departing traffic were accommodated on runway 21R. In addition several aircraft were taxiing, two aircraft were under tow, and another vehicle was operating on the manoeuvring area (with a blanket clearance to operate on the taxiways only).
The intersection of taxiways G4 and A5 is not clearly visible to the controller due to the distance from the TWR(the intersection is 2600 meters in a straight line from the control tower) and at night the lights of aircraft blend with the lights of the apron area.
Occurrence date: 26/08/2008
Occurrence time:

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 50 %
OVERALL SEVERITY: 100 %
OVERALL REPEATABILITY: 0 %
ATM GROUND: 50 %
ATM GROUND SEVERITY: 100 %
ATM GROUND REPEATABILITY: 0 %

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	Safety margin infringed significant	7			7	(1)
Rate of Closure	High (>40 and <=80 knots)	4			4	(2)
Controllability						
Conflict Detection	Potential Conflict detected	0			0	(3)
Plan	Plan INADEQUATE	3			3	(4)
Execution	NO execution	5	Execution CORRECT	0	5	(5)
Ground Safety Net	Not applicable	0			0	(6)
Recovery	NO recovery or the ATM ground actions for recovery have worsened the situation or ATM airborne has worsened the situation	10	Recovery CORRECT	0	10	(7)
Own Initiative see and avoid	See and avoid pilot or driver decision	10	See and avoid pilot or driver decision	0	0	(8)
Pilot Reaction			Pilot / Driver took other effective action, as a result of see and avoid decision	0	0	(9)
Total		39		-10	29	

Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures						(10)
Equipment						(11)
Human Resources Management						(12)
Non-Systemic/ Human Involvement Issues						
Other Contributing Factors						(13)
Window of Opportunity						
Method						
Situation						(14)
Total		0		0	0	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation: Wing tips did not touch and the GND marshalls confirmed that there was enough roome btw them.

(2) Rate of Closure: The A330 5kn whilst the A340 was 15kt.It was decided that rate of closure low was not appropriate as the 15kts is the speed restriction.

(3) Conflict Detection: The ATCO knew of the 2 conflicting aircraft.

(4) Plan: The ATCO assumed that the A330 will taxi ahead of the A340.

(5) Execution: The ATCO did not watch the 2 aircraft after clearing them to taxi and did not inform the a/c of his/her plan.

The crews could not see each other, therefore the airborne side executions is not penalised.

(6) Ground Safety Net

(7) Recovery: Frequency change for the A340 that made the crew aware of the other aircraft.

(8) Own Initiative see and avoid: A340 noticed the A330 at the last second.

(9) Pilot Reaction:

(10) Procedures:

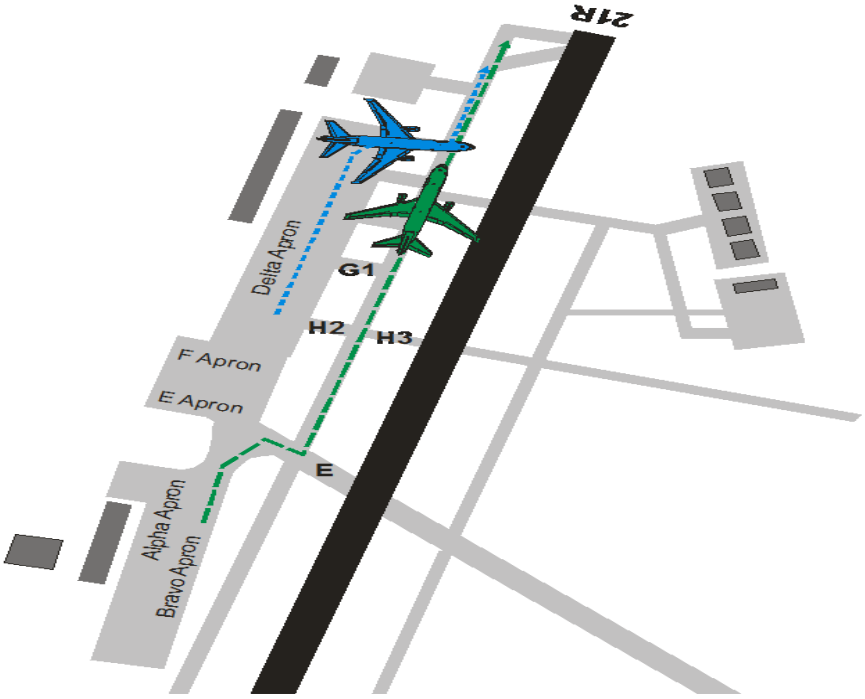
(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors:

(14) Window Of Opportunity:

Plot of the occurrence



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9. Only One Aircraft

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

9.1. 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 22 – *One Aircraft – 'Description'*

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9.2. Severity

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

It is to be noted that in the context of the EC Regulation No.691/210 – Performance Scheme Regulation, the second KPI for safety only concerns the use of RAT for the severity assessment of certain types of occurrences for the first reference period 2012-2014.

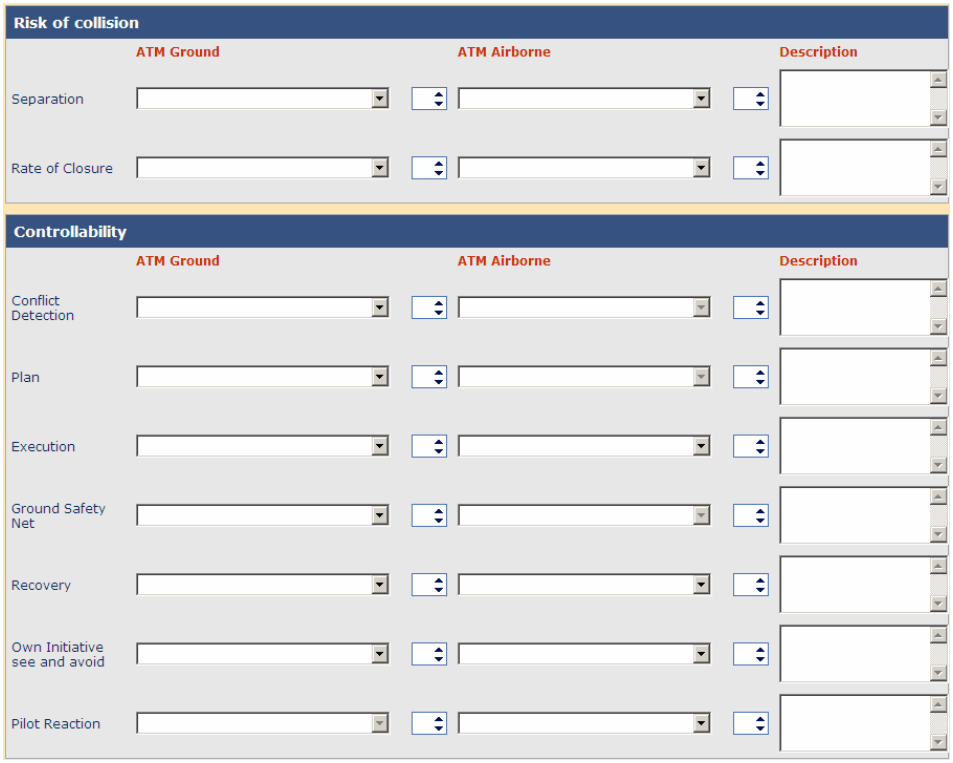

Figure 23 – *One Aircraft – 'Severity'*

9.2.1. 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.

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.

9.2.1.1. Separation

For this type of occurrence this criterion evaluates the aircraft proximity to ground, areas or obstacles as a percentance from the safety margins.

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.

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).

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.

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.

9.2.1.2. Rate of Closure

The score for risk of collision, either from the achieved distance or the rate of closure, could be lowered if there is positive visual identification of the encounter by the pilot involved in the occurrence.

The rate of closure should be measured at the moment the safety margin is infringed (not at the closest point of approach). 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'.

Should the members of the moderation panel can 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 allows the user to document the rationale behind the chosen score, for later reference.

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9.2.2. Controllability

Controllability is the second major sub-criterion for assessing severity that describes the "level of control" air traffic controllers and pilots/drivers 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 safety margin 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

  Elements such as: weather, visibility and surface conditions should be taken into account as applicable.

9.2.2.1. 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 box of the RAT web-tool is deemed. 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 includes procedures such as Standing Agreements where conflict detection between specific aircraft is not required, just compliance with the procedure.

  This option should also be scored when detection was made with the support of a predictive system warning 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 should NOT be scored automatically whenever the prescribed separation minima between an aircraft and ground/area/obstacle is infringed. Due consideration shall be given to the circumstances associated to the event.

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

- **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.

- **'Potential Conflict NOT detected'**

  This criterion shall be scored when the air traffic control staff did not detect the potential conflict or it was detected too late to enable effective collision avoidance. 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 Airspace Infringements) potential conflict **Detection** is **'NOT applicable'**. Consequently the **Planning** and **Execution** sub-criteria are also **'NOT Applicable'** and a 0 points should be scored.

- **'Unknown'**

  This option shall be selected in case there is no information concerning the potential conflict detection by the ATM Ground is available to the members of the panel/investigators. In such cases the criterion will not be scored. This would negatively affect the Reliability Indicator. Therefore, in case that information is not available, a user of the RAT methodology is strongly encouraged to return to the results of the investigation (or lease with the investigator) and seeks the missing data.

9.3.1.1. Plan

Planning sub-criterion refers to the ATM Ground plan to maintain prescribed separation or safety margins between the aircraft involved and ground/areas/obstacles. 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.

Deleted: Planning sub-criterion refers to the ATM Ground plan to solve a hazardous situation

The ATM Ground plan refers to the plan developed by the air traffic control staff to solve the detected hazardous situation before the safety margins between the aircraft involved and ground/areas/obstacles would have been infringed. At this point in the risk assessment process a RAT user should evaluate this planning considered by the ATC. Any further actions taken after the safety margins are infringed should be analysed and scored as part of the Recovery phase.

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- **'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 safety margins between the aircraft involved in the occurrence and ground/areas/obstacles.

- **'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 chance or do not have an alternative course of action).

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- **'No Plan'**

  This option shall be automatically scored when **conflict** is **not detected**, although the ATM Ground is in charge with providing separation between the aircraft involved and ground/areas/obstacles.

  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 between the aircraft involved in the occurrence and ground/areas/obstacles.

9.2.2.2. Execution

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 has not complied with the instructions provided by the air traffic control staff.

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

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- **Execution CORRECT**

  When assessing execution, time and efficiency of that execution should be considered.

- **Execution INADEQUATE**

  ATM Ground's execution is **inadequate** when it is neither timely nor effective. It refers to the execution of the initial plan developed in the 'Planning' criterion before the safety margins between the aircraft involved in the occurrence and ground/areas/obstacles would have been infringed.

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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.

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

- **'NO execution'**

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

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

  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 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 (see above paragraph) or in case of occurrences where the ATM Ground is not in charge of providing separation between the aircraft involved in the occurrence.

9.2.2.3. 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 Ground Safety Net Triggered**

  This option shall be selected when the conflict was not detected or detected late by the ATM Ground and the ground safety net (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 execution is not applicable (see above paragraph) or in case that the airport is not equipped with a ground safety net system.

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

- **'Recovery INADEQUATE'**

  By selecting this option the user indicates that the ATM (Ground and Airborne) reaction, after the actual conflict is declared, had not improved the situation.

- **'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 a TCAS/pilot see and avoid action was triggered or not. It could be that the reason for not following the ATC instruction was a TCAS RA/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 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.

9.2.2.5. Own Initiative See and Avoid

- **'GPWS trigger OR See and avoid pilot decision'**

  This option should be selected for cases where the GPWS trigger or 'See and avoid pilot or driver decision' had saved the day

  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 RF is not negatively affected.

- **'NO GPWS Warning'**

  This option should be selected the GPWS should have been triggered in accordance with its implementation logic but failed to function. However, pilot actions taken based GPWS warning could have saved the day. This option should be scored on the ATM Airborne column.

  In respect of the ATM Ground, choosing this option will ensure that the RF is not negatively affected.

9.2.2.6. Pilot reaction

This criterion assesses pilot's execution of GPWS warnings or 'see and avoid decision', as applicable. It should be scored on the ATM airborne column. The following options are available for the user:

- ‘**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 that pilot reacted incorrectly to the GPWS warning. It should be equally selected for occurrences where there is no GPWS warning triggered but the pilot took other inadequate action that worsened the situation.

The comments field added to the form allows the user to document the rationale behind the chosen score for later reference.

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.”

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9.3. Repeatability

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

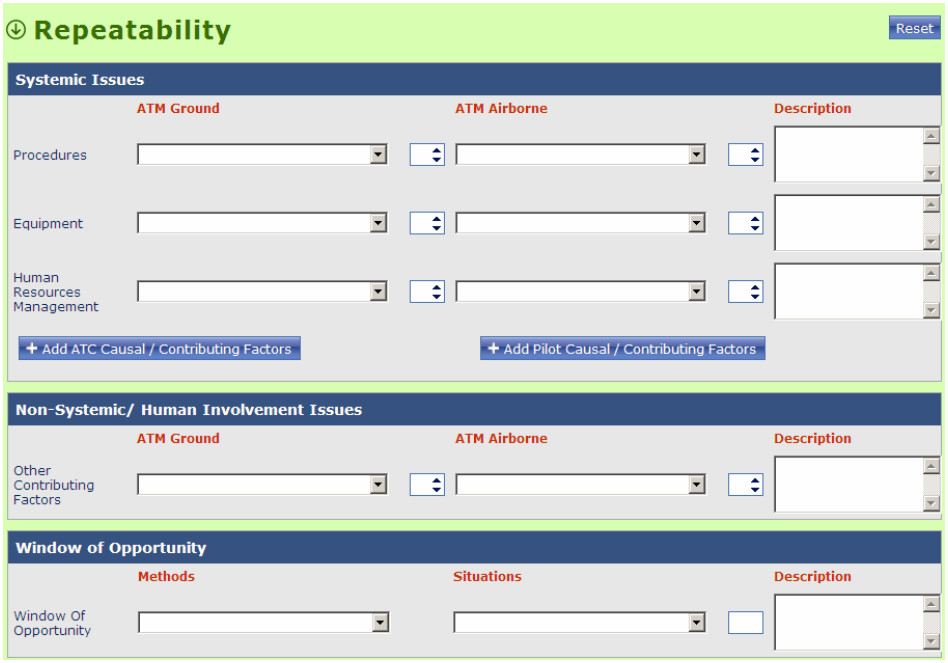

Figure 24 – *One Aircraft – 'Repeatability'*

9.3.1. 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.

9.3.1.2. 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).

9.3.1.3. Equipment

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

9.3.1.4. 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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9.3.1.5. ATC /Pilot Causal/Contributing Factors

- Systemic/Contributing Factors to an occurrence are and related both to the ATC and Pilot actions

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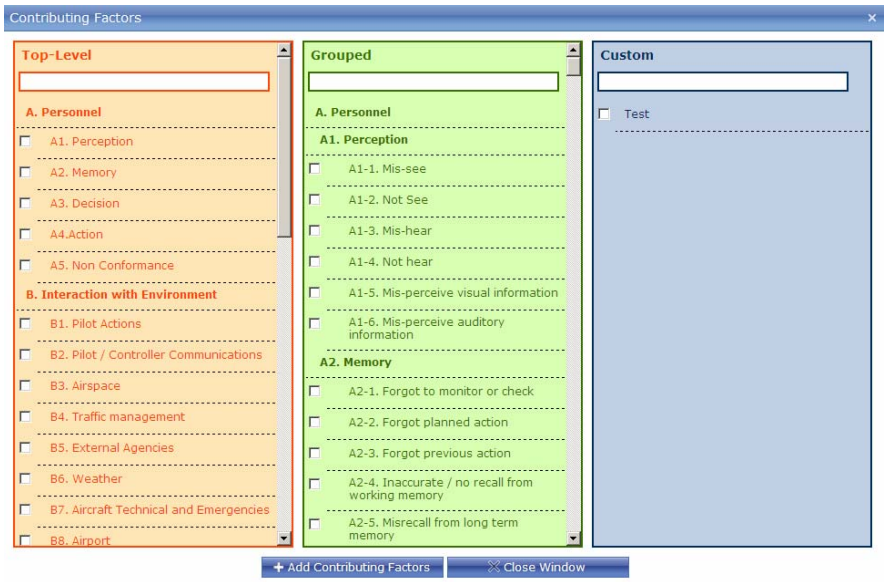

Figure 25 – *One Aircraft – 'Contributing Factors'*

A user of the RAT web tool can select several causes for each occurrence both related the actors involved in the events.

Customised causes can be defined by the user and added to the web tool. It is to be noted that more than one cause can be selected by ticking the relevant boxes.

Irrespective of whether they are systemic or not, all contributing factors are part of the repeatability criteria and will influence the likelihood of reoccurrence and NOT the severity part.

9.3.2. Non-Systemic/ Human Involvement Issues

9.3.2.1. Other Contributing Factors

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

  Contextual conditions, as described in the EAM2/GUI 8[7], refer to the circumstances that exist at the time of the safety occurrence. Originally described by Reason (1990, 1991)[8] 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.

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

[8] 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.

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.

9.3.3. 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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9.4. Examples of Scored Occurrences

Risk Analysis Tool Report

EUROCONTROL

Reference number: NCFIT
Occurrence type: One aircraft
Description: ABC6P was cleared to descend to 3000ft;
Pilot read back 2000ft;
Wrong read back was no challenged by the ATCO;
The radar shots show the aircraft descending to 2000ft
Analysis:
The radar shots show the ABC6P descending to 2000ft;
The terrain northwest of ADN is 1733 ft;
The weather was 9999 plus broken at 1100ft;
ABC6P would have been visual with the high ground above the cloud;
The aircraft is GPWS equipped.
Occurrence date: 04/09/2011
Occurrence time: 07:17:00

A1	B1	C1	E1	D1	N1
A2	B2	C2	E2	D2	N2
A3	B3	C3	E3	D3	N3
A4	B4	C4	E4	D4	N4
A5	B5	C5	E5	D5	N5
ATM	ATM Ground				

RELIABILITY FACTOR:
OVERALL: 42.5%
OVERALL SEVERITY: 65%
OVERALL REPEATABILITY: 20%
ATM GROUND: 45%
ATM GROUND SEVERITY: 70%
ATM GROUND REPEATABILITY: 20%

Severity						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Risk of collision						
Separation	Separation <=25% minimum	10			10	(1)
Rate of Closure	Low (<=60knots, <=1000ft/mn)	1			1	(2)
Controllability						
Conflict Detection	Potential Conflict with ground/area/obstacle detected	0			0	(3)
Plan	Plan CORRECT	0			0	(4)
Execution	Execution INADEQUATE	3	Execution INADEQUATE	7	10	(5)
Ground Safety Net	Unknown					(6)
Recovery	NO recovery or the ATM ground actions for recovery have worsened the situation or ATM airborne has worsened the situation	10	Unknown		10	(7)
Own Initiative see and avoid	Unknown		Unknown			(8)
Pilot Reaction			Unknown			(9)
Total		24		7	31	

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Repeatability						
Criteria	Recorded Value ATM Ground		Recorded Value ATM Airborne		Value ATM	Comments
Systemic Issues						
Procedures						(10)
Equipment						(11)
Human Resources Management						(12)
Non-Systemic/ Human Involvement Issues						
Other Contributing Factors						(13)
Window of Opportunity						
Method	Normal					
Situation	Daily Routine	7			7	(14)
Total		**7**		**0**	**7**	

Contributing Factors

ATC:

PILOT:

Comments

(1) Separation: The aircraft descended to 300ft above ground. MSA in the area 2800ft.

(2) Rate of Closure: Based on the altitude of the NTP6P given in the radar shots the rate of closure is Low

(3) Conflict Detection:

(4) Plan:

(5) Execution:

(6) Ground Safety Net: No data available concerning the availability of GPWS and whether and when was triggered.

(7) Recovery: We assumed that btw the time MSA was infringed and 300ft no instructions were given by the ATCO. For the pilot side there is no data available.

(8) Own Initiative see and avoid: No data available concerning the functionning of the 'see and avoid' barrier.

(9) Pilot Reaction: No data available.

(10) Procedures:

(11) Equipment:

(12) Human Resources Management:

(13) Other Contributing Factors:

(14) Window Of Opportunity: Normal operating conditions!

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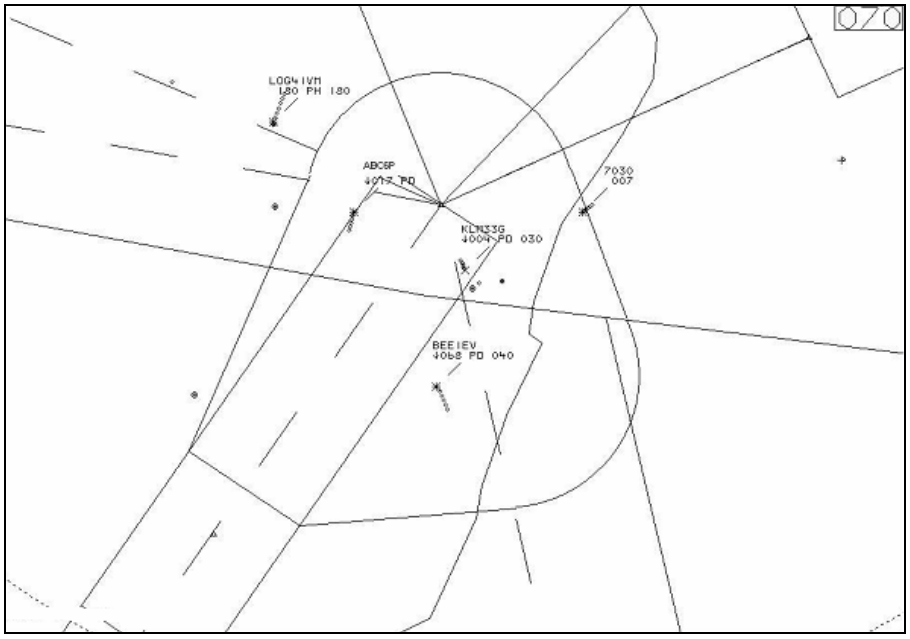
Plots of the Occurrence



10. ATM Specific Occurrences

10.1. Overview of the RAT for ATM Specific Technical Events

This section provides guidance on how to use the 'ATM Specific Occurrences' sheet of the RAT. As indicated in Table 2 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 Technical Events the severity and the overall risk of reoccurrence is determined based on a combination of criteria and their chosen options. To this end, 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 the severity of the ATM Specific Technical Events and the risk posed on the ATM System, the development of the RAT tool was made independently from any particular design of an ATM system.

Therefore the tool 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 Technical Events 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 remediate the failure should be the same. As such the tool does not only consider the actual effect of the failure on the operations but also the potential one.

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10.2. 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.

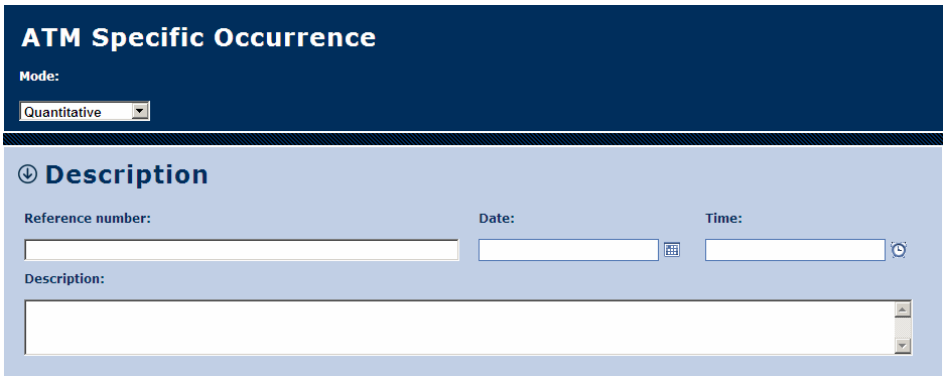

Figure 26 – *ATM Specific Occurrences– 'Description'*

10.3. Severity

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

In the context of the EC Regulation No.691/210 – Performance Scheme Regulation, the second KPI for safety only concerns the use of RAT for the severity assessment of certain types of occurrences for the first reference period 2012-2014.

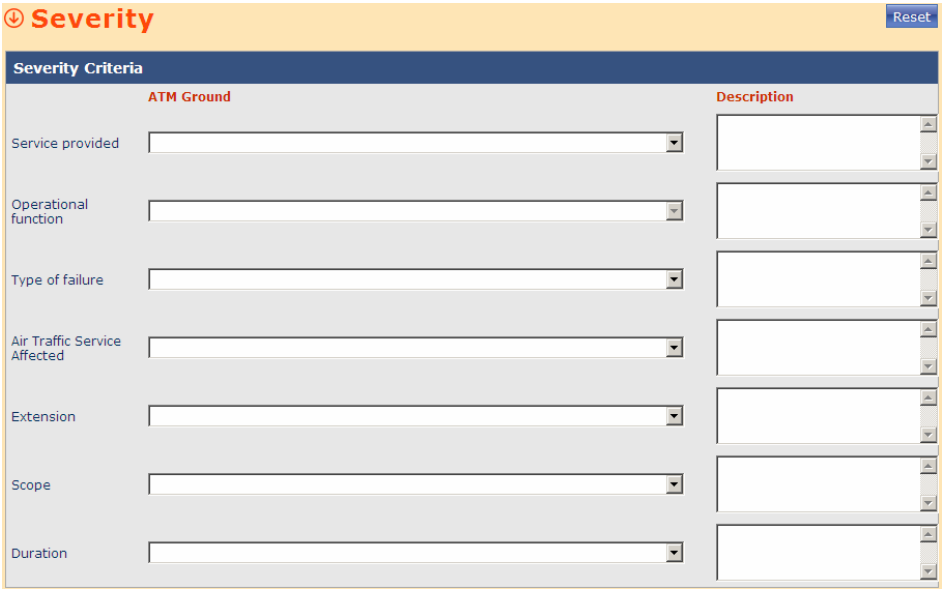

Figure 27 – *ATM Specific Occurrences– 'Severity'*

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

- Service provided
- Operational function
- Type of failure
- Service affected
- Extension
- Scope
- Duration

10.3.1. ATM/ANS Service/Function Provided

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

- **Communication**

  Aeronautical fixed and mobile services to enable ground-to-ground, air-to-ground and air-to-air 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;

- **Air Traffic Services**

  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.

10.3.1.1. Operational Function

Each ATM Specific Technical Event 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***

    Two-way communication between aircraft and stations or locations on the surface of the Earth.
  - ➔ ***Ground/Ground Communication***

    Two-way communication between stations or locations on the surface of the Earth.
- **Navigation Services**
  - ➔ ***Navigation Function***
- **Surveillance Services**
  - ➔ ***Air Surveillance***

    Those facilities and services used to determine the respective positions of aircraft in the air to ensure safe separation.
  - ➔ ***Ground Surveillance***

    Those facilities and services used to determine the respective positions of aircraft and vehicles on the ground to allow the detection of conflicts.
  - ➔ ***Surface Movement Guidance and Control (SMGC)***

    The SMGC function provides routing, guidance and surveillance for the control of aircraft and vehicles. This function enable 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.
- **Air Traffic Services**
  - ➔ ***Flight Plan Information***

    Specified information provided to air traffic service units, relative to an intended flight or portion of a flight of an aircraft
  - ➔ ***Flight Information and Alert***

    Provision of Flight Information (e.g. last position) in support to Alerting Services
  - ➔ ***Operations Room Management Capability***

    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 (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.

- **Support 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.

10.3.1 Type of Failure

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

- **Total Loss of Function**

  The function is not available to the controller or pilot.

- **Partial Loss of Functio**

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

- **Redundancy Reduction**

  It represents a loss of a technical back-up. Therefore, there are fewer technical ways to provide the function

- **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**

  The technical staff is unable to control or monitor the functio[illegible]f this occurrence leads to the removal of the main function the ATM Specific Event shall be scored as a 'total loss' of the functio[illegible]

- **Corruption of Supervision**

  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 tool should score the failure incurred by the respective action

The picture bellow illustrates the concepts of **Total Loss of function** and **Redundancy Reduction** for the **failure of Air-Ground Communication function**

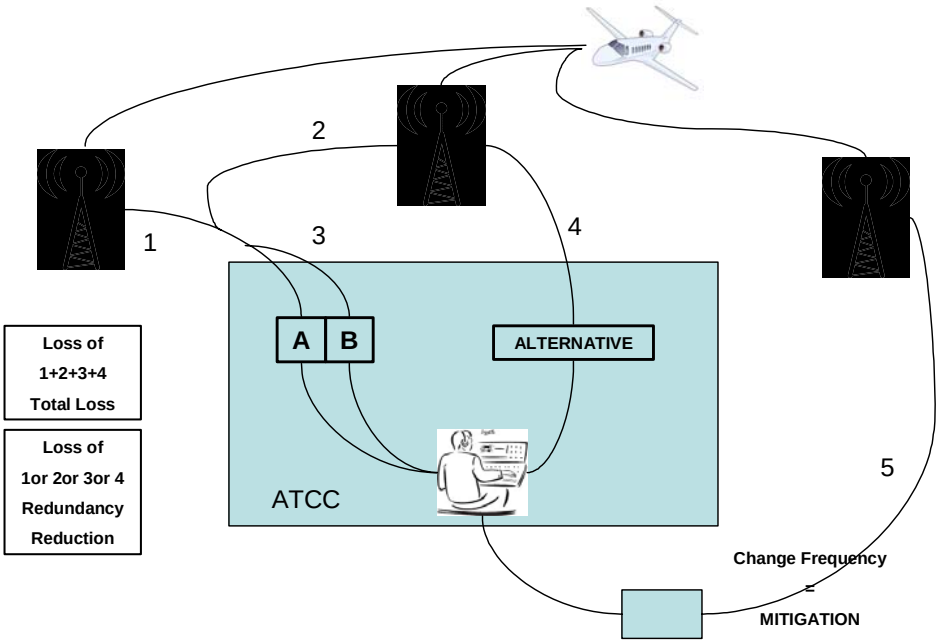

Figure 28 – *ATM Specific Occurrences – 'Total Loss and Redundancy Reduction - Failure of Air-Ground Communication'*

10.3.1.3. 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

10.3.1.4. 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 bellow illustrates the different options available in the Extension criterion: CWP, Sector and Unit

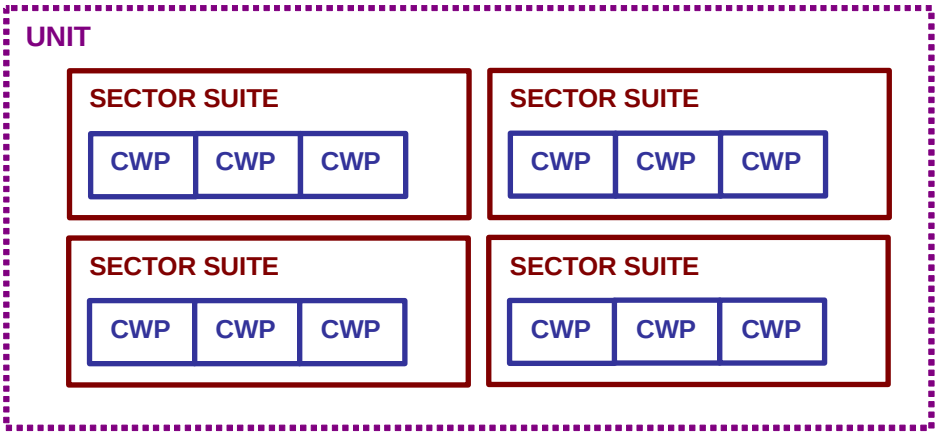

Figure 29 – *ATM Specific Occurrences – 'Extension of the failure in an ATC Unit'*

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**.

10.3.1.5. 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 frequencies, all aircraft as applicable.

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	Pilot(s)
Surveillance	Air Surveillance	Displayed Radar Track(s)
Surveillance	Ground Surveillance	Displayed Radar Track(s)
Surveillance	Surface Movement Guidance & Control	Aircraft(s)/Vehicle(s)
Air Traffic Services	Flight Plan Information	Flight Plan(s)
Air Traffic Services	Flight Information & Alert	Flight(s)
Air Traffic Services	Ops Room Management	N/A (extension should be sufficient)
Air Traffic Services	Decision Making Support	Fight(s)
Air Traffic Services	Safety Nets	Conflict(s)
Air Traffic Services	Real Time Airspace Environment	Route(s), Area(s), …
Air Traffic Flow Capacity Management	Tactical & Real Time	Flight(s)
Information Services	Aeronautical Information	Information Type(s)
Information Services	Meteorological Information	Information Type(s)

Figure 29 – *ATM Specific Occurrences – 'Scope of the Technical Failure'*

10.3.1.6. Duration

T1 is the time interval between the initiation of the technical event and the moment when it triggers **actual** or **potential operational consequences** either for the ATCO or pilot.

- **Duration less than T1**

  The user should choose this option when the technical failure did not last long enough to trigger actual or potential operational consequences on air traffic controller or pilot.

  In such case the severity of the ATM Technical Event should automatically have no impact on the air traffic services (severity E). Consequently, there is no need for the user to further apply the RAT tool for this technical failure (just record the severity E).

- **Duration greater than T1**

  The user should choose this option when the technical failure lasted longer than T1 and triggered actual or potential operational consequences on air traffic controller or pilot.

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Graphical representation of the role of T1

Steady State of the Technical System (no failure)

The charts below illustrate the ATM ANS system both in a steady state and failure modes, in order to ease the understanding of the role of T1:

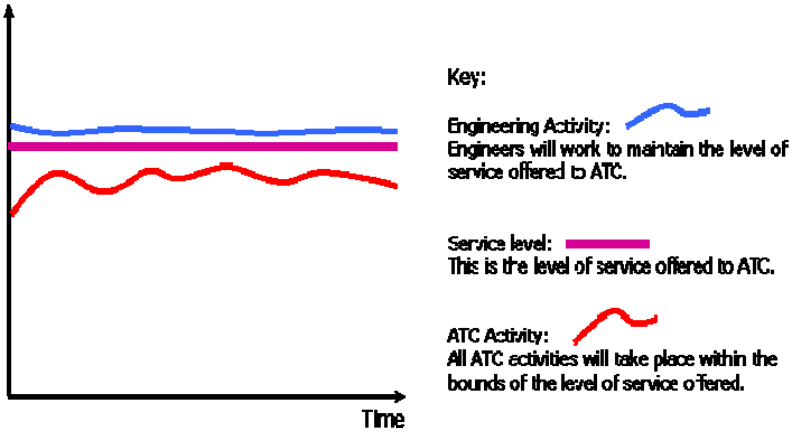

Figure 3 – *ATM Specific Occurrences – 'ATM System in a Steady State'*

ATM Specific Technical Event with an Operational Impact

The chart bellow 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).

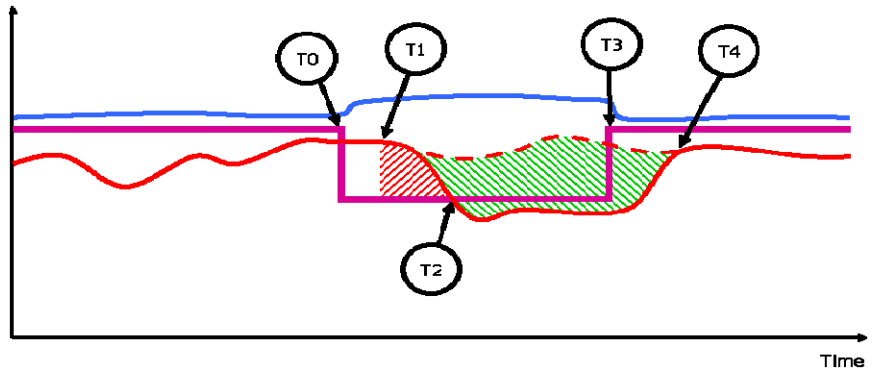

Figure 3 – *ATM Specific Occurrences – 'Operational Impact'*

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

T0	ATM Specific Technical Event commences.
T0 to T1	ATM Specific Technical Event has no operational impact as the ATC maintain desired traffic level.
T1	ATM Specific Technical Event triggers operational consequences on ATC controller or pilot
T1 to T2	Potential safety impact on ATC or pilot

T3	The ATM Specific Technical Event finishes
T1 to T4	Business effect on ATC or Pilot (e.g. regulations applied)
T4	ATC returns to the desired traffic levels

Redundancy Reduction

The chart bellow illustrates the occurrence timeline in the case of a redundancy reduction with no operational impact (duration is less than T

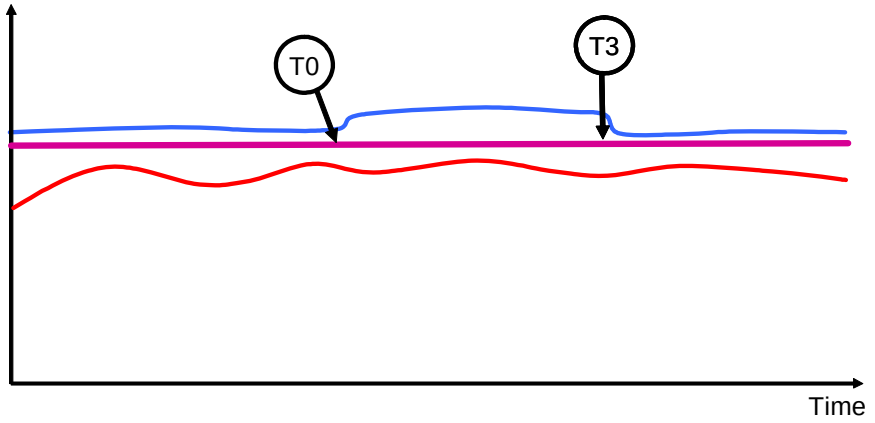

Figure 31 – *ATM Specific Occurrences – 'Redundancy Reduction'*

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

T0	ATM Specific Technical Event commences.
T1	Does not take place.
T2	Does not take place.
T0 to T3	ATM Specific Technical Event has no impact. ATC maintain desired traffic level.
T3	ATM Specific Technical Occurrence finishes.
T4	Does not take place.

10.3.2. 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 retrieve 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

Figure 32 – *ATM Specific Occurrences – 'Sample of the Look-Up Table'*

10.3.3. Severity Classes

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

- **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.

- **D – Not determined**

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

- **E – No effect on ATM Services**

  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.

10.3.4. 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 – Figure 32).

- **Range of Severities**

  According to the above screen-shot, 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**

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

- **T1 Value**

  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.

  Deleted: , it is to be pointed out that

- **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 33) for the list of previous failures of that service that have been recorded into the RAT web-tool.

  Deleted: done

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.

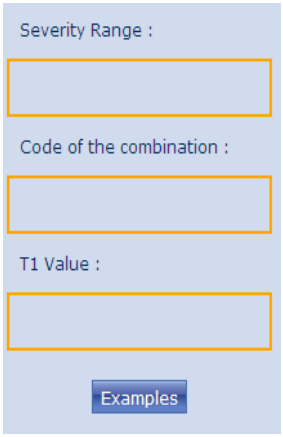

Figure 33 – *ATM Specific Occurrences – 'Web-Tool Features'*

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10.4. Repeatability

Caveat:

The repeatability part for the ATM Specific Occurrences may still be subject to further changes during the RP1 (2012-2014). Consequently, the number next to severity which is associated to the likelihood of recurrence should not be taken into consideration if the repeatbility part is not scored.

The repeatability part of the RAT scheme aims at assessing the likelihood of reoccurrence of the incident.

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

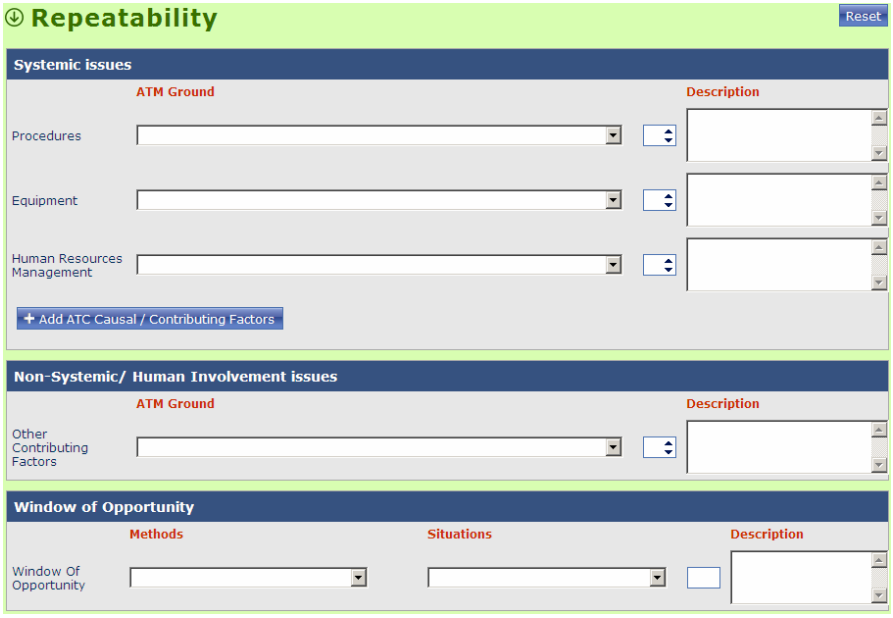

Figure 34 – *ATM Specific Occurrences – 'Repeatability'*

10.4.1. 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.

10.4.1.1. 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).

10.4.1.2. Equipment

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

10.4.1.3. 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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10.4.2. Non-Systemic/ Human Involvement Issues

10.4.2.1. Other Contributing Factors

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

  Contextual conditions, as described in the EAM2/GUI 8[9], refer to the circumstances that exist at the time of the safety occurrence. Originally described by Reason (1990, 1991)[10] 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.

[9] Guidelines on the Systemic Occurrence Analysis Methodology (SOAM)
[10] 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.

10.4.3. 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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10.5. Examples of scored ATM Specific Technical Occurrences

10.5.1. Example 1

Risk Analisys Tool Report

EUROCONTROL

Reference number: RUG10-TECH-01
Occurrence type: ATM Specific Occurrence
Description: Power failure in a regional TWR that rendered the ATIS equipment unavailable. ATIS info not available to the ATCO. However, the MET data could be retrieved.
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5

ATM

VALUES:
SEVERITY LOOKUP: E
SEVERITY RANGE: E
CODE OF THE COMBINATION: AD-AIS/200
T1 VALUE: No value

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Information Services		(1)
Operational function	Aeronautical Information		(2)
Type of failure	Partial Loss of function		(3)
Air Traffic Service Affected	Aerodrome control services		(4)
Extension	Unit		(5)
Scope	All		(6)
Duration	> T1		(7)

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Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		**0**	

Contributing Factors

ATC:

Comments

(1) Service provided: Power failure in a regional TWR that rendered the ATIS equipment unavailable.

(2) Operational function:

(3) Type of failure: ATIS message was still broadcast.

(4) Air Traffic Service Affected:

(5) Extension:

(6) Scope:

(7) Duration:

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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10.5.2. Example 2

Risk Analisys Tool Report

Reference number: RUG10-TECH-02
Occurrence type: ATM Specific Occurrence
Description: Failure of the transmitters on board the aircraft caused interferences affecting the approach control services.
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5
ATM					

VALUES:
SEVERITY LOOKUP: C
SEVERITY RANGE: C
CODE OF THE COMBINATION: AP-AGC/201
T1 VALUE: No value

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Communication		(1)
Operational function	Air/Ground Communication		(2)
Type of failure	Partial Loss of function		(3)
Air Traffic Service Affected	Approach control services		(4)
Extension	Unit		(5)
Scope	Some		(6)
Duration	> T1		(7)

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Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		**0**	

Contributing Factors

ATC:

Comments

(1) Service provided:

(2) Operational function:

(3) Type of failure: Frequency interference is scored as degradation of the air-ground communications!

(4) Air Traffic Service Affected:

(5) Extension: The whole unit is affected!

(6) Scope:

(7) Duration:

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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10.5.3. Example 3

Risk Analisys Tool Report

EUROCONTROL

Reference number: RUG10-TECH-03
Occurrence type: ATM Specific Occurrence
Description: Failure of the trunking system (a complex type of computer-controlled two-way radio system that allows sharing of relatively few radio frequency channels among a large group of users.
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5

ATM

VALUES:
SEVERITY LOOKUP: C
SEVERITY RANGE: C
CODE OF THE COMBINATION: AP-AGC/201
T1 VALUE: No value

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Communication		(1)
Operational function	Air/Ground Communication		(2)
Type of failure	Partial Loss of function		(3)
Air Traffic Service Affected	Approach control services		(4)
Extension	Unit		(5)
Scope	Some		(6)
Duration	> T1		(7)

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Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		**0**	

Contributing Factors

ATC:

Comments

(1) Service provided:

(2) Operational function:

(3) Type of failure: Frequency interference is scored as degradation of the air-ground communications!

(4) Air Traffic Service Affected:

(5) Extension: The whole unit is affected!

(6) Scope:

(7) Duration:

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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10.5.4. Example 4

Risk Analisys Tool Report

Reference number: RUG10-TECH-10
Occurrence type: ATM Specific Occurrence
Description: Total loss of the AMAN function in an approach unit (Arrival Manager is an aiding tool for decision making purposes).
In case of changing the runway settings; in order to determine if runway in closed or blocked; new proceeding aircraft were not correctly displayed in the arrival sequencing.

Software anomalies occurred in relation with the new software version that led to an incorrect calculation in AMAN and lead loss total function.
Switch over to redundancy or reboot of the tool were not successful. After consultation with the Supervisor the AMAN was classified as unreliable and therefore render unserviceable.
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5
ATM					

VALUES:
SEVERITY LOOKUP: C
SEVERITY RANGE: C
CODE OF THE COMBINATION: AP-DMS/100
T1 VALUE: No value

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Air Traffic Services		(1)
Operational function	Decision Making Support		(2)
Type of failure	Total Loss of function		(3)
Air Traffic Service Affected	Approach control services		(4)
Extension	Unit		(5)
Scope	All		(6)
Duration	> T1		(7)

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Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		**0**	

Contributing Factors

ATC:

Comments

(1) Service provided:

(2) Operational function:

(3) Type of failure:

(4) Air Traffic Service Affected:

(5) Extension:

(6) Scope:

(7) Duration:

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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10.5.5. Example 5

Risk Analisys Tool Report

Reference number: RUG10-TECH-11
Occurrence type: ATM Specific Occurrence
Description: The Paper-Less-System (PSS) become unavailable

All south positions were impacted by this failure (loss of availability).

The Supervisor determined to impose flow control measures for a short time frame. The PSS function was restored following the restart of the equipment.
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5

ATM

VALUES:
SEVERITY LOOKUP: C
SEVERITY RANGE: C
CODE OF THE COMBINATION: AR-FPI/200
T1 VALUE: ~300s

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Air Traffic Services		(1)
Operational function	Flight Plan Information		(2)
Type of failure	Partial Loss of function		(3)
Air Traffic Service Affected	Area control services		(4)
Extension	Unit		(5)
Scope	All		(6)
Duration	> T1		(7)

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Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		0	

Contributing Factors

ATC:

Comments

(1) Service provided:

(2) Operational function:

(3) Type of failure:

(4) Air Traffic Service Affected:

(5) Extension:

(6) Scope:

(7) Duration:

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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10.5.6. Example 6

Risk Analisys Tool Report

Reference number: RUG10-TECH-04
Occurrence type: ATM Specific Occurrence
Description: Failure of the RWY lighting system.
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5

ATM

VALUES:
SEVERITY LOOKUP: C
SEVERITY RANGE: C
CODE OF THE COMBINATION: AD-NAV/100
T1 VALUE: 0s

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Navigation		(1)
Operational function	Navigation		(2)
Type of failure	Total Loss of function		(3)
Air Traffic Service Affected	Aerodrome control services		(4)
Extension	Departure/Arrival		(5)
Scope	Horizontal Guidance		(6)
Duration	> T1		(7)

Intentionally Left Blank

Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		**0**	

Contributing Factors

ATC:

Comments

(1) Service provided:

(2) Operational function:

(3) Type of failure:

(4) Air Traffic Service Affected:

(5) Extension:

(6) Scope:

(7) Duration:

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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10.5.7. Example 7

Risk Analisys Tool Report

Reference number: RUG10-TECH-05
Occurrence type: ATM Specific Occurrence
Description: Failure of the STOP bars.
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5
ATM					

VALUES:
SEVERITY LOOKUP: C
SEVERITY RANGE: C
CODE OF THE COMBINATION: AD-SNT/100
T1 VALUE: No value

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Air Traffic Services		(1)
Operational function	Safety Nets		(2)
Type of failure	Total Loss of function		(3)
Air Traffic Service Affected	Aerodrome control services		(4)
Extension	Unit		(5)
Scope	All		(6)
Duration	> T1		(7)

Intentionally Left Blank

Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		0	

Contributing Factors

ATC:

Comments

(1) Service provided:

(2) Operational function:

(3) Type of failure:

(4) Air Traffic Service Affected:

(5) Extension:

(6) Scope:

(7) Duration:

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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10.5.8. Example 8

Risk Analisys Tool Report

Reference number: RUG10-TECH-06
Occurrence type: ATM Specific Occurrence
Description: Total loss of air surveillance in approach and aerodrome control services.
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5

ATM

VALUES:
SEVERITY LOOKUP: B
SEVERITY RANGE: B
CODE OF THE COMBINATION: AD-ASV/100
T1 VALUE: No value

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Surveillance		(1)
Operational function	Air Surveillance		(2)
Type of failure	Total Loss of function		(3)
Air Traffic Service Affected	Aerodrome control services		(4)
Extension	Unit		(5)
Scope	All		(6)
Duration	> T1		(7)

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Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		**0**	

Contributing Factors

ATC:

Comments

(1) Service provided:

(2) Operational function:

(3) Type of failure:

(4) Air Traffic Service Affected: Same severity obtained for Approach Control Services

(5) Extension:

(6) Scope:

(7) Duration:

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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10.5.9. Example 9

Risk Analisys Tool Report

Reference number: RUG10-TECH-07
Occurrence type: ATM Specific Occurrence
Description: Failure: Significant interference across all three Clacton sector frequencies resulting in their sudden loss. Back up R/T was affected by the same interference.

Operational Impact: Maastricht UAC was instructed not to transfer any further traffic. BPK LTMA departures were halted. S13 was assigned on to standby frequency 133.525 (LAG E standby) whilst S14 was allocated standby frequency 136.6. There was no spare frequency for S12. Based tactical knowledge S12 was instructed to use freq 120.025
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5
ATM					

VALUES:
SEVERITY LOOKUP: A
SEVERITY RANGE: A
CODE OF THE COMBINATION: AR-AGC/120
T1 VALUE: ~20s

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Communication		(1)
Operational function	Air/Ground Communication		(2)
Type of failure	Total Loss of function		(3)
Air Traffic Service Affected	Area control services		(4)
Extension	Sector Suite		(5)
Scope	All		(6)
Duration	> T1		(7)

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Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		0	

Contributing Factors

ATC:

Comments

(1) Service provided:

(2) Operational function:

(3) Type of failure:

(4) Air Traffic Service Affected:

(5) Extension:

(6) Scope:

(7) Duration:

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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10.5.10. Example 10

Risk Analisys Tool Report

Reference number: RUG10-TECH-08
Occurrence type: ATM Specific Occurrence
Description: Failure: At 04:33 UTC and 04:55 UTC it appears we had no available transmitter on 135.530MHz selected.
This failure had the potential to cause ATC difficulties. Fortunately, due to the worload at the time of day no issues were reported by ATC.
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5

ATM

VALUES:
SEVERITY LOOKUP: C
SEVERITY RANGE: C
CODE OF THE COMBINATION: AR-AGC/230
T1 VALUE: ~20s

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Communication		(1)
Operational function	Air/Ground Communication		(2)
Type of failure	Partial Loss of function		(3)
Air Traffic Service Affected	Area control services		(4)
Extension	CWP		(5)
Scope	All		(6)
Duration	> T1		(7)

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Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		**0**	

Contributing Factors

ATC:

Comments

(1) Service provided:

(2) Operational function:

(3) Type of failure: Single frequency that dropped out - possible due to software issues. There was a partial loss as the controller could receive the pilots' messages!

(4) Air Traffic Service Affected:

(5) Extension: CWP affected.

(6) Scope:

(7) Duration: The controller was not aware of the failure as he did not need to transmit any message.

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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10.5.11. Example 11

Risk Analisys Tool Report

Reference number: RUG10-TECH-09
Occurrence type: ATM Specific Occurrence
Description: Momentary failures across both the main and alternative data networks.
Some external customers reported temporary loss of Radar and Flight Data, and phantom ringing of operational telephone circuits.
Occurrence date: 18/04/2012
Occurrence time:

AA1	A1	B1	C1	E1	D1
AA2	A2	B2	C2	E2	D2
AA3	A3	B3	C3	E3	D3
AA4	A4	B4	C4	E4	D4
AA5	A5	B5	C5	E5	D5

ATM

VALUES:
SEVERITY LOOKUP: C
SEVERITY RANGE: C
CODE OF THE COMBINATION: AR-FPI/100
T1 VALUE: ~480s

RELIABILITY FACTOR:
OVERALL: 50%
OVERALL SEVERITY: 100%
OVERALL REPEATABILITY: 0%

Severity			
Criteria	Recorded Value ATM Ground		Comments
Severity Criteria			
Service provided	Air Traffic Services		(1)
Operational function	Flight Plan Information		(2)
Type of failure	Total Loss of function		(3)
Air Traffic Service Affected	Area control services		(4)
Extension	Unit		(5)
Scope	All		(6)
Duration	> T1		(7)

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Repeatability			
Criteria	Recorded Value ATM Ground		Comments
Systemic issues			
Procedures	N/A		(8)
Equipment	N/A		(9)
Human Resources Management	N/A		(10)
Non-Systemic/ Human Involvement issues			
Other Contributing Factors	N/A		(11)
Window of Opportunity			
Method	N/A		
Situation	N/A		(12)
Total		**0**	

Contributing Factors

ATC:

Comments

(1) Service provided:

(2) Operational function:

(3) Type of failure:

(4) Air Traffic Service Affected:

(5) Extension:

(6) Scope:

(7) Duration:

(8) Procedures:

(9) Equipment:

(10) Human Resources Management:

(11) Other Contributing Factors:

(12) Window Of Opportunity:

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11. 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:

1. Hazard Generation,

2. Hazard Resolution and

3. 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 looked upon in the systemic issues part and therefore in the repeatability criteria.

Figure 34 – *Barrier Model*

Detailed guidance and explanation on 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, for the sake of brevity of these guidelines. A summary is given in the excel files containing the mark sheets and also the RAT web-tool.

It is to be noted that the hazard resolution barrier has been broken down into:

- DETECTION
- PLANNING and
- EXECUTION sub-barriers.

These sub-barriers should be scored as part of the severity assessment of all operational occurrences. Therefore the user should refer back to each marksheet for scoring related guidance.

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12. 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. The effect can be readily seen at the top left hand side of the RAT-web tool. 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.

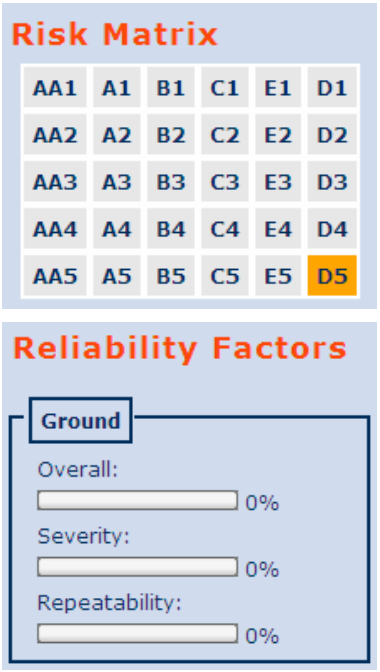

Figure 35 – *Risk Matrix and Reliability Factors*

Two Reliability Factors (RF) are tracked, one for severity and one for Repeatability.

The notion of a RF is multifold:

- 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 assessment (scoring) undertaken, based on the data available to answer the questions in the marksheets.

If enough data are 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 (see Figure 34). 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 RFS 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 7 – ATM Ground Contribution), the ATM ground induced risk is automatically set to 'N'.

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13. Risk Classification Charts

The following Risk Classification chart is applicable for the following marksheet:

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

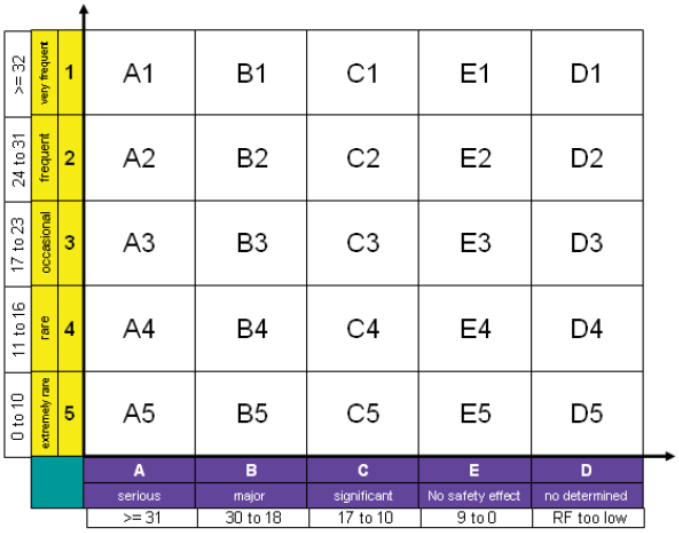

Figure 36 – *Risk Classification Chart for Operational Occurrences*

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

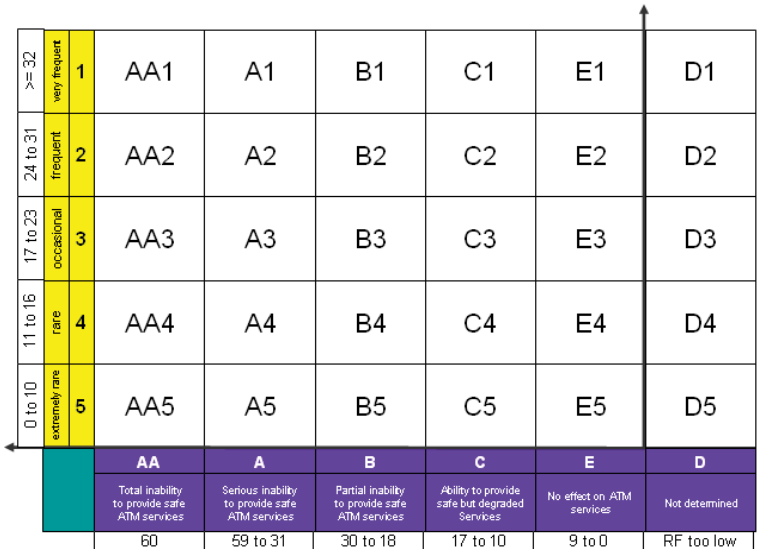

Figure 37 – *Risk Classification Chart for ATM Specific (Technical) Occurrences*

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14. Acronyms

A-SMGCS	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
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
RFR	Reliability Factor for Repeatability
RFS	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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