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EUROCONTROL

SOAM QRG
Systemic Occurrence Analysis Methodology

Quick Reference Guide V2

Contents

Introduction

This quick reference guide (QRG) has been prepared to provide guidance on the application of SOAM (Systemic Occurrence Analysis Methodology) to the investigation of ATM safety occurrences in support of EUROCONTROL Member States and good practice recommendations of EUROCONTROL's European Safety Team.

SOAM is a process for conducting a systemic analysis of data collected during an ATM safety occurrence (incident or accident) investigation, and for summarising and reporting this information using a structured framework and standard terminology.[1]

SOAM aims to broaden the spotlight from focussing on the errors of individuals to identify contributing factors at all levels of the organisation or aviation system. The correct application of SOAM will identify systemic safety deficiencies and guide development of effective findings and recommendations to prevent the recurrence of events.

SOAM can also be used to identify actions of individuals and elements of the system that contributed positively to maintaining safety and mitigated or prevented the effects of a safety occurrence. The SOAM elements have started to be aligned with new eTOKAI / RAT taxonomy.

This pocket guide outlines the SOAM methodology and sets out the key steps for applying it to any level of ATM safety occurrence, from local and relatively minor safety incidents to major aircraft accidents.

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[1] Further detail on the application of SOAM can be found in: EUROCONTROL. (2005). *EAM2/GUI8: Guidelines on the Systemic Occurrence Analysis Methodology (SOAM).* Brussels: Author.

Objectives of Investigation

Safety occurrences[2] are by definition events in which there was an unplanned deviation from the desired system state, resulting in loss or damage to equipment or personnel, or increased potential for such outcomes. Every safety occurrence provides an opportunity to understand how the deviation occurred, and to identify ways of preventing it from happening again.

The objectives of safety occurrence investigation are to:

- Establish what happened and why
- Identify local conditions and organisational factors that contributed to the occurrence
- Review the adequacy of existing system controls and barriers
- Formulate recommendations for corrective actions to reduce risk and prevent recurrence
- Identify and widely disseminate any important lessons from the safety occurrence
- Detect trends that may highlight specific system deficiencies or recurring problems.

The fundamental purpose of safety investigation is the *prevention* of further occurrences.

It is not our task to apportion blame or liability.

[2] Within this guide, the term 'safety occurrence' is used to refer to all levels of safety events, including incidents and accidents.

When should we investigate?

The decision to conduct an investigation using SOAM may be determined by the severity of the occurrence, along with a judgement about potential safety lessons to be learnt from the event. In most organisations this responsibility resides with the Safety Department.

ICAO ANNEX 13

Within ICAO contracting states, safety occurrences are investigated according to the provisions of ICAO Annex 13, which deals with the investigation of aircraft accidents and incidents.[3]

The following definitions of aircraft accidents and incidents are provided in Annex 13.[4]

Defining an Accident:

An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which:

a) a person is fatally or seriously injured as a result of:
   - being in the aircraft, or
   - direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or
   - direct exposure to jet blast, or

[3] International Civil Aviation Organization. (2010). *Annex 13 to the Convention on International Civil Aviation: Aircraft accident and incident investigation, Tenth edition, July 2010.* Montreal: ICAO.

[4] These definitions have been abridged for brevity. Complete definitions are provided in ICAO Annex 13.

b) the aircraft sustains damage or structural failure which:
   - adversely affects the structural strength, performance or flight characteristics of the aircraft, and
   - would normally require major repair or replacement of the affected component, or

c) the aircraft is missing or completely inaccessible.

Defining an Incident:

An occurrence, other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operation.

European Regulations

Within Europe, the investigation of both serious incidents and aircraft accidents are covered by *Regulation (EU) 376/2014 of the European Parliament and of the Council of 3 April 2014* on the reporting, analysis and follow-up of occurrences in civil aviation.

These European Regulations are consistent with the principles of ICAO Annex 13.

Assessing the level of investigation

The level of investigation chosen for a safety occurrence may be determined by the severity of the occurrence.

EUROCONTROL provides guidance on classifying safety occurrences according to the severity of their effect on the safe operations of an aircraft and its occupants. Excluding accidents, which are clearly defined under ICAO Annex 13 and must always be investigated within contracting states, the severity levels in this scheme are:

A: **Serious Incident** – "An incident involving circumstances indicating that an accident nearly occurred" (ICAO Annex 13);

B: **Major Incident** – An incident associated with the operation of an aircraft, in which safety of aircraft may have been compromised, having led to a near collision between aircraft, with ground or obstacles;

C: **Significant Incident** – An incident involving circumstances indicating that an accident, a serious or major incident could have occurred, if the risk had not been managed within safety margins, or if another aircraft had been in the vicinity;

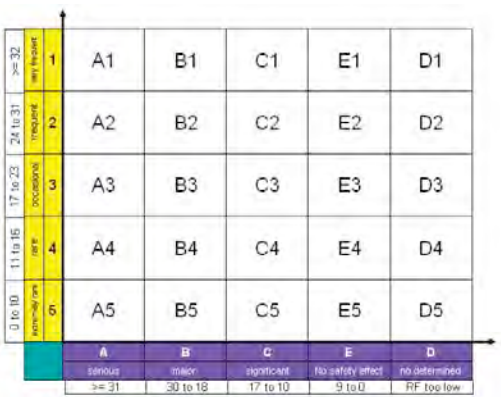
E: **No (immediate) safety effect** – An incident which has no (immediate) safety significance; and

D: **Not determined** – insufficient information available to determine the risk involved.

It is highly desirable to use SOAM for investigation and analysis of occurrences rated in the top three (A, B & C) severity levels outlined above or their equivalent.

The use of SOAM for events of lesser severity is optional and should be determined via a cost/benefit analysis of the potential safety lessons or payoff versus the resources necessary to conduct the investigation.

EUROCONTROL's Risk Analysis Tool (RAT)[5] provides guidance on risk classification following the investigation of an event, including the following chart for application to operational ATM occurrences.



Risk Classification Scheme for Operational ATM Occurrences

[5] EUROCONTROL. (2014). *Risk Analysis Tool - RAT: Guidance Material, Version 1.0.* Brussels: Author.

Ten Principles of Systems Thinking

This section includes ten principles of systems thinking for safety adapted from EUROCONTROL's White Paper on the topic[6], which are consistent with SOAM rationale and should be applied during the investigation process.

Ten Principles of Systems Thinking

Principle 1: Field Expert Involvement
The people who do the work are experts in their field and a critical source of safety knowledge. To understand and learn from their experience, and improve the system, involve those who do the work / were involved at the time of an event.

[6] EUROCONTROL (2014). *Systems Thinking for Safety: Ten Principles. A White Paper.* Brussels: Author.

Principle 2: Local Rationality

People do things that make sense to them given their goals, understanding of the situation and focus of attention at that time. Work activities and safety occurrences need to be understood from the local perspectives of those involved.

Principle 3: Just Culture

People usually set out to do their best and achieve a good outcome. Adopt a mindset of openness, trust and fairness. Attempt to understand actions in context, and adopt language that is non-judgemental and non-blaming.

Principle 4: Demand & Pressure

Demand and pressures relating to system efficiency and capacity have a fundamental effect on performance. Human performance needs to be understood in terms of competing demands on the system and the resulting pressures on people.

Principle 5: Resources & Constraints

Success depends on the availability of adequate resources and appropriate system constraints. Consider the adequacy of staffing, competence, information, equipment, procedures and other resources, and the appropriateness of rules and other constraints.

Principle 6: Interactions & Flows

Work progresses in flows of inter-related and interacting activities. Understand system performance in the context of the flows of activities and functions, as well as the interactions that comprise these flows.

Principle 7: Trade-offs

People have to apply trade-offs in order to resolve goal conflicts and to cope with the complexity of the system and the uncertainty of the environment. Consider how people make trade-offs from their point of view and try to understand how they balance efficiency and thoroughness in light of system conditions.

Principle 8: Performance Variability

Continual adjustments are necessary to cope with variability in demands and conditions. Performance of the same task or activity will vary. Understand the variability of system conditions and behaviour. Identify wanted and unwanted variability in light of the system's need and tolerance for variability.

Principle 9: Emergence

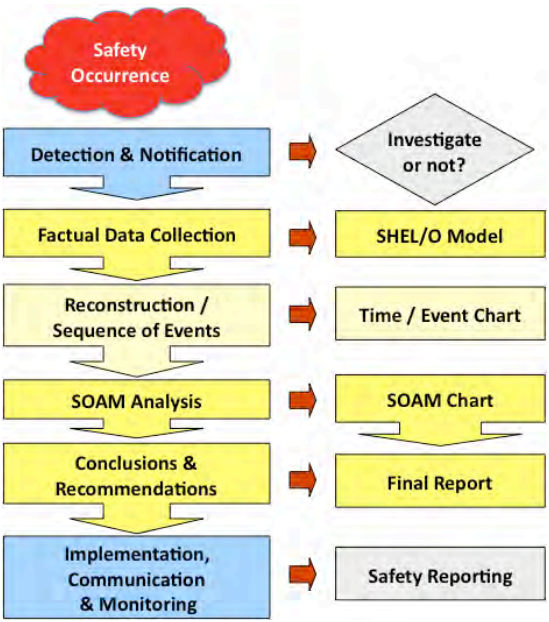
System behaviour in complex systems is often emergent; it cannot be reduced to the behaviour of components and is often not as expected. Consider how systems operate and interact in ways that were not foreseen during design and implementation.

Principle 10: Equivalence

Success and failure come from the same source – ordinary work. Focus not only on failure, but also how everyday performance varies, and how the system anticipates, recognises and responds to developments and events.

Investigation process overview

The diagram below depicts a generic safety investigation process that can be followed, employing the SHEL/O and SOAM tools described in this guide.

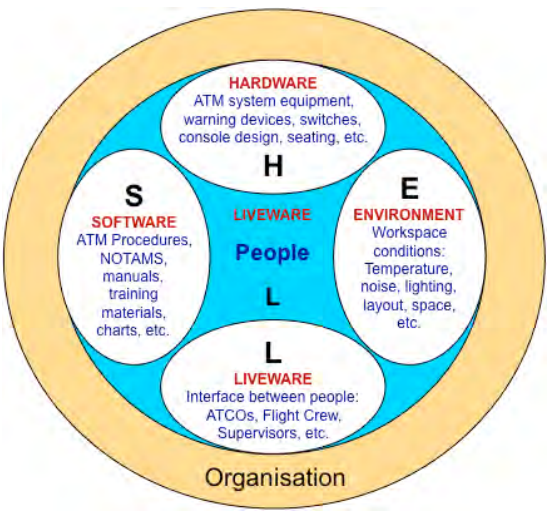


Safety Investigation Process

Gathering factual data

While there is no definitive or prescribed method for the gathering of investigation data, it is useful to gather data within some form of broad descriptive framework, to help with the initial sorting of facts. An adaptation of the SHEL Model (Edwards, 1972, Hawkins 1986) provides the basis for such a descriptive framework.

The SHEL/O Model, including an additional element to cover Organisational aspects, is depicted below.



The SHEL/O Model

Data should be gathered across five SHEL/O elements (the four original areas of the SHEL model, and an additional fifth element – Organisation):

- *Software* – procedures, manuals, charts, etc.
- *Hardware* – ATM equipment, workplace layout, etc.
- *Environment* – workspace conditions, noise, temperature, or other factors that affect people
- *Liveware* – the human elements (people)
- *Organisation* – organisational decisions / actions that impact on the conditions under which people perform their work.

While the data gathering and analysis phases in an investigation are typically depicted as discrete, in reality they are part of a repetitive, circular process. After an initial data collection phase, a preliminary analysis can be conducted, which will identify gaps that can be filled by further data gathering. This process will continue until the systemic analysis has eliminated unanswered questions and reached a logical conclusion.

Examples of the types of data that can be collected under each SHEL/O element are provided in the tables below.

SOFTWARE

PERSON-SYSTEM INTERFACE (SOFTWARE)

- What was the nature of the procedures (eg., SOPs, NOTAMS, Emergency Procedures) used by people involved in the occurrence, for example in regard to:
  - Availability
  - Suitability
  - Supervisory requirements of procedures / work instructions
  - Quality / clarity of documentation
  - Use / usability
- What other written materials were relevant to people involved in the occurrence (eg., maps, charts, checklists, rules, regulations)?

HARDWARE

HUMAN-MACHINE INTERFACE (HARDWARE)

- What were the features of the equipment provided to people in the workplace, for example:
  - Serviceability
  - Functionality
  - Usability
  - Familiarity
  - Availability
  - Design, eg., display quality: colours, illumination, discernibility of returns, signal strength, mode identification
  - Reliability, eg., transmission / reception quality
  - Interaction with equipment and its affect on workload and skill maintenance, eg., navigational aids, flight information display, communications equipment, etc.

ENVIRONMENT

PERSON-ENVIRONMENT INTERFACE

Which features of the work environment impacted on the performance of the people involved in the occurrence? For example:

- Temperature / humidity
- Illumination
- Spaciousness
- Layout / design of workspace
- Noise from equipment / other people

ORGANISATION

- Training:
  - Design
  - Delivery
  - Standardisation
  - Evaluation
- Workforce Management:
  - Staff selection
  - Staffing levels
  - Work rosters
  - Tasking and workload
  - FRMS
- Risk Management:
  - Hazard identification
  - Risk assessments
  - Control measures
  - Effectiveness
- Accountability:
  - Management commitment to safety
  - Responsibility for safety
- Communication:
  - Information dissemination
  - Standardised processes
  - Feedback
- Organisational Culture and Safety Culture:
  - Safety Management Systems
  - Reporting processes
  - Organisational response to occurrences
  - Change management
  - Just Culture issues

LIVEWARE

PHYSICAL FACTORS

- Physical characteristics (eg., height, weight, age)
- Sensory limitations (eg., vision, hearing)

PHYSIOLOGICAL FACTORS

- Fatigue (eg., acute, chronic, task induced)
- Lifestyle factors, health, nutrition, stress

PSYCHOLOGICAL FACTORS

- Information processing (eg., perception, memory, situational awareness, decision making)
- Focus of attention (eg., distraction, monotony, boredom, task fixation, inattention)
- Recent experience (eg., at this location, in this position, with similar traffic loads, etc.)
- Motivation / attitude

PSYCHOSOCIAL FACTORS

- Lifestyle changes (eg., change in family circumstances, other domestic issues)

PERSON-PERSON INTERFACE

- Oral communications:
  - Misinterpretation
  - Phraseology
  - Content
  - Rate of speech
  - Language issues
  - Readback / hearback
- Team interactions:
  - Supervision
  - Relationships
  - Morale, composition (eg., in/experience)
- Management:
  - Relations with staff
  - Resource allocation
  - Organisational change
  - Career progression
  - Labour relations

Introducing SOAM

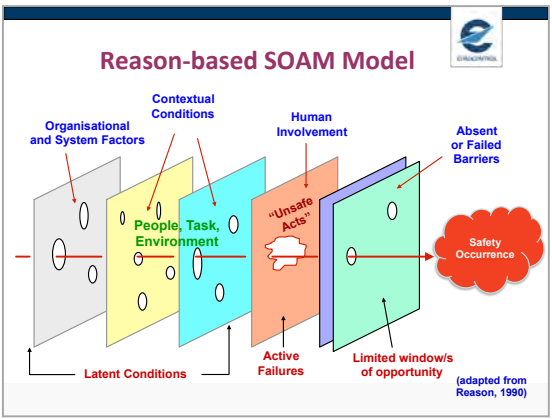
The Systemic Occurrence Analysis Method (SOAM) is a safety occurrence analysis tool based on principles of the well-known 'Reason Model' of organisational accidents (Reason, 1990, 1997, 2008).

SOAM is a non-linear process for conducting a systemic analysis of the data collected in a safety occurrence investigation, and for summarising this information using a structured framework and standard terminology. SOAM draws on the theoretical concepts inherent in the Reason Model, but also provides a practical tool for analysing and depicting the complex inter-relationships between all contributing factors in a safety occurrence.

SOAM allows the investigator to overcome one of the common limitations of safety investigation – the tendency to focus primarily on identifying what people did or did not do ~ those intentional or unintentional acts of operators ~ that may have triggered a safety occurrence.

Reason's original 'Swiss Cheese' model has been adapted and refined within SOAM. The terminology used has been altered in accordance with a 'Just Culture' philosophy, reducing the implication of culpability and blame for both individuals and organisations.

In SOAM, Reason's 'Unsafe Acts' are referred to as *Human Involvement*, 'Psychological Precursors of Unsafe Acts' as *Contextual Conditions*, and 'Fallible Decisions' as *Organisational and System Factors*. 'Absent or Failed Defences' are referred to as *Absent or Failed Barriers.* The SOAM adaptation of the original Reason Model is shown overleaf.



Like other systemic analysis techniques, SOAM requires the investigator to probe deeper than a basic factual report that simply answers questions such as “What happened, where and when?"

First, data must be collected about the conditions that existed at the time of the occurrence that influenced the actions of the people involved. These in turn must be explained by asking what part the organisation played in creating these conditions, or allowing them to exist, thereby increasing the likelihood of a safety occurrence.

SOAM thus supports the fundamental purpose of a safety investigation - to identify and understand the factors that contributed to an occurrence and to prevent it from happening again.

SOAM is aligned with and supports 'Just Culture' principles by adopting a systemic approach that does not place undue focus on individual error, either at the workplace or management level. It avoids attributing blame by:

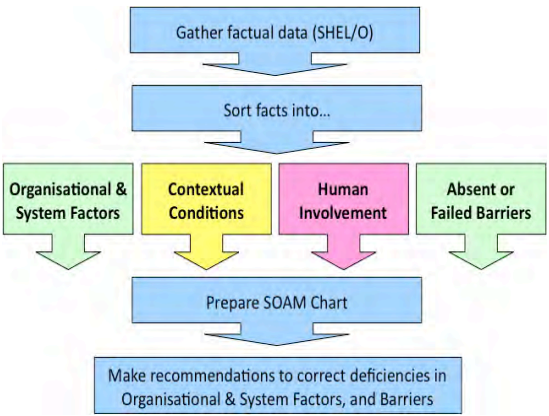
- Broadening the focus from people's actions, instead seeking to identify the conditions that influenced or shaped their behaviour; and
- Identifying latent organisational factors that allowed less than ideal conditions to exist, under which a safety occurrence could be triggered.

SOAM can be applied both reactively and proactively. The process can be applied to any new occurrence, and is also suitable for the retrospective analysis of previously investigated occurrences in an attempt to extract additional lessons for the promotion of safety.

SOAM can also be applied proactively to generic safety occurrences (eg., AIRPROX, level busts, separation minima infringements, runway incursions, etc.) or to hypothetical events. These applications should result in a comprehensive analysis of the absent or failed barriers and latent conditions that are commonly found to contribute to such events, thereby identifying areas of organisational weakness that need to be strengthened to improve safety and prevent future occurrences.

SOAM process overview

When using SOAM it is recommended that the analysis process depicted below is followed:



After completing the SOAM Chart, discussed in more detail later in this guide, recommendations should be developed to address all identified *Organisational and System Factors* and all *Absent or Failed Barriers*.

SOAM analysis

Having collected the data, the first stage of SOAM analysis involves sorting each item of factual information into an appropriate element. This is a progressive sorting activity that should be conducted as a group exercise if the investigation is being conducted by a team. Each fact is dealt with in turn, and subjected to the following test:

Contribution Test:
Does this fact represent a condition or event that contributed to the occurrence?

The purpose of this test is to exclude any facts that did not contribute to the occurrence. If the information is nonetheless considered important to safety, it can be detailed in a separate section of the investigation report.

If a fact satisfies this test, it can then be classified as belonging to one of the following SOAM elements:

- *Human Involvement*
- *Contextual Conditions*
- *Organisational or System Factors*
- *Absent or Failed Barriers*

Check Questions are supplied for each SOAM element to assist with classification. The relevant check question should be applied at each stage of the SOAM analysis process to ensure that each fact fits correctly in the category for which it is being considered.

Identifying Human Involvement

The first step of the SOAM classification process is to identify the contributing human actions or non-actions that triggered the safety occurrence.

These actions / non-actions may be errors and/or acts of non-conformance[7], and are normally associated with the behaviour of front-line workers and operational staff.

The question at this stage should not be *why* people behaved as they did, but simply '*what were their contributing actions / inactions?'* just prior to the event.

At each stage of the SOAM process, a check question should be applied to test whether an item fits within the definition of Human Involvement.

Check Question 1: Human Involvement
Does the item describe an action or non-action taking place immediately prior to, and triggering / contributing to the occurrence?

NB: While most safety occurrences are triggered by the actions or inactions of front line staff, there are some events where this is not the case (e.g., component failure, as in the NASA 'space shuttle' accidents). In such cases the event may be triggered by an unusual combination of *Contextual Conditions* (discussed in some detail below). Also, in some rare cases the relevant triggering action (e.g., a maintenance error) may have occurred days, weeks or months prior to the event.

[7] The terms 'error' and 'non-conformance' are defined in the Glossary at the end of this guide.

The tasks performed by an ATCO, a pilot, or a technician involve multiple forms of information processing, including detection, integration and interpretation of information, as well as projecting, planning and decision making. An information-processing model can thus enable a more detailed analysis of the cognitive tasks that might be performed by a controller as an occurrence unfolds.

While not necessary for applying SOAM, deeper analysis of the processes contributing to Human Involvement can be conducted using various tools and techniques not included within SOAM, such as Rasmussen's[8] Decision Ladder or EUROCONTROL's HERA technique (Human Error in ATM; EUROCONTROL, 2003)[9].

While identifying triggering actions or inactions of workers is an important first step to understanding an occurrence, no investigation should end there. If a simple error can trigger a safety occurrence it is an indicator of faults deeper within the system that need to be examined.

The correct identification of Human Involvement provides a foundation for the next stage of the SOAM process, which focuses on trying to understand why people acted as they did, through examination of the *Contextual Conditions* in place at the time of the occurrence.

[8] Rasmussen, J. (1982). Human errors: A taxonomy for describing human malfunction in industrial installations. *Journal of Occupational Accidents, 4,* 311-333.

[9] EUROCONTROL. (2003). *The Human Error in ATM Technique (HERA-JANUS).* Brussels: Author.

Identifying Contextual Conditions

Contextual conditions describe the circumstances existing at the time of the safety occurrence that can directly influence human performance in the workplace. These are the conditions that promoted the errors and / or non-conformances identified in the previous step.

In the 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 / people behaved as they did?"

Again, a check question is applied to ensure that the items being classified fit the definition of contextual conditions.

Check Question 2: Contextual Conditions
Does the item describe an aspect of the workplace, local organisational climate, or a person’s attitudes, personality, performance limitations, physiological or emotional state that helps explain their actions / inactions and / or contributed to the occurrence?

Five categories of contextual conditions can be distinguished, two relating to the local workplace, and three to people:

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

The following examples are provided to help investigators to correctly identify contextual conditions. In each table, items are listed according to whether they are most likely to influence errors or violations, or are common to both.

WORKPLACE CONDITIONS		
Error / Mitigation Factors	**Common Factors**	**Non-conformance Factors**
Communication Signal to noise ratio Designer / user mismatch Human-system interface (HMI) Reliance on informal knowledge (vs written SOPs or instructions) Demanding shift patterns / work rosters Work environment (e.g., temperature, lighting, noise, workspace, etc.)	Supervision Time pressures Time shortage Working conditions Tools / equipment Visibility / access to job / worksite Procedures / instructions Supervisor to staff ratio Workload Staff availability Hazard identification and management	Task allows for / encourages easy shortcuts Work schedules or quotas encourage / require shortcuts or rule-bending to complete the task

ORGANISATIONAL CLIMATE		
Error / Mitigation Factors	**Common Factors**	**Non-conformance Factors**
Organisational culture Validity of procedures	'Housekeeping' of documents or equipment Applicability of procedures Commercial or production pressure	Non-conformance tolerated by management Procedures impractical or unworkable Compliance goes unrewarded Errors reprimanded Macho culture Perceived licence to bend rules Inappropriate supervisory example Subjective norms condoning deviation from SOPs Management sanctions Little or no worker autonomy Worker status Industrial climate

ATTITUDES AND PERSONALITY FACTORS		
Error Factors	**Common Factors**	**Non-conformance Factors**
Confidence	Belief that personal skill can overcome risk 'Can do' attitude Judgement Complacency Overconfidence	Attitude to 'the system' Behavioural beliefs: (can't / won't happen to me) Job dissatisfaction 'Learned helplessness' Self-esteem Personality: narcissistic; unstable extrovert; non-compliant Motivated by personal gain High risk tolerance Misperception of hazards

PHYSIOLOGICAL AND EMOTIONAL FACTORS		
Error Factors	**Common Factors**	**Non-conformance Factors**
Disturbed sleep patterns Domestic problems Stress / fatigue Physical and health problems Misuse of drugs, alcohol or medicines	Performance anxiety Arousal state (too low/high) Monotony / boredom Emotional state Circadian low points	Hostility / mood Disregard for personal safety

HUMAN PERFORMANCE LIMITATIONS		
Error Factors	**Common Factors**	**Non-conformance Factors**
Negative transfer Knowledge deficiency Target fixation; preoccupation; distraction Confirmation bias Expectancy bias False perceptions False sensations Memory failures: - encoding interference / storage loss / retrieval failure / prospective memory Perceptual set Reduced situational awareness False inference and / or reasoning	Skill level Ability level Training Unfamiliarity with task Over-familiarity with task	

Identifying Organisational & System Factors

This section explains how to identify the organisational and broader system factors (OSFs) that contributed to the occurrence. OSFs describe circumstances that existed before the occurrence and produced the relevant contextual conditions, or allowed them to remain in place, which in turn influenced people's actions and/or inactions.

Twelve categories of OSF have been identified as frequently contributing to ATM safety occurrences. The 12 factors and their corresponding two-letter codes are listed below.

Code	Organisational / System Factor
TR	Training
WM	Workforce Management
AC	Accountability
CO	Communication
OC	Organisational Culture
CG	Competing Goals
PP	Policies and Procedures
MM	Maintenance Management
EI	Equipment and Infrastructure
RM	Risk Management
CM	Change Management
EE	External Environment

Once again, a check question is applied to ensure that the items being considered fit within the definition of organisational and system factors.

Check Question 3:
Organisational & System Factors
Does the item describe an aspect of the organisation's culture, systems, processes, or decision-making that existed before the occurrence and which resulted in the contextual conditions or allowed those conditions to continue?

The following pages provide further information on the 12 SOAM organisational and broader system factors. The detail provided for each factor includes:[10]

- A *Definition* that broadly describes the factor, and gives examples of the issues and characteristics associated with it.
- *Indicators* of the different types of deficiencies that may be classified under the particular OSF.
- *Consequences* - examples of the visible symptoms of deficiencies that may be observed under the OSF.

Note that for each OSF the characteristics listed are indicative only and are not intended to be exhaustive or definitive. They can apply to an organisation, or to the broader system within which the organisation operates. They can also sometimes have positive impact.

[10] Further details, including illustrative case studies, are provided in the SOAM guidelines document: EUROCONTROL. (2005). *EAM2/GUI8: Guidelines on the Systemic Occurrence Analysis Methodology (SOAM)*. Brussels: Author.

Training (TR)

Factors relating to the suitability and quality of training provided for workers involved in conducting tasks related directly to the occurrence. These may include issues to do with the design, structure, duration, knowledge content, delivery, assessment, and frequency of training processes.

Indicators of TR deficiencies:

- Training design (syllabus, structure, content)
- Training delivery (methods, devices, duration)
- Task / training fit
- Training standardisation
- Amount of training provided
- Competency assessment
- Training planning
- Assessment of training effectiveness

Consequences of TR deficiencies may include:

- Mismatch between required and actual performance
- Lack of required knowledge and/or skill
- Inadequate training
- Inference or reasoning deficiencies
- Misperception of hazards
- Inability to perform assigned task/s
- Excessive supervision required
- Lengthy task completion times
- Negative transfer
- Unfamiliarity with task
- Workload management problems

Workforce Management (WM)

Factors relating directly to management of operational staff. Includes HR policies and practices that impact on staff workload, supervision, performance and morale, such as organisational structure, job design, selection, recruitment, tasking, staffing levels, experience levels, remuneration / reward systems, but excludes training.

Indicators of WM deficiencies:

- Organisational structure/work design and/or job design
- Industrial relations / staff morale
- Selection methods and processes
- Staffing levels / workforce experience
- Rostering practices / tasking and workload
- Fatigue Risk Management practices
- Supervisor to staff ratio
- Team composition / experience levels
- Contractor management

Consequences of WM deficiencies may include:

- Slow or inadequate response to anomalies
- Communication deficiencies
- Inappropriate selection (person/job mismatch)
- Undesirable shift patterns / worker fatigue
- Inadequate supervisor to staff ratio
- Improper tasking / under-staffing
- Age and/or experience imbalance
- Worker autonomy (too little/too much)
- Low worker status and/or pay
- Task design encourages shortcuts and / or violations
- Inexperience (not lack of training)

Accountability (AC)

Factors relating directly to the accountability of key staff and the way in which responsibilities are assigned to them. Includes issues such as the assignment of responsibility for safety from senior management levels down, oversight of performance in safety-related duties, clear definition and communication of accountabilities throughout the organisation, and processes to ensure that accountabilities are fulfilled.

Indicators of AC deficiencies:

- Demonstrated management commitment to safety
- Clearly defined accountabilities for operational safety
- Processes to ensure accountabilities are fulfilled
- Response by management to reported or rumoured breaches of rules or procedures by workers
- Mechanisms to ensure that the commitment to safety is reflected in everyday actions of managers and staff
- Mechanisms to ensure that safety is embedded within the organisation as a top operational priority

Consequences of AC deficiencies may include:

- Lack of conviction regarding the importance of safety
- Blurred lines of responsibility for safety
- Accountability “gaps” for safety critical activities
- Action not taken by management to redress known safety problems/concerns
- Ambiguity regarding where safety concerns should be directed
- Confusion amongst managers over who should take action on safety-related concerns/deficiencies
- Management commitment to safety not reflected in the beliefs or behaviours of workers

Communication (CO)

Factors relating to the suitability and quality of communication systems and methods within the organisation. This relates to the availability and flow of information, whether and how employees are informed about safety critical information, and the clarity and quality of formal and informal communication processes.

Indicators of CO deficiencies:

- Documented policies and procedures
- Clarity of organisational structure and responsibilities
- Standardised communication tools
- Information flow within the organisation
- Communication within the organisation
- Communication with other facilities
- Coordination within/between work groups or teams, with other sectors or departments
- Shift handover procedures

Consequences of CO deficiencies may include:

- Uncertainty or ambiguity regarding how to apply specific work rules or procedures
- Uncertainty or ambiguity regarding organisational structure and responsibilities
- Communication breakdowns, misunderstandings
- Inadequately informed workforce (including all staff and contractors)
- Uncertainty about where/how to obtain information
- Lack of management knowledge or understanding regarding staff concerns, behaviour, etc.

Organisational Culture (OC)

Factors relating to shared values and beliefs within an organisation that influence “the way things are done”, and distinguish the organisation from others. Includes safety culture elements such as commitment to safety, safety awareness, Just Culture, wariness about potential for accidents, and the capacity to learn from events.

Indicators of OC deficiencies:

- Values and beliefs relevant to safety and quality
- Demonstrated management commitment to safety
- Safety Management Systems / reporting processes
- Examples set by supervisors and management
- Management response to safety occurrences
- Management response to reporting of safety concerns
- Processes for anticipating and protecting against future incidents or accidents
- Capacity to admit faults and learn from experience

Consequences of OC deficiencies may include:

- Toleration / condoning of routine violations
- Rule compliance not encouraged or supported
- Perceived licence for staff to 'bend the rules'
- Risk-taking / ‘macho’ culture encouraged
- Inappropriate example set by management
- Evidence of a 'blame culture' / unfair or unjust management sanctions following occurrences
- Defensive response to issues (denial, cover-ups, etc)
- Low morale, job dissatisfaction / lack of pride in work
- Adversarial industrial climate
- Poor housekeeping / inadequate supervision
- Complacency (that can't/won't happen here)

Competing Goals (CG)

Factors relating to conflicts between competing goals. These may include conflicts between safety and planning or economic targets or goals, in addition to the vested interests of groups or individuals within the organisation. Typically characterised by an overemphasis on budget or production goals at the expense of safety.

Indicators of CG deficiencies:

- High emphasis on unit or organisational productivity to the potential detriment of safety
- Discord or tension between production priorities and safe work
- Imbalance between budget constraints and safety
- Tacit approval of informal 'short-cuts' that increase productivity
- Management priorities and emphasis excessively focussed on production goals other than safety
- Achievement of productivity, service or other goals is rewarded ahead of safety objectives

Consequences of CG deficiencies may include:

- Staff shortages
- Budget cuts to safety programs
- Budget cuts to training programs
- Lack of resources necessary to get the job done
- Workload pressures
- Time shortage / time pressures
- Acceptance of routine violations / 'Practical drift'
- Pressure to short-cut procedures
- High workload levels

Policies and Procedures (PP)

Factors relating to the quality and suitability of policies, procedures and standards. Includes applicability, clarity, currency, specificity, availability, use and standardisation of all written work instructions and processes.

Indicators of PP deficiencies:

- Relevance or applicability of policies, procedures, checklists and instructions
- Level of detail included in documentation
- Standardisation of operational procedures
- Feedback loop between document authors and users
- Availability of procedures or other documentation
- Practicality / usability of procedures / other instructions

Consequences of PP deficiencies may include:

- Inaccurate, poorly written, unclear or out of date procedures / instructions
- Some important tasks not covered by procedures
- Different versions of the same procedure in circulation
- Lack of standardisation within/between centres, sectors and/or work groups or teams
- Different groups / sectors using conflicting procedures
- Non-SOP application of procedures / requirements
- Lack of understanding of policies and procedures
- Procedures that do not reflect operational practice
- Encouragement of procedural short-cuts and violations
- Procedures that protect the system not the individual
- Poor mix of “hands on” work and written instructions (over-reliance on undocumented knowledge)
- Failure to address legal, regulatory and/or other corporate obligations

Maintenance Management (MM)

Factors relating to management of ATM facility and equipment maintenance. Typically includes the planning, scheduling, resourcing and oversight of maintenance and repair activities. MM also includes the effectiveness with which contracted organisations and staff are selected, inducted, trained, supervised and kept informed.

Indicators of MM deficiencies:

- Serviceability of ATM equipment and facilities
- Scheduling of maintenance activities
- Standardisation of maintenance activities
- Communication about maintenance activities
- Resourcing of maintenance activities
- Supervision of maintenance activities
- Equipment operating manuals and documentation
- Processes for Contractor Management

Consequences of MM deficiencies may include:

- Poorly maintained or unserviceable equipment
- Unscheduled shutdowns or delays due to equipment malfunctions or defects attributable to inadequate or inappropriate maintenance
- Maintenance activities conducted at inappropriate times (eg., peak traffic / work periods)
- Operational staff unaware of maintenance activities
- Low quality work performed by maintenance staff
- Differences between standard of work performed by maintenance staff and contractors
- Lack of knowledge and/or concern shown by staff and / or contractors about hazards and risks associated with maintenance activities

Equipment and Infrastructure (EI)

Factors relating to the design, quality, availability and serviceability of workplace equipment and other hardware used in conducting or supporting ATM operations. This element includes Human-Machine Interface (HMI) issues that impact on usability of equipment and infrastructure.

Indicators of EI deficiencies:

- HMI design
- Ergonomics
- Equipment displays, functions and layout
- Purchase of 'fit-for-purpose' equipment
- Equipment / system design: Users require additional training or procedures to 'work-around' deficiencies
- Standardisation of equipment design
- Work station layout and / or fit out
- Working conditions

Consequences of EI deficiencies may include:

- Inefficient / unsuitable HMI
- Inadequate tools and equipment
- Difficult access to work stations
- Negative transfer
- Increased workload
- Reduced situational awareness
- Inadequate system feedback
- Information / task overload
- Negative signal to noise ratio
- Cramped working conditions
- Noisy work environment
- Uncomfortable working environment

Risk Management (RM)

Factors relating to the systems, procedures, accountabilities and activities within the organisation that are designed to identify, analyse, manage and monitor risk. Risk is defined as any aspect of an organisation's operation that has a potential to cause damage or harm to people, equipment, the environment, the organisation's reputation, or the wider community.

Indicators of RM deficiencies:

- Management understanding of the importance of RM
- Risk management policy and documentation
- Risk identification processes, eg., hazard reporting and analysis systems
- Qualitative and quantitative risk measurement methods
- Training and competence of personnel involved in risk assessment and compliance activities
- Assignment and monitoring of responsibilities and accountabilities for risk identification and control
- Safety assessment processes
- Risk Assessments

Consequences of RM deficiencies may include:

- Hazards not identified and/or appropriately managed
- Unnecessarily high risk levels
- Operational risks not prioritised
- Controls do not address high priority risks adequately
- Increased safety occurrence rates
- Unexpected costs / losses
- Threats to employee and/or customer welfare
- Non-compliance with regulatory requirements

Change Management (CM)

Factors associated with planning, testing, implementation and review of significant modifications to organisational structure/equipment, or major transition from one organisational work process / system to another. Includes activities intended to instil new values/attitudes/norms/ behaviours, to support new ways of working / new technology, and/or overcoming resistance to change.

Indicators of CM deficiencies:

- Definition of change goals or objectives
- Consideration of scope and consequences of change
- Design, management, oversight and review of implementation plans
- Communication about objectives, outcomes and implications of change; potential benefits / drawbacks
- Change timing and/or timeframes
- Concern about the human impact: effect on employee values, attitudes, morale, performance
- Monitoring of pre- and post-change performance

Consequences of CM deficiencies may include:

- Resistance to change
- Deterioration in safety performance or other KPIs
- Gaps in structures, accountabilities or procedures
- Uncertainty / confusion about roles and responsibilities
- Mismatch between tasks and available resources
- Change/s not implemented effectively / on time
- Loss of 'corporate knowledge / memory'
- Increased staff stress / hostility / apathy / absenteeism
- Decreased concern for SOPs, rules, safety, etc.
- Reduced motivation / morale

External Environment (EE)

Factors relating to elements of the ATM system and/or broader aviation system that fall outside the direct influence of the organisation yet can be considered to fall within the scope and potential influence of the safety investigation. May include international or local regulatory requirements or standards, issues of strategic airspace organisation and management, external air traffic flow management (such as NMOC), airport and/or broader system infrastructure design and maintenance, etc.

Indicators of EE deficiencies:

- Consultation / communication / coordination between the various agencies and organisations involved in local and/or global ATM system and/or aviation system regulation and operation
- Safety Management Systems
- Safety regulation and oversight

Consequences of EE deficiencies may include:

- Ambiguous or conflicting requirements
- Inefficient and/or hazardous movement of air traffic
- Inaccurate / conflicting documentation
- Inadequate aerodrome markings, signage, lighting, etc.
- Inadequate quality assurance processes
- Non-compliance with regulatory requirements
- Reduced situational awareness of ATCOs / flight crews
- Inadequate or ineffective coordination / communication within / between various organisations
- Ineffective communication of safety-critical information
- High workload

Identifying Barriers[11]

Complex socio-technical systems typically contain multiple barriers or defences to protect the system against hazards and undesired events. Barriers protect the system against both technical and human failures.

Barriers are the last minute measures that failed or were missing, and therefore did not (a) prevent an action from being carried out or an event from taking place; or (b) prevent or reduce the impact of the consequences. A key objective of safety investigation is to identify barriers that:

1). were in place but did not work as intended to prevent the occurrence or minimise its consequences, or

2). were not in place, but might have prevented the occurrence if they had been or

3). were in place and worked fully or partially and contributed to minimise the consequences.

Actions are then recommended to strengthen the barriers that failed or were absent at the time of the occurrence, or promote / re-enforce those barriers that worked.

Once again, a check question is used to ensure that the item being considered fits the definition of a Barrier.

Check Question 4: Barriers
Does the item describe a work procedure, aspect of human awareness, physical obstacle, warning or control system, or protection measure designed to prevent an occurrence or lessen its consequences?

[11] While Professor James Reason used the term 'Defences' in his modelling of organisational accidents, and the terms are interchangeable, 'Barriers' is the terminology used in SOAM.

The following six barrier types represent successive lines of defence, beginning with awareness and understanding of risks and hazards in the workplace. If this first line of defence is breached, subsequent barriers (restriction, detection, and so on) are designed to contain the situation and limit adverse consequences.

BARRIER TYPES
Awareness: Understanding about the system state, risks and hazards, and knowledge of the rules, guidelines, procedures and controls that apply to the task, eg: • Rules, guidelines, SOPs • Communication (eg., briefings, shift handover) • Training outcomes (*ab initio*, OJT, TRM, etc.) • Supervision
Restriction: Limitation of movement or actions, or establishing pre-conditions for action, through physical, functional or administrative means, eg: • Instructions, Clearances, Checklists, SOPs, etc. • Read back / hear back, standard phraseology • Work permits, work orders • Deadman systems, equipment interlocks • Software logic, passwords, etc.
Detection: Indicating systems (human or engineered) that warn about the system status, including the presence of non-normal conditions or imminent dangers, eg: • Warnings, alarms, alerts, eg., Short Term Conflict Alert (STCA), Minimum Safe Altitude Warning (MSAW), Area Proximity Warning (APW), TCAS, EGPWS, NOTAMS. • Signals (visual, auditory) • Detection by ATCO, flight crew • Signage (e.g., cautions, reminders, etc.)

BARRIER TYPES (cont)
Control and interim recovery: Recovering from a non-normal condition and restoring the system to a safe state, with minimal harm or loss, eg: • Timely and accurate action by people • Successful recovery action by ATCO / flight crew • Heroic improvisation
Protection and containment: Defending people against injury and minimising environmental damage by controlling the accidental release of harmful energy or substances, eg: • Walls, doors, filters, containers • Personal Protective Equipment (PPE) • Seat belts, harnesses, airbags
Escape and rescue: Enabling potential victims to escape out-of-control hazards; treating injuries, restoring the environment, eg: • Emergency exits, escape slides, first aid • Emergency services, Rescue and Fire Fighting

It should be noted that while common in many industries, the final two barrier types identified above, *Protection and containment* and *Escape and rescue*, would rarely be encountered within typical ATM safety occurrences.

The work of Professor Erik Hollnagel provides further discussion and clarification of the various barrier types and functions.[12]

[12] Hollnagel, E. (2004). *Barriers and accident prevention.* Aldershot, UK: Ashgate.

Hollnagel, E. (2008). Risk + barriers = safety? *Safety Science 46,* 221-229.

The SOAM Chart

The final product of the SOAM analysis process is a SOAM summary chart depicting:

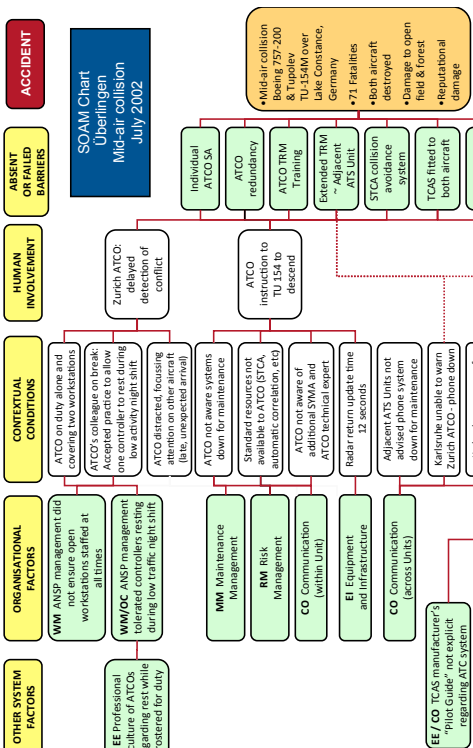
- Each contributing factor – grouped according to the methodology as *Absent or Failed Barriers*, *Human Involvement*, *Contextual Conditions* and *Organisational and System Factors*; and
- Links representing the association between a contributing factor (e.g., a human in/action), and its precursor conditions (i.e., the context in which the action took place).

Creating SOAM chart links

In creating links in the SOAM summary chart, facts in different elements should be linked if one is thought to have influenced the other. For example, if a Contextual Condition (e.g., high workload) is considered to have influenced Human Involvement (e.g., a procedural error) then a link should be drawn between them. Similarly, if an Organisational Factor (e.g., Workforce Management: Low staff levels) is considered to have created a contextual condition (e.g., high workload), or allowed it to continue to exist, then a link should be drawn between them.

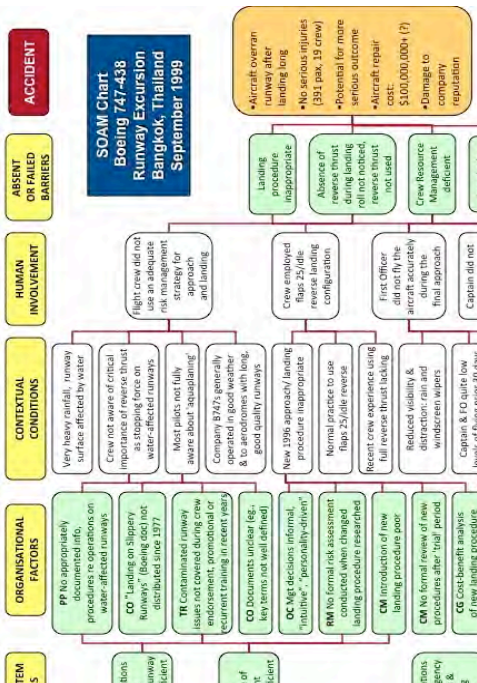
The SOAM Chart is very useful for briefing others and sharing lessons gained from identification and analysis of the circumstances surrounding an occurrence.

Example SOAM charts are shown on the following pages. In each example, data taken from the official investigation report of an event has been used to create a SOAM chart depicting the occurrence.



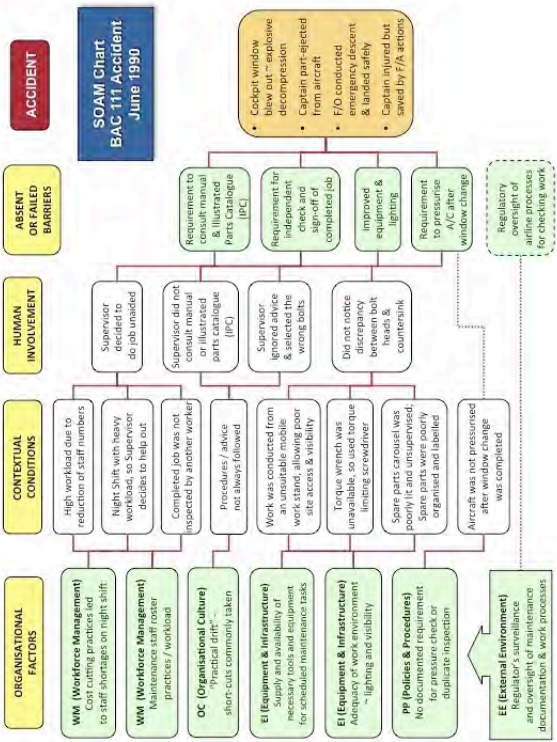
SOAM Chart ~ Überlingen Mid-air collision

Data from the official investigation report has been used to develop a SOAM chart for the July 2002 mid-air collision over Überlingen, southern Germany.



SOAM Chart ~ Bangkok Runway Excursion

In this example, information taken from the investigation of a B747-438 runway excursion in Bangkok has been used to develop the SOAM Chart.



SOAM Chart ~ BAC 111 Rapid Decompression

In this example, information taken from the investigation of a well-known BAC 111 explosive decompression event has been used to develop the SOAM Chart.

Developing Effective Recommendations

Developing recommendations for corrective action is a critical element of any occurrence investigation process. The relevance, quality and practicality of remedial recommendations made following an investigation will determine their utility to those in a position to implement safety improvements.

This section describes the logical process applied under SOAM for generating recommendations that:

- Are directly and clearly linked to the facts included in the SOAM analysis chart
- Are focussed on findings that are amenable to corrective action
- Reduce the likelihood of a recurrence of the event, and/or reduce future risk,
- Promote positive barriers and organisational aspects found to have contributed to limit the consequences of the safety occurrence.

In formulating recommendations, the SOAM process requires that all factors listed under the following two SOAM elements be addressed:

- The deficient *Barriers* (Absent or Failed), and
- The *Organisational and System Factors*

Each identified *Barrier* and each listed *Organisational or System Factor* must be addressed by at least one recommendation for corrective action, unless already adequately covered by a previous recommendation.

For example, an ineffective warning system may be identified as a *Failed Barrier* as well as an *Equipment*

and Infrastructure and/or *Maintenance Management* issue at the Organisational Factor level, but a single recommendation for corrective action *may* suffice.

Checking that all identified (evidence-based) deficiencies in Barriers and Organisational Factors are addressed by recommendations will ensure that all latent conditions unearthed during the investigation are addressed by remedial action/s. This can also help to eliminate the problem of unrelated recommendations being made by exuberant investigators on matters of personal interest that were not identified as contributing factors in the occurrence[13].

It should be noted that any Barriers or Organisational and System Factors that were found to work to mitigate or limit the consequences of a safety occurrence may attract recommendations to promote or strengthen their effectiveness and use.

Recommendation Checklist

Recommendations should:

- focus on systemic deficiencies and absent, failed or mitigating barriers, *not* on people and their actions
- be clearly linked to evidence ~ the facts or conclusions of the investigation regarding contributing factors
- aim at reducing the likelihood of recurrence of the event, and/or reducing risk
- focus on findings that are amenable to corrective action

[13] Information on assessing the impact of recommendations can be found in EUROCONTROL EAM2/GUI8: *Guidelines on the Systemic Occurrence Analysis Methodology (SOAM).*

- be specific and prescriptive enough to be practical, but not cover subject matter outside the expertise of the investigators
- not be contaminated by the personal agendas or predispositions of the investigator/s
- be targeted to include specific reference to an accountable manager, department or organisation responsible for implementing the recommendation
- include realistic compliance time limits.
- where appropriate, promote positive findings.

SMARTER

The SMARTER mnemonic can also be used to guide the quality and effectiveness of safety recommendations. Using S-M-A-R-T-E-R, investigators should ensure that recommendations made are:

S – Specific

M – Measurable

A – Accountable

R – Reasonable

T – Timely

E – Effective

R – Reviewed

SOAM Quality Assurance Checklist

When concluding the SOAM analysis process, use this quality assurance checklist to ensure that you have completed the following steps:

- ❑ Facts of the occurrence established
- ❑ Relevant data gathered and reviewed
- ❑ All contributing *Human Involvement*, *Contextual Conditions, Organisational or System Factors* and *Absent or Failed Barriers* identified and classified, using the supplied Check Questions
- ❑ SOAM Chart prepared
- ❑ Issues which may require follow-up or further data collection identified and actioned
- ❑ Adequacy of existing barriers and system controls reviewed
- ❑ Recommendations made to address all deficient Barriers and Organisational / System Factors
- ❑ Available data reviewed to ensure that all findings and recommendations are supported by evidence
- ❑ Recommendations reviewed to ensure they are realistic, practical and clearly linked to the facts and findings of the investigation
- ❑ Findings, conclusions and recommendations reviewed by relevant subject matter experts
- ❑ Safety actions or recommendations requiring follow-up identified and assigned
- ❑ Key lessons from the safety occurrence identified and distributed

Risk Analysis Tool - RAT

EUROCONTROL also provides a very useful tool for the qualitative assessment of risk associated with any ATM related safety occurrence: the *Risk Analysis Tool* (RAT).

The RAT is a practical 'post-investigation' tool that can be employed to quantify the risk or re-occurrence associated with safety events that have already been investigated using SOAM.

Full details on the use of the RAT, including a convenient web-based application tool can be found within the RAT Guidance Material published by EUROCONTROL.[14]

[14] EUROCONTROL. (2015). *Risk Analysis Tool - RAT: Guidance Material, Version 2.0*. Brussels: Author.

Glossary

Attitudes and personality factors	A category of Contextual Conditions relating to individual attitudes and personality evident at the time of a safety occurrence that influence the performance of the operator.
Barriers	The final lines of defence that protect the system against technical and human failures. They may be work procedures, aspects of human awareness, physical obstacles, warning or control systems, or protection measures designed to prevent an occurrence, or lessen its consequences. One objective of the investigation process is to identify absent or failed barriers and take action to strengthen these.
Confirmation bias	The tendency to look for confirming cues or supporting evidence only. In other words, looking for data that *confirms* our initial impression or beliefs, and overlooking evidence that might indicate we are wrong. Ambiguous evidence is usually interpreted as supporting an existing belief or position. Due to 'confirmation bias', it is very difficult to change an initial impression or belief.
Contextual Conditions	The conditions that exist immediately prior to a safety occurrence that directly influence performance in the workplace. These can increase the likelihood of an error or non-conformance being committed. Known in the original Reason Model as *'psychological precursors of unsafe acts'*. SOAM categorises these into: workplace conditions; organisational climate; attitudes and personality factors; human performance limitations; and physiological and emotional factors.
Error (Human Error)	Definition by James Reason in "Human Error" (1990): "Error is intimately bound up with the notion of intention. The term 'error' can only be meaningfully applied to planned actions that fail to achieve their desired consequences without the intervention of some chance or unforeseeable agency. An error is NOT intentional. You make an error when: what you do differs from what you intended; or your plan was inappropriate."
Human Involvement	Refers to people's actions or non-actions that immediately contributed to / triggered the safety occurrence. Known in the original Reason model as 'active failures' and 'unsafe acts' (commonly referred to as errors and/or violations).

Human Performance Limitations (HPL)	Factors relating to limitations in human information processing and performance characteristics that may increase the likelihood of an error or non-conformance being committed.
Just Culture	An organisational perspective that discourages blaming the individual for an 'honest mistake', irrespective of actual or potential consequences. Sanctions are only applied to individuals when there is evidence of intentional non-conformance / deliberately reckless / negligent behaviour.
Negative transfer	A condition in which previous experience causes interference with the learning or execution of a task, usually due to conflicting stimuli or response issues.
Non-conformance	A deliberate deviation from rules, regulations or procedures. A person committing non-conformance fully intends their actions / inactions and is aware that they are deviating from known rules and procedures.
NOTAMs	Notices to Airmen.
Organisational climate	Factors relating to organisational issues (such as management or supervisory attitudes / behaviour, norms, culture and morale) that exist at the time of an occurrence and influence the performance of the people involved.
Organisational Factors	Factors at the organisational level that exist before the occurrence and produce, or allow the existence of, *Contextual Conditions* that influence the actions of people that triggered the event. As with all *latent conditions*, OSFs and Contextual Conditions may go unnoticed for a long period of time until they combine with other conditions and individual actions to breach the barriers of the system and contribute to an occurrence.
Perceptual set	The tendency to perceive a situation in a particular way due to our past experiences with similar situations.
Physiological and emotional factors	One of the categories of *Contextual Conditions* that exist at the time of an occurrence and influence the performance of the operator. To do with the physiological and emotional state of the people involved.

Safety Culture	The set of beliefs, norms, attitudes, and practices within an organisation concerned with minimising exposure of the workforce and the general public to dangerous or hazardous conditions. It promotes a shared attitude of concern and responsibility for safety (adapted from ICAO).
Safety occurrence	An accident, serious incident or incident, as well as other defects or malfunctioning of an aircraft, its equipment and any element of the Air Navigation System.
SHEL/O Model	The SHEL/O model provides a descriptive framework of human factors principles that can guide the collection of data in an investigation. The five components of the expanded SHEL/O model are: *Software* (procedures, manuals, symbology, etc.); *Hardware* (equipment, workplace layout, etc.); *Environment*; *Liveware* (the human element); and *Organisation*.
Situation assessment	Using our experience to assess the whole situation, often recognising it as an instance of a familiar type, a 'typical situation'. The familiarity of the situation allows us to call up from memory a mental template of how to proceed. If the situation is not familiar, further situation assessment is required in order to make a decision.
Situational awareness	Situational awareness (SA) is a constantly evolving picture of the surrounding environment. It involves being aware of what is happening around you to understand how information, events, and your own actions will impact on your goals and objectives, both now and in the near future. Being aware of what is happening around you and understanding what information means to you now and in the future, is the basis for effective situational awareness.
System Factors	These are the same as *Organisational Factors*, except they can be traced to external organisations (airlines, regulators, etc.) or other parts of the broader aviation system that are outside the direct control or influence of the organisation under investigation.
Workplace conditions	Factors relating to the work environment, HMI issues and procedures that exist at the time of an occurrence and can increase the likelihood of an error or violation being committed. A category of *Contextual Conditions*.

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