

**Guidelines for Investigation of  
Safety Occurrences in ATM**

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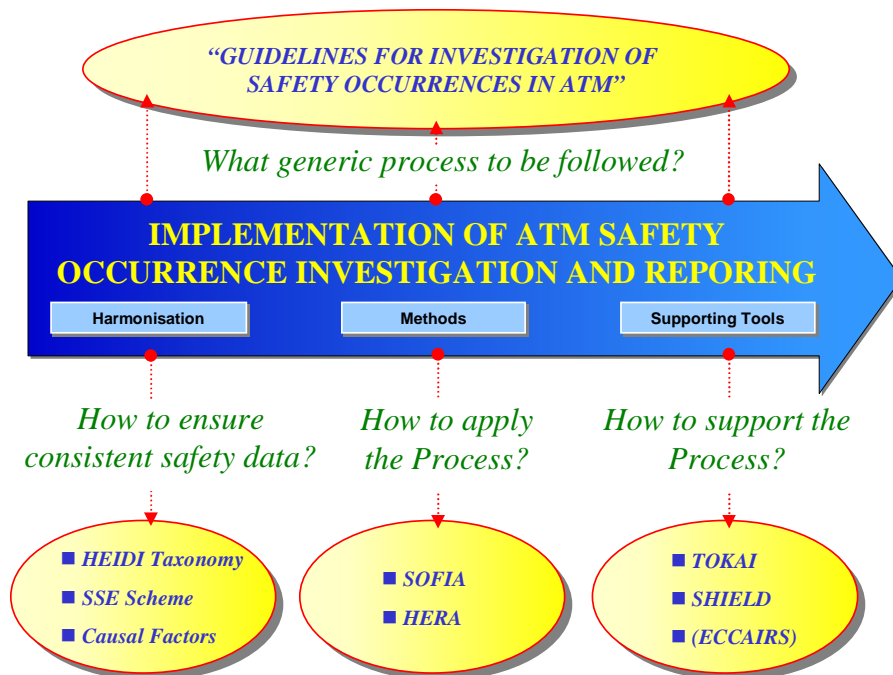


## Executive Summary

This document is intended to help Air Navigation Service Providers implement and maintain:

- The Regulatory Requirement for safety achievement “Safety Occurrences” from EUROCONTROL Safety Regulatory Requirement ESARR3;
- Regulatory Requirements from EUROCONTROL Safety Regulatory Requirement ESARR2;
- EUROCONTROL Safety Policy Principle “Safety Occurrences”.

The document position within the Safety Occurrence Investigation Package is illustrated the next figure.



A number of generic phases are common to many occurrence investigation and reporting systems. Occurrence detection is followed by data acquisition. This is followed by occurrence reconstruction. Occurrence reconstruction, in turn, is followed by incident analysis. Recommendations are then proposed on the basis of this analysis. Finally, there is the reporting and exchange of information about an occurrence. Each of these phases is considered in turn and recommended practices are identified. The ATM service provider

should arrange the investigation process as described or in a similar way that ensures that the main principles are met.

The guidelines that are presented in this document are heavily dependent upon the service provider's ability to operate within a non-punitive environment. It is unlikely that any national system will satisfy the ESARR2 requirements if contributors have a justified fear of retribution. In January 2000, MATSE VI recommended that Ministers ensure the timely implementation of the arrangements included in the EUROCONTROL Safety Improvement and Measurement Programme in all ECAC Members States, within "a non-punitive environment". This does not imply that the submission of a report will absolve a contributor from the normal legal sanctions but that the key element to the success of any occurrence reporting system is the trust that contributors should place in the impartiality of their system.

It should be recognised, however, that there is a possibility that any accident or incident could trigger criminal or civil legal proceedings. Members of the Safety Management Group should keep this in mind and be careful not to introduce blame qualifications in the final reports and any safety record produced during the investigation.

This guidance could be applied:

- to any reporting and assessment scheme (e.g., mandatory or voluntary scheme);
- to safety occurrences detected by human or automatic device.

The guidance is based on existing practices in European Air Navigation Service Providers (ANSPs) and on similar systems in other industries.

It is also important to emphasise that this guidance material avoids any assumptions about the managerial and organisational structures in particular ANSPs. The use of terms such as "safety manager" reflect a generic role that might, in practice, be performed by a number of individuals within any particular organisation.

# Chapter 1

## A Systemic Approach for Occurrence Investigation

### 1.1 *What is a “systemic approach” to investigation?*

---

***A number of organisations advocate a so-called “systemic” approach to the investigation of occurrences.***

Specific safety occurrences may indicate deeper weaknesses.

The key issue is whether or not the system as a whole performs as expected. If these expectations are correct and a system element failed then improvements can be isolated within that element. However, if the expectations under which a system operates are incorrect then deeper questions should be asked about the potential for further occurrences from these wider systemic failures.

For instance, a large number of human errors may indicate underlying organisational problems in shift allocations or in team organisation, rather than a number of unrelated instances of individual failure. Similarly, a large number of continuing technical failures may indicate underlying acquisitions and maintenance problems rather than a more specific set of deficiencies in a particular piece of equipment.

---

## 1.2 Active and Latent Failures.

***A systemic view includes the idea that there are active and latent causes of an occurrence.***

Latent causes are deficiencies in a system that do not lead directly to an occurrence. For example, the lack of a reliable backup system is a latent failure. It would not impact the ability to provide ATM services until the primary system fails. This failure is the trigger or catalytic event that exposes these latent deficiencies in the system.

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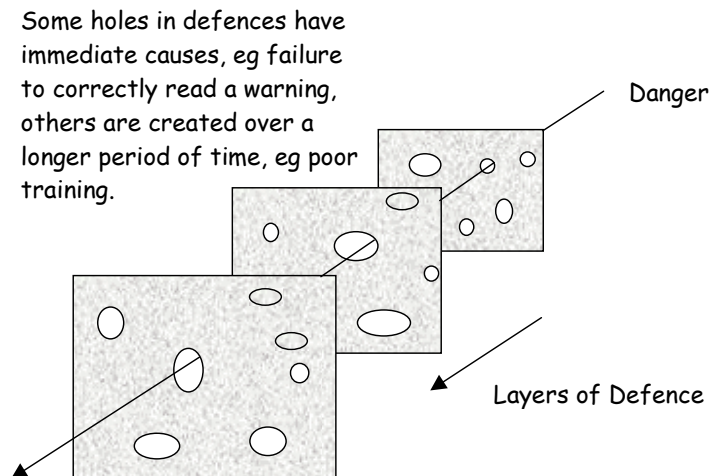
## 1.3 Barriers and Defences

***This systemic view takes into account the role of barriers or defences in an occurrence.***

This is illustrated in the following figure. Here the immediate causes of an occurrence manage to find holes in the defences that protect a system.

For instance, if equipment failure occurs then the ATC operator may provide a primary barrier against such a failure by detecting it and responding appropriately. Every so often, these barriers will fail. For instance, fatigue or high workload may prevent a controller from detecting the failure. Other defences should then protect the system. For instance, the aircrew might detect the problem. Accidents and occurrences occur when failures combine with weaknesses in the defences that protect the system.

---



**Figure 1: Model of Defences and Occurrences**

## 1.4 **When does an occurrence begin?**

***A systemic view of occurrence investigation provides answers to the framing problem that is a major issue for safety management.***

---

It can often be difficult to identify the scope or extent of an occurrence investigation. When does an occurrence really begin?

For instance, data misreading by a controller might be seen as a human error. The same occurrence might also be traced back to a poor design of the Human Machine Interface (HMI). The supplier of the HMI, in turn, might argue that the problems stemmed from requirement elicitation and specification. This example illustrates that many occurrences may have deep organisational causes.

In this respect, James Reason describes three stages in the development of such accidents: the organisational factors stage, the local workplace factors stage and the unsafe acts stage. Organisational factors may include the lack of strategic or managerial control. Local workplace factors may include insufficient training, poor communications, and unworkable procedures. Unsafe acts are the “visible” part of the system behaviour, like communication, co-ordination or traffic monitoring errors.

***The investigation process should look at the immediate symptoms of a failure to uncover the deeper causes.***

---

This involves reconstructing the way in which barriers were avoided or overcome by unsafe acts, workplace factors and organisational problems.

---

## 1.5 **What terminology should be used during the investigation process?**

<b>Guideline 1: Harmonised and consistent set of terms should be used for the occurrence investigation and reporting.</b>
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***To exchange meaningful safety information one should ensure consistent terminology usage for the investigation.***

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EUROCONTROL in co-operation with regulatory authorities and service providers representatives developed a harmonised taxonomy for safety occurrence investigation and reporting - HEIDI. HEIDI is supporting:

- Classification of the occurrence – Event Type and Classification;
-

- 
- Defining the circumstantial factors – Background Data;
  - Explaining the causal factors – Explanatory Factors;
  - Drafting Safety Recommendations.
- 

## **1.6 Editorial practice**

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***What the verb “should” means in this document”?***

The nature of present document is guidelines for one possible way of organising and performing ATM Occurrence Investigation process. Therefore the operative verb “should” is used for recommending practices.

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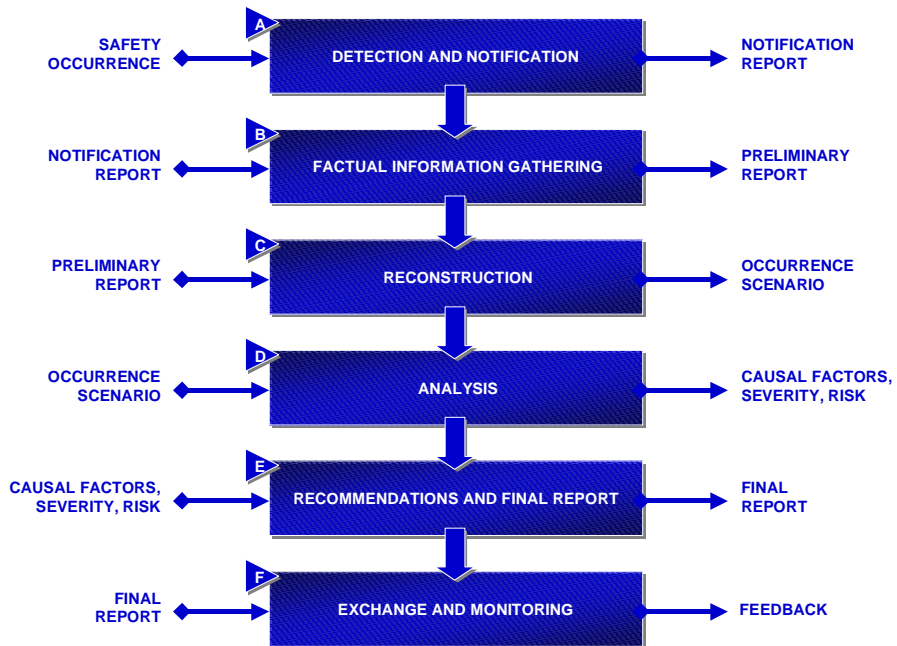
# Chapter 2

## The Generic Process: Overview

Figure 2 provides an overview of the generic process and its phases.

Appendix A provides a graphical overview of the different people and groups who help to implement these phases. Appendix C provides a similar illustration for the inputs and outputs during each stage of an occurrence investigation.

Appendix H identifies a number of more detailed guidelines that are intended to support these different aspects of occurrence investigation.



**Figure 2:** Elaboration of the Generic Phases in Occurrence Investigation



# Chapter 3

## Key Roles in Occurrence Investigation

In order to facilitate the description of each step of the process, the following actors are identified. These actors do not directly reflect individuals or groups within a particular service provider. For example, some tasks may be shared between a number of different persons or teams.

### 3.1 *The Notifier*

#### *Triggering the process.*

---

This is the person who initially contributes to the occurrence notification.

---

### 3.2 *The Supervisor*

#### *Safeguarding the service.*

---

In these guidelines, we propose that the supervisor receives the initial notification, in order to safeguard the services. There are a number of alternative mechanisms that might also be used to ensure that service provision is safely maintained following an occurrence.

---

### **3.3 The Safety Management Group**

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#### ***Managing the process.***

The safety management group is ultimately responsible for the management of the overall investigation process and for ensuring that recommendations are acted upon.

---

### **3.4 The Investigator**

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#### ***Gathering information and analysing event.***

Once reports have been received, the Safety Management Group or a similar body should appoint Investigator-In-Charge to co-ordinate further factual information gathering and analysis, and should appoint investigation team. Roles and duties in the team should be defined.

---

### **3.5 Ensuring Participation and Consensus in the Investigation Process.**

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#### ***A key concern throughout the occurrence investigation process is to encourage participation and consensus.***

There are many different ways in which this can be achieved. For example, the individuals who report an occurrence can be invited to join the teams of investigators who are responsible for identifying any causal factors. Alternatively, these **Contributors** may be sent copies of the documents that are produced during the investigation, analysis and reporting of an occurrence. Staff representatives may also be kept informed. The key point is that although there may be different routes to consensus, it is critical that procedures and mechanisms are open and accountable. From this it follows, for instance, that key decisions to suspend or continue an investigation should be documented and then confirmed by others within a safety management team.

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### **3.6 Relationships with the Regulator**

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#### ***It is important to identify a mechanism for monitoring the performance of the occurrence investigation system as part of the ATM provider's safety management system.***

For instance, a regulatory group should receive copies of all final reports into occurrences as well as reports from the safety managers that describe the measures that have been taken to implement any safety recommendations. It is also expected that the regulator will initiate periodic investigations into particular problems should they continue to receive occurrence reports about similar occurrences.

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### **3.7 Legal aspects of ATM safety occurrence investigation**

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***Investigators should perform the process of investigation with the aim to prevent similar occurrences in the future and to help reducing the risk for aircraft operations.***

This is a completely different process from the one to apportion blame or liability. It should be recognised, however, that there is a possibility that any accident or incident could trigger criminal or civil legal proceedings.

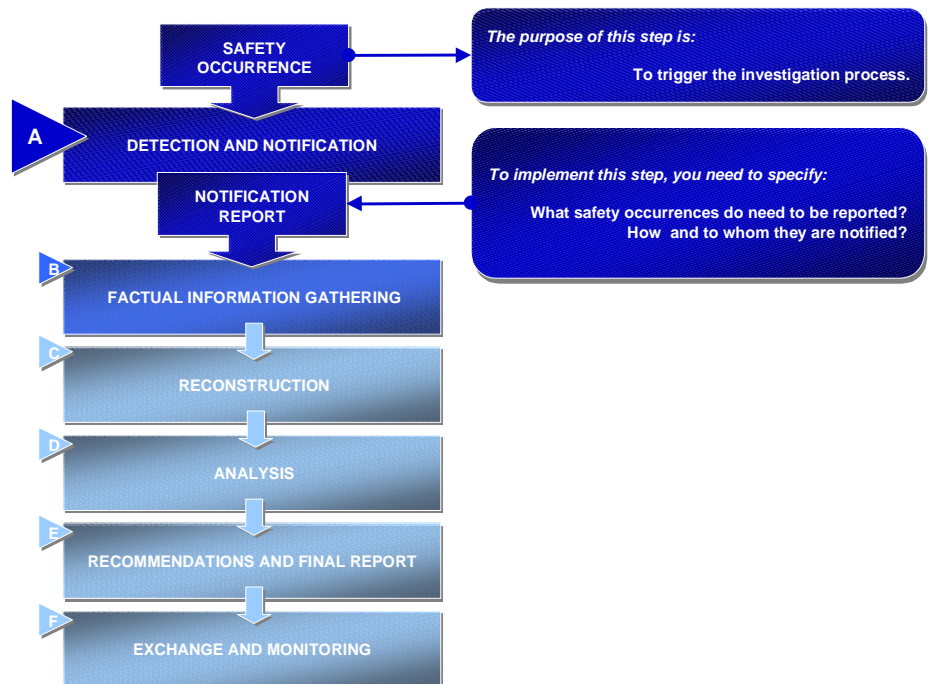
Members of the Safety Management Group should keep this in mind and be careful not to introduce blame qualifications in the final reports and any safety record produced during the investigation. It is also often the investigators who are requested to testify to the legal proceedings in relation with the safety occurrences.

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# Chapter 4

## Generic Phase A: Detection and Notification



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Occurrence can be detected in many different ways. For example, they may be detected through:

**Input**

- the direct involvement of ATM personnel;
- an automated warning within a safety net / monitoring tools;
- a report from aircrew;
- information provided from the general public;

In each case, the occurrence should elicit an appropriate response from the ANSP.

**Output**

---

Completed notification report. Appendix D provides an approved EUROCONTROL form for report.

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## **4.1 What needs to be reported?**

**Guideline 2: The type and scope of occurrences that are to be reported should be published. The list of occurrences to be reported should be based on international and national regulations.**

***ESARR2 defines what should be covered within an occurrence reporting system. The list should be extended to cover internal needs.***

---

However, local circumstances may also affect what is and what is not covered by this scheme. To summarise, the scope of the system should meet the ESARR2 minimum criteria for occurrence classification, but may also be supplemented by their local experience.

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## **4.2 To whom the occurrence is notified?**

**Guideline 3: Notification is initially passed to supervisors, responsible for the immediate safeguarding the service.**

***Special provision should be made for those circumstances in which personnel might submit an occurrence report to other people.***

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For example, there is an understandable reluctance to provide reports that might jeopardise an individual's relationship with their immediate superiors, especially if those superiors are implicated by an occurrence.

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### **THE ROLES OF THE SUPERVISOR**

- *The supervisor should, obviously, safeguard continued service provision. The controllers involved in an occurrence should be removed from their control position. The sense of guilt that can follow from an occurrence may impair the controller's ability to continue safe operation.*
- *The supervisor is also responsible for safeguarding automated data sources, including radar and traffic logs that will be needed during any subsequent investigation.*
- *Supervisors should then perform an initial factual information gathering exercise by issuing standard report forms to the staff involved. Their reports should be elicited while memory recall is still fresh.*
- *Supervisors may also be asked to record additional contextual information. For instance, they can provide information about their view of the controller workload prior to the occurrence.*
- *The supervisor should also take initial steps to notify regional and national safety teams, at Safety Manager level, that an occurrence has occurred and that report forms are being generated. This is critical for occurrence registration and also to alert regional and national investigators that they will be required to analyse the data that has been obtained in the aftermath of an occurrence.*
- *The supervisor, in accordance with the pre-defined organisational procedure, should decide on the involvement of Human Factors Specialist early in the process of investigation.*
- *In preparing this guidance material, several ATM providers have stressed the importance of providing receipts as occurrence reporting forms are passed within an organisation. This enables the individuals who have submitted a report to determine how their input is being dealt with. These receipts can also help to ensure that an occurrence is acted upon in a prompt and timely manner.*

## 4.3 **When is it decided to halt the investigation?**

**Guideline 4: All stages of an investigation should be conducted unless the Safety Management Group accepts a written justification for halting the process at any stage.**

***The general principle is to complete the investigation.***

---

However, it should also be possible to halt an investigation at any point providing a written justification is provided. For low criticality occurrences, a form can be completed. For more complex occurrences, such a decision would require more documentation.

The key point here is that it should be possible to review not just those occurrences that were investigated, but also those occurrences that might otherwise have been forgotten through lack of subsequent investigation.

***The Safety Management Group or an equivalent organisation should approve any decision to halt an investigation.***

---

This is important because subsequent incidents may lead service providers to reconsider such decisions. This may lead to conflict if particular individuals are identified with such important decisions. Collective responsibility helps to minimise the impact of such problems.

***The resources that are available to incident investigation are clearly finite. It can also be difficult to determine whether or not an enquiry should be conducted a priori.***

---

As a result, trained staff can be used to filter occurrence reports. It is important that these Gatekeepers document the reasons for their decision to filter out an occurrence. Their decisions and the overall impact of these interventions should be monitored to avoid under-reporting and bias. The filtering should therefore be open and auditable. In particular, it is important to demonstrate that reporting systems consider occurrences that have the potential to reduce the level of service provisions in addition to occurrences that directly affect aircraft themselves.

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## 4.4 **How should Safety Net and monitoring tools be used?**

**Guideline 5: Safety net and monitoring tools can be used to detect occurrences.**

***It is also possible to use automated tools to supplement the source of reports.***

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For example, safety nets provide an important means of structuring the risk assessments that support ATM service provision. These networks comprise both ground and airborne systems, including ground proximity warning systems (GPWS), minimum safe altitude warning (MSAW), short-term conflict alerts (STCA), area proximity warning (APW) and aircraft collision avoidance system (ACAS).

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***The components of a safety net perform a dual role.***

Firstly, they warn operators about a safety occurrence that is taking place or about the potential for a more severe occurrence.

Secondly, they can be used to monitor and trigger occurrence-reporting procedures when they automatically detect that certain adverse circumstances have occurred. For example, supervisors might be expected to complete a report whenever one of these systems generates a warning.

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***The use of automated tools should gain staff acceptance.***

Firstly, it can be difficult to ensure staff acceptance if new generations of monitoring tools are used in addition to the core components of the safety net, mentioned above.

Secondly, spurious alarms can de-motivate personnel and create hostility to the reporting system that would jeopardise its future success.

One solution to these problems is to allow supervisors to decide not to further investigate any occurrences that are notified by an automated system. If this path is followed, it is again important that a written justification be provided to the Safety Management Group.

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***The components of a safety net should not reduce the number of incidents being investigated.***

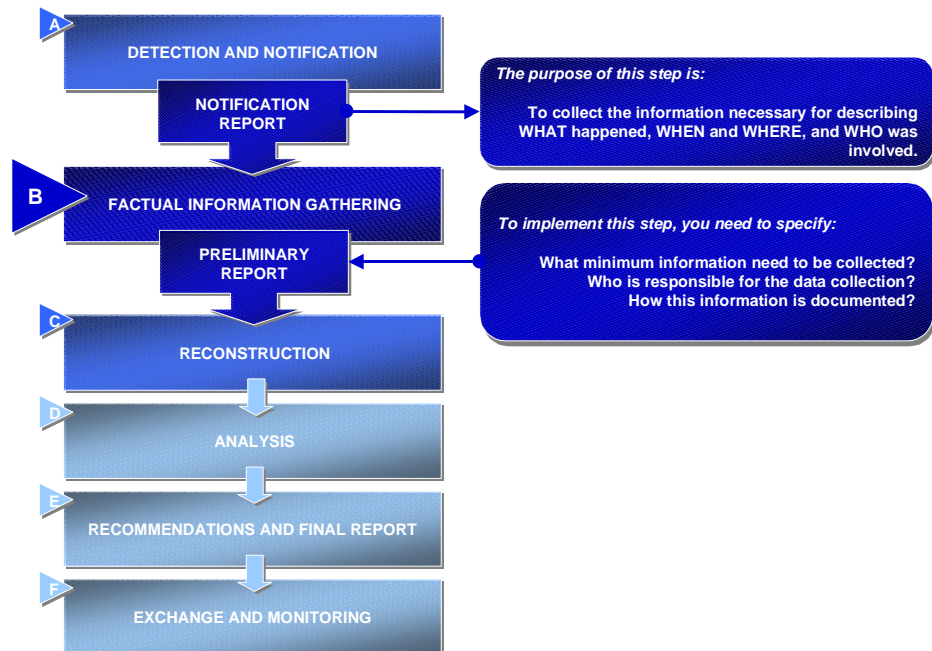
These tools provide short-term protection by helping operators to detect and potentially avoid certain types of occurrences. However, ANSPs should investigate the underlying causes of the problems that these systems detect. If the warning is the result of a false alarm then that should also be investigated.

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# Chapter 5

## Generic Phase B: Factual Information Gathering



**Input**

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Completed notification report.

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**Output**

Comprehensive data sets to support subsequent steps of the investigation.

Preliminary Report.

---

## **5.1 What data should be gathered?**

<b>Guideline 6: Standard procedure should specify the data that is to be gathered.</b>
--

***Procedure for factual information gathering after an incident should be documented and disseminated.***

---

The responsibility for data gathering should be defined. The procedure should be known so that it then becomes a straightforward task to contact, for instance, the meteorological office to gather information about the conditions before, during and after an occurrence.

---

***Checklists could be used to specify what data should be gathered.***

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This is necessary to ensure that data is not lost. The checklist approach may also prevent unnecessary tasks being performed or needless duplication of tasks. The checklist should identify the purpose of each item of information to be gathered. It is also important to specify a deadline by which checklist should be completed after an occurrence.

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***It is important to emphasise that this information may also be collected for occurrences that are initially identified as having relatively low consequences.***

---

These occurrences can provide critical information about events that in other contexts might have had far more profound outcomes. They can also help to support more general forms of quality improvement, through better training or through the usual maintenance and acquisition procedures for ATM systems.

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### **MINIMUM SET OF INFORMATION**

*The following minimum set of information should be available to any subsequent investigation:*

- *statements (interview reports) from the notifiers and contributors;*
- *voice and data link communications recordings (air-ground, ground-ground and open microphone on the working positions);*
- *surveillance recordings;*
- *copies of meteorological reports and forecasts;*
- *flight data (flight plans, flight progress strips etc.);*
- *observations made by the investigators;*
- *logs and statements regarding the technical and operational status of the equipment;*
- *personal notes and any other relevant data.*

## **5.2 Who is responsible for data gathering?**

**Guideline 7: The local safety department is responsible for factual information collection.**

---

Although the actual tasks of factual information collection can be delegated, it should be clear who is ultimately responsible for the factual information gathering tasks.

Agreed guidelines ensure consistency and prevent individual judgements from causing necessary information to be lost or biased.

***There should be a clear chain of responsibility for the co-ordination of the data-gathering tasks.***

An important consideration here is what to do if a supervisor or manager is involved in an occurrence. In such circumstances, there should be procedures that enable the individual to delegate their factual information gathering responsibilities to another responsible employee. This should normally only be permitted with the express permission of the organisation's safety management or through the submission of a written form that indicates the transfer of responsibility to an identified individual.

---

## 5.3 Who should produce the preliminary report?

**Guideline 8: Approved investigators should issue a preliminary report and conduct any follow-up factual information gathering.**

***Investigators should use the gathered information to draft the preliminary occurrence report.***

***It is also important to note that the safety management group may decide that the preliminary report should immediately be passed to other centres or regions that might also experience similar occurrences.***

---

This should be completed within three days (or other pre-defined time period) of an occurrence and passed to the safety management group.

They may then decide to conduct further enquiries. The precise nature of these subsequent investigations depends upon the occurrence that is being investigated. For example, more detailed system logs will be required if equipment failure is being considered. These information sources would be redundant if an occurrence investigation focussed upon an individual instance of human error. This illustrates how additional expert support may be required to perform these more detailed activities.

Further factual information gathering will also be required because individual ATM teams will necessarily have a limited view of an occurrence. For instance, they may only have partial information explaining the behaviour of flight crew as an occurrence develops.

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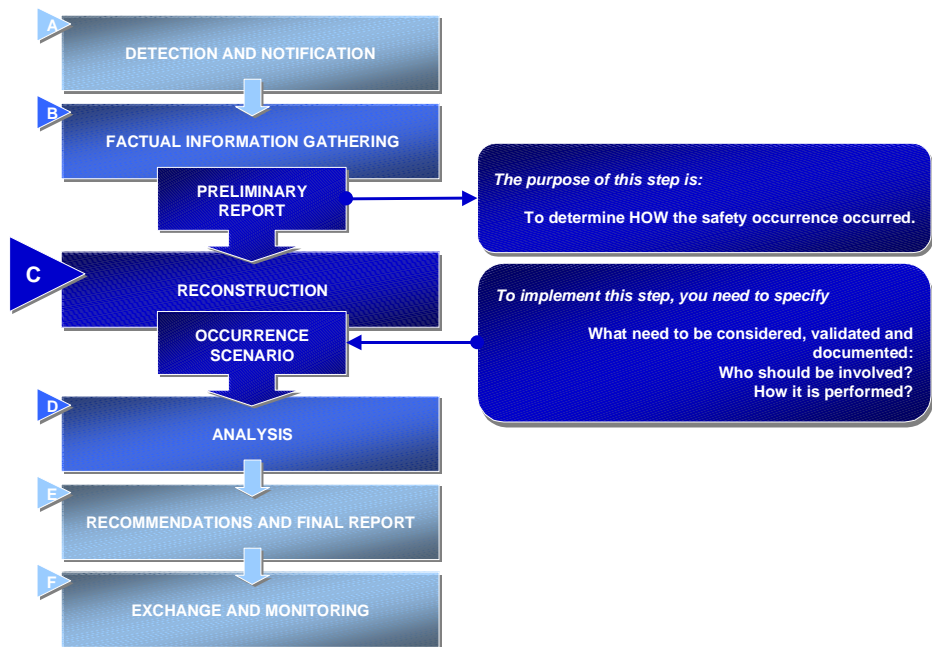
This is particularly important in the case of equipment failures that might be replicated in other systems. They may also be pro-active in both soliciting evidence from airline personnel and, conversely, in passing directly to them any preliminary report that has direct implications for airline operations.

If an airline contributes in this way then they ought to be provided with updates about the progress of the investigation to ensure external confidence in the reporting system.

---

# Chapter 6

## Generic Phase C: Reconstruction



**Input**

---

Comprehensive data sets.

Preliminary report.

---

**Output**

---

Structured presentation of the facts about an occurrence.

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## **6.1 What needs to be done for event reconstruction**

---

***The reconstruction of an occurrence is a transition phase between the immediate reporting of an occurrence and the subsequent analysis that identifies the causal factors, which lead to the occurrence.***

The output of this reconstruction phase should be a set of events that agrees with recorded information and which unifies the views of the various persons who were involved in these events immediately before and after the occurrence.

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## **6.2 Who should be involved in event reconstruction?**

**Guideline 9: Notifiers and contributors should be involved in occurrence reconstruction. This helps to validate the outcomes of previous phases; it helps to identify omissions in the notification report and can encourage further participation.**

---

***There are a number of reasons why the individuals who report an occurrence also ought to be involved in the reconstruction of that occurrence.***

The first reason is that the reconstruction process can prompt controllers to remember significant events or occurrences that might unintentionally have been omitted in the aftermath of an occurrence. They can also alter or revise their recollection of events when faced with information from other information sources, in particular evidence from automated systems and communications transcripts.

There are other reasons why the people who notify an occurrence also ought to be involved in its reconstruction. In particular, several ATM providers report that it has important psychological and motivational benefits for the individuals who are concerned in an occurrence. Their involvement during occurrence reconstruction can help them to move away from any sense that they are the focus of an investigation.

It can also help, by their direct contribution, to improve the understanding of the causal factors that lead to the occurrence.

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Involvement in reconstruction can, therefore, form part of critical incident stress management techniques. A number of ATM providers also offer counselling to help controllers overcome the sense of guilt and blame that they feel in the aftermath of an occurrence. Controllers are asked to nominate colleagues who will fulfil this support role in the aftermath of an occurrence. These individuals should then participate in a recognised counselling scheme. After receiving this training, they can help controllers to overcome some of the negative feelings that can affect their longer-term ability to successfully perform traffic management duties. The costs of investing in this form of mutual workplace support are argued to be relatively small in comparison with the costs of training replacement controllers.

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### **6.3 How is the event reconstruction validated?**

**Guideline 10: Record, playback and simulation tools should be exploited to the possible extend.**

***The complexity of occurrences demands that some form of playback and/or simulation tools be used to support reconstruction.***

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Record and playback systems, and in some occasions simulation systems, offer a number of potential benefits. These benefits include the ability to replay incident reconstruction to the many different individuals who may have witnessed an occurrence.

This system enables time-synchronised replay of all information available to a controller; including meteorological data and recorded voice communications. These replays are used to recreate operational occurrences for review by quality assurance teams and by other controllers.

They are also used in awareness, training and certification activities. The output from some of these reconstruction systems can be automatically saved and used during simulation exercises in which previous occurrences are used for lessons learned dissemination and to direct the future training of controllers.

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## **6.4 What should be used to support the event reconstruction?**

**Guideline 11: A formal approach to occurrence reconstruction and analysis should be adopted by using a proven method (e.g., SOFIA - Sequentially Outlining and Follow-up Integrated Analysis).**

***It is important to document any reconstruction and analysis using a method that is well understood and produces repeatable results.***

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Investigators often have individual ways of conducting an investigation based on their expertise, past experience and local operating environment. However without necessary guidance, many investigators develop their own methodologies and techniques. This can lead to inconsistencies that may bias the results of an investigation. It can also make it difficult to reproduce the results of any enquiry performed by different investigators or even by the same investigator. We cannot control the quality of accident reports relying on personal conclusions without consistent investigation methods and sound, objective quality assurance criteria. We cannot link work products with previously predicted safety performance promised in safety approval documents or regulations or derived from safety assessments or safety surveys.

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**THE SOFIA METHODOLOGY - SOFIA is described in more details in the SOFIA Reference Manual.**

**A method to support these demands was developed in EUROCONTROL in collaboration with the Bulgarian Air Traffic Services Authority. The method is called SOFIA – Sequentially Outlining and Follow-up Integrated Analysis.**

**SOFIA is an analytical and graphical method supporting the process of ATM safety occurrence investigation and developed to be compliant with ESARR 2. SOFIA is recommended for use in the following phases of the investigation process: Factual information gathering; Event reconstruction; Event Analysis and Issuing Recommendations.**

**SOFIA combines a representation of the sequence of events leading to the safety occurrence with its causal and contributory factors. It refers to the three layers proposed by J. Reason: unsafe acts, local workplace factors and organisational factors.**

**The method uses event/condition building blocks to describe the causal chain leading to an occurrence. Building blocks are associated with a unique actor at a particular moment in time. Actor(s) can be any representative player in the occurrence - Crew; Individual pilot; ATCO; Airport vehicle drivers; Separation; Weather etc. An actor can be a person but also an aircraft, an aircraft system, and/or an ATM system. An actor is also any attribute, which is important and is dynamic in the course of particular occurrence like separation.**

**SOFIA supports investigators to distinguish between the causes of an occurrence. Following the ICAO definition, causes can be broadly interpreted to include actions, omissions, events, conditions, or a combination thereof, that lead to an accident or incident. An occurrence is usually the result of a sequence of events. All causes together form the set of adverse conditions for a particular occurrence. However, the findings of any analysis may focus on some of these conditions that may, in the future, combine with other occurrences to cause similar but not necessarily identical incidents.**

## 6.5 What should be considered in the event reconstruction?

**Guideline 12: Reconstruction should also consider the worst, plausible scenarios.**

***This process can help assess whether or not a recommendation has to be issued to avoid this worst case scenario.***

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During any reconstruction it is important not simply to consider what did happen during an occurrence but also what might have happened. Barriers and defences may not be available next time, especially if the aircrew intervened to mitigate the occurrence. For example, if an accident was avoided because aircrew established visual contact then that occurrence should be treated as if an accident had occurred because ATC personnel cannot rely upon visual contact by aircrew to ensure adequate separation (except in the exactly pre-defined conditions).

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***If external intervention, such as aircrew observation, did help to avert an occurrence then it may be necessary to produce several different reconstructions for a single occurrence.***

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For instance, one might be used to indicate those events that are known to have occurred during an occurrence. Another reconstruction might also be used to demonstrate a “worse case scenario” in which all mitigation and detection factors are removed. This will necessarily involve a certain amount of speculation but it is nevertheless important if the insights from a specific occurrence are to be generalised so that future adverse event can be prepared for.

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***The more general point here is that a worse case scenario should also be considered during occurrence reconstruction.***

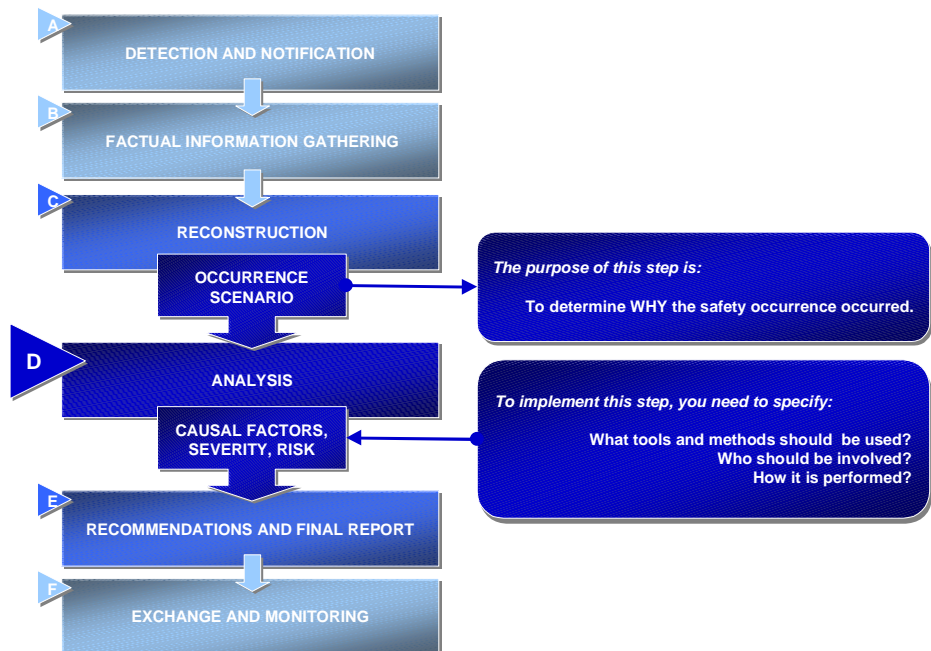
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The cliché that “without any aircraft, there would be no ATM problems” has particular relevance here. If a failure occurs under light traffic conditions then the consequences might be relatively limited and hence any reconstruction would be straightforward. However, it should not be assumed that any future failure would also occur when ATM personnel have sufficient resources of time and attention to detect and respond to similar occurrences under heavier traffic conditions.

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# Chapter 7

## Generic Phase D: Analysis



**Input**

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Reconstructed event.

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**Output**

Argumentation about WHY occurrence occurred.

Explanation of technical/operational and underlying factors issues.

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***There may be instances in which the causal analysis leads to new questions being asked about the reconstruction of events.***

This, in turn, may create the need for further factual information gathering. The exact nature of this iterative process will be determined by available resources and by the seriousness of the occurrence as dictated by Regulatory Requirements, such as ESARR2, and by local priorities.

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## **7.1 What should be done during the analysis phase?**

**Guideline 13: A systemic approach should be adopted. The boundary of an investigation should be assessed and documented.**

***Final reports should include sections on unsafe acts, local workplace factors and organisational failures.***

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EUROCONTROL have developed a range of tools to support the human factor analysis (unsafe acts) of an occurrence, using the HEIDI taxonomy and the HERA technique. Moreover, the investigator should analyse also whether local workplace factors or even organisational failures did not trigger or contribute to the unsafe acts.

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## **7.2 Who needs to be involved in the analysis process?**

**Guideline 14: Human factors specialist should support the analysis phase.**

***Specialist help should be used if we are to improve our understanding of increasingly complex occurrences involving the interaction between human operators and technical systems.***

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Human factors issues are increasingly being recognised as critical to an understanding of ATM occurrences. However, even with the support of techniques like HERA, there will still be circumstances when human factors specialist should support the analysis of an occurrence for the interpretation and analysis of human error.

For instance such support is necessary to distinguish errors in intention from incorrect execution. Similarly, it can be difficult to

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determine whether a problem may have arisen from a genuine error or from a deliberate violation of operation procedures.

Even if these distinctions are apparent during the analysis of an occurrence, further work may be required to identify the underlying causes of an error. For example, there is a range of well-documented techniques for determining whether high workload or poor situation awareness contributed to an occurrence. Unless one of these recognised techniques is used then it can be difficult for investigators to defend their subjective judgements about the probable causes of human error during examination by a regulator.

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### **7.3 How should the severity of the occurrence be assessed?**

**Guideline 15: Risk Assessments should be based on EUROCONTROL Regulatory Requirements (ESARR 2). ANSPs could also establish their own severity classification for safety management purposes.**

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There are two ways in which risk assessment may be integrated into occurrence investigation process.

***A formal criticality and frequency assessment should be performed for any of the occurrences that are investigated by regional and national investigators.***

Firstly, local investigators can perform a preliminary risk assessment during the analysis phase. This helps to determine the allocation of resources that will be provided to any investigation. Clearly an infrequent, low criticality occurrence may not merit the resources of a high-criticality event.

Secondly, a national review of occurrences may take place during subsequent stages of occurrence investigation. This is intended to ensure that consistent criteria are applied to the analysis of any risk posed by an occurrence.

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***It is important that any occurrence investigation system be closely tied to the use of risk assessment in ATM safety cases.***

Risk assessment helps to prioritise the allocation of finite resources: more resources should be allocated to those failures that pose the highest risk.

Not only will future safety cases have to be informed by the occurrences being investigated, but so too will any existing safety cases that make inappropriate assumptions about the nature of potential risk. The process of reconstruction and simulation can also be used in the aftermath of an occurrence to identify worst-case scenarios.

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This scheme aims to harmonise the risk assessment of safety occurrences, in order to be able to identify key risk areas at European level. ESARR2 specifies also the tolerability of identified risk.

***ESARR2 specifies a risk classification scheme for safety occurrence.***

It should be possible to trace the justifications for a particular severity assessment and that this assessment should be linked to the EUROCONTROL Regulatory Requirements.

For ANSPs, this linking of occurrence reporting and of risk assessment will help to ensure that safety cases have a firm foundation in operational experience.

***ANSPs may operate their own local classification schemes.***

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For example, UK NATS has developed and introduced into practice a Safety Significance Scheme. Ultimately, however, this process of national or regional moderation should be conducted to ensure that the levels of risk that are assigned to an occurrence can eventually be linked to internationally agreed definitions; see for example the more detailed guidelines in ESARR2 and ESARR4.

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## ***7.4 What needs to be taken into account while assessing risk?***

<p><b>Guideline 16: Risk assessment of new occurrences should refer to assessed past occurrences.</b></p>
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***This is an important means of feeding information about previous occurrences forward into the subsequent development of air navigation services.***

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In assessing the future likelihood of an occurrence, it is important not simply to take into account the occurrence that is currently under investigation but also any previous occurrences that have similar causes or outcomes.

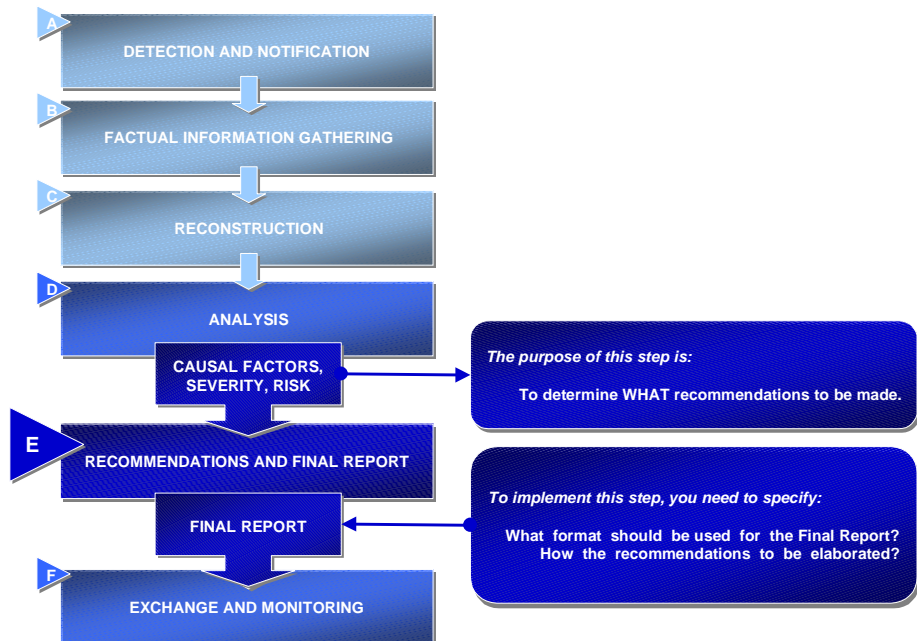
Moreover historic data about previous occurrences represents an extremely valuable source of information for the subsequent design of ATM services. This data can be used to inform systems acquisition. They can also be used to identify areas in which training should be updated. The key point is that the information collected should be used as widely as possible to improve service provision.

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# Chapter 8

## Generic Phase E: Recommendations and Final Report



**Input**

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Argumentation about WHY occurrence occurred.

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**Output**

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The final report.

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## **8.1 What should be done during the step?**

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The main product from any particular occurrence investigation should be the recommendations that are made in the final report.

It is, however, possible to identify a number of further products that can be obtained from occurrence investigation. For example, an analysis of several previous occurrences can be used to inform future safety recommendations.

Organisations should build and maintain organisation-wide Risk Repository to be referenced during the above mentioned processes. After the safety recommendation is elaborated it should be introduced in this Repository together with all identified risks information. By this Risk Repository is becoming a common reference source of all the safety processes.

***There is also a need for guidance on how to evaluate whether a safety recommendation should be made.***

It may not always be necessarily to revise operating practices in response to every incident. Too many ill-advised revisions in the response to individual occurrences can have a chaotic impact and can jeopardise the future success of a reporting system. Clearly, such a decision depends upon the individual judgement of an investigator with regard to the particular events during each occurrence. However, these judgements should be validated, ideally through documented consultations with other investigators. The drafting of such recommendations also depends upon an assessment of their potential efficiency, of any undesired side effects, of interactions with previous recommendations on the subject etc. The following guidelines support these activities.

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## **8.2 How recommendations should be issued?**

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***Recommendations should be kept as generic as possible to allow deciding on the best concrete remedial action.***

Each Recommendation should contain the elements:

- Problem to be addressed;
  - Proposed (if any) concrete remedial action;
-

- 
- Argumentation for the adequacy and feasibility of the remedial action;
  - Possible difficulties and side effects with the implementation;
  - Timing constrains;
  - Recipient;
  - Required reply;
- 

### **8.3      *How should the final report be issued?***

**Guideline 17: The final report should be issued in an approved format.**

***This ensures consistency and aids comparisons between occurrence reports.***

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The drafting of the final report should follow a set format. This helps to ensure that all of the data that might be relevant to an occurrence is recorded in an accessible form that can be retrieved at a later date. This is critically important if analysts are to trace trends in occurrences that emerge over several months or even years.

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### **A typical format**

- 1. Title – ATS unit and aircraft involved, place and date of the occurrence.**
- 2. Synopsis - A brief summary of the occurrence that provides all of the minimum data requirements that were identified in factual information gathering.**
- 3. Factual Information - A chronology of events derived from reconstruction together with a brief description of any alternate chronologies that might have been considered during the investigation. WHAT happened during the occurrence?**
- 4. Analysis - An analysis of these events that describes the judgements that were made about the causes of an occurrence. WHY it happened in the way that it did?**
- 5. Conclusions – list of findings and causal factors.**
- 6. Safety Recommendations - The recommendations from the occurrence investigation. If no recommendations were made then this decision should be justified. If several recommendations are made then they should be prioritised and this ordering should also be justified.**
- 7. Appendices - Finally appendices may contain additional expert statements or evidence that was gathered during the analysis and which is considered relevant to a subsequent interpretation of the occurrence. Immediate feedback may also be included from the notifier and the supervisor if they provided a response to the initial analysis mentioned in guideline 9.**

**Checklist to ensure that any report considers the minimum of relevant information to support its findings:**

***Evidence and Factual Information:***

1. Does the final report contain a summary of the information obtained about the occurrence both from interviews and automated logs?
2. Does the final report provide sufficient information for readers to assess the reliability of that data, especially if there was inconsistent or missing evidence?
3. Does the factual data adequately explain any unusual circumstances, of workload or system failure, that might affect the readers interpretation of the evidence?

***Analysis:***

1. Does the report determine whether or not the ANSP could have anticipated the occurrence?
2. Does the report determine whether ATM personnel had the means to avoid and mitigate the occurrence?
3. Does the analysis explain any particular human factors issues that exacerbated the occurrence or greatly contributed to its likelihood?
4. Were there any precursors of that incident, which were not given required attention?

***Conclusions:***

1. Does the report state whether it was feasible to avoid the occurrence and, if not, does it state the steps that could be taken to improve the management of future occurrences?
2. Does the report specify time limits and validation constraints on the implementation of future improvements?
3. Does the report specify whether any steps ought to be taken to ensure that any future occurrences of similar occurrences are detected, notified and responded to?

## 8.4 *How recommendations should be reviewed?*

**Guideline 18: Safety recommendations should be reviewed and the outcomes of the review should be documented in the final report.**

*There should be an established mechanism to review the draft final report.*

Final reports should contain recommendations that are intended to either reduce the likelihood of an occurrence or mitigate the impact of that occurrence should it occur.

The investigators are trained personnel who are free to make independent decisions about potential recommendations. Moreover in some cases, investigation could be independently conducted by national regulators or specific investigation bodies.

## 8.5 *Who should be involved in the review?*

**Guideline 19: Reports should be accessible to all staff involved in the investigation.**

*The notifier and the supervisor should receive a copy of the draft final report.*

The analysis of any occurrence requires a certain amount of subjective interpretation based upon the events that were identified by the previous analysis. It is entirely possible that this analysis may fail to consider relevant information. It may also trigger further relevant recollections from both the person notifying the occurrence and from their colleagues. It is, therefore, appropriate to provide the notifier and their supervisor with a draft copy of the causal analysis and severity assessment. There are a number of recommended techniques for exploiting the feedback that can be provided in response to a preliminary causal analysis. In some reporting systems, the comments of the notifier and their supervisor are used in an informal way to inform the subsequent redrafting of an occurrence report. The investigator then has considerable freedom over the extent to which they incorporate any changes into a final draft. Alternatively, other ATM providers may insert these additional comments as a very brief appendix to the final report that is submitted to the regulator and other external agencies.

*The Safety Management Group should review the recommendations.*

The final occurrence report should include an appendix summary from the Safety Management Group that reviews each of the recommendations and states whether or not it is accepted for implementation. The rationale for each decision should also be provided. This response then forms a blueprint for subsequent intervention to reduce the occurrence or mitigate

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the consequences of future occurrences.

In providing an argument for or against a recommendation, the Safety Management Group should not only consider the particular investigated occurrence. They should also consider whether there have been any previous occurrences, similar to the one being investigated. This implies that they should monitor occurrences throughout their operations but also, when possible, those in other ANSPs. They should also consider the “plausible” worst case scenarios that form part of the analysis that has been conducted by the regional or national investigators. Decisions to accept recommendations may be guided not only by what **DID** happen but also by what **MIGHT** have happened. Recommendations may not only focus on remedial or mitigating actions. They may also focus on improved techniques for monitoring and recording the occurrence of future similar occurrences. This is particularly important if managers believe there is a problem with under-reporting. Such recommendations, if accepted, can lead managers to conduct specific reporting initiatives through the publications that are used to disseminate findings back to staff.

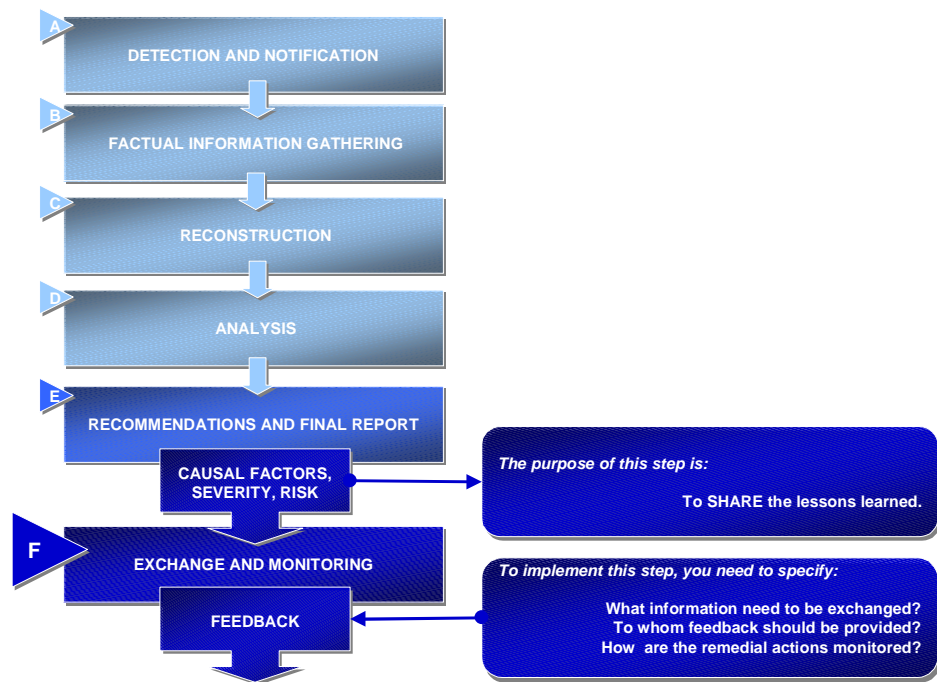
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# Chapter 9

## Generic Phase F: Exchange and Monitoring



**Input**

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Final report.

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**Output**

The submission of a final report is not the end of the occurrence investigation process. Feedback should at least be provided:

- To the personnel, so that they know the impact of previous failures and of the improvements that have been made following from those occurrences. This is usually in form of a lessons learned meeting;
- To the training system, so the training syllabus and criteria to be evaluated and reconsidered in light of the findings and safety recommendations;
- To Safety Management System, Quality Management System and Management to improve the overall management function (including but not restricted to safety and quality).

It is also important that ANSPs also consider the long-term storage and retrieval of the occurrence reports that they generate.

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## 9.1 *To whom should feedback be provided?*

**Guideline 20: Feedback should be provided to personnel.**

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***Personnel should trust the system and be confident in its value.***

Occurrence investigation systems provide a valuable source of information that can be communicated back to personnel within the ATM provider. The importance of this feedback should not be under-emphasised.

It is increasingly being recognised that human factors are a causal factor in many occurrences. As a result, ATC personnel can be provided with constant reminders about the importance of particular procedures and working practices through the occurrences and near occurrences that are investigated by occurrence reporting systems.

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## 9.2 *How to disseminate the recommendations?*

***Many ANSPs already provide newsletters and other publications to disseminate the lessons that are learnt from***

It is possible to identify and, therefore to advocate, two different approaches to these publications. **The first** is published regularly – for example once every month. These publications provide two or three pages of information about recent occurrences. Usually the text is prefixed by a brief narrative or

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**occurrence reporting systems.**

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analysis that is intended to draw lessons from these occurrences and potentially link adverse situations to the procedures and protocols that might have avoided them. **The second** class of publications provides a much less frequent overview of key topics that have been identified over many months of reports. The distribution is more restricted and it is intended to inform managers and policy makers as much as it is intended to have a direct effect on operating practices.

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### **9.3 How should the effectiveness of recommendations be assessed?**

**Guideline 21: Periodic reviews and monitoring help to assess the success or failure of remedial actions or whether actions that were not accepted ought to now be performed.**

***It is important to validate accepted recommendations.***

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The Safety Management Group should monitor the success or failure of the actions that are approved following a final report. It can be very difficult to predict the many different ways in which future occurrences might differ from previous occurrences. As a result, periodic reviews should be conducted to detect patterns of similar occurrences that might emerge in spite of additional safeguards. In particular, many previous occurrence reporting systems have resorted to the use of low cost remedies, such as reminder notices and warnings. Whilst these techniques can have a short-term effect on staff performance, they do not provide a long-term solution to occurrences involving human error. The initial costs of implementing more fundamental changes can be offset by the repeated costs of continued occurrences when recommendations are only partially implemented.

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***It is recommended that review meetings be conducted on a 3, 6 or 12 monthly basis to review recent occurrence reports.***

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Such meeting should not only review the causes of the occurrences, as documented in the final reports. They should also address a number of more general issues relating to the effective management of the occurrence-reporting programme:

- Is an ATM personnel actively participating in both confidential and anonymous systems? In particular, are there any regional or operational variations in the frequency of occurrence reports in relation to overall traffic patterns?
  - Do investigators have sufficient training and resources to conduct their investigations effectively? In particular, is it possible to identify weaknesses or biases in the analysis and recommendations that have been produced following certain occurrences?
-

- 
- Are remedial actions having the anticipated effect in reducing the likelihood of occurrences or in mitigating their impact? For example, are changes in training techniques having the anticipated impact upon the operational performance of ATM personnel?
  - Are there any underlying changes in the technological infrastructure or in the operating environment that might make certain types of occurrence more likely and, if so, should special reporting initiatives be conducted, for example by issuing special forms that request information about these particular occurrences?

As before, this is a preliminary list. Local and regional circumstances should help to determine the agenda of these meetings that are primarily intended to ensure effective management of the reporting system.

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## **9.4 How should the risk assessment scheme be reviewed?**

**Guideline 22: Studying changes in the severity weightings over time can assess the success of the scheme.**

***The benefits of maintaining the system should be demonstrated to be worthwhile.***

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The previous sections of this document have identified a number of practices and procedures that are intended to support occurrence investigation and reporting. Each of these techniques incurs additional expense to ANSPs. It is, therefore, important that managers be provided with some means of assessing whether their expenditure is yielding benefits.

The validation of an occurrence investigation system is a very difficult problem. The annual frequency of high severity occurrences is very low amongst European ATM providers, often only one or two per year. Unusual events can lead to single occurrences that, in turn, can have a considerable impact upon any trend data. As a result, several ATM providers monitor the success of an occurrence reporting system not by examining the frequency of high severity occurrences but by looking at the frequency of medium to low severity occurrences. There are, however, a number of further methodological problems in measuring the success of an occurrence reporting system. A fall in the number of reports may either indicate an overall improvement in safety or it may indicate less participation in the system. Some reporting systems, therefore,

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aim to maintain the same number of submissions whilst ensuring that the severity of the occurrences that are reported goes down. All of this depends upon a consistent and coherent severity classification system, such as the HEIDI taxonomy.

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## **9.5 What should also be done with investigation reports?**

***It is also very important that the data gathered from occurrence reporting should also be used during target setting.***

In particular, the output of these systems can provide quantitative evidence to back-up the use of risk assessments during future development. This helps to ensure a direct link between the safety 'feedback' about previous incidents and the safety 'feed-forward' of information into the system development.

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***Results from the investigations are also used to compile the annual statistical data about ATM occurrences that are requested by regulatory documents such as ESARR2.***

These include the total number of occurrences in a state, classified according to severity level, phase of flight, flight rules etc. These classifications depend upon the ability to extract statistical information based on the data requirements and analysis techniques that have been advocated in the generic phases in this document.

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## Recommended Reading

### **EUROCONTROL documents:**

Available on: <http://www.eurocontrol.be/dgs/src/documents/deliverables/>

Safety Regulatory Requirement: Reporting and Assessment of Safety Occurrences in ATM, Ref. ESARR 2.

Severity Classification Scheme for Safety Occurrences in ATM. Ref: GM1 - ESARR 2, Brussels, Belgium, 1999. Available on:

Use of Safety Management Systems by ATM Service Providers, ESARR 3.

Risk Assessment and Mitigation in ATM, ESARR 4, Brussels, Belgium, 2000.

Decision of the Permanent Commission – DECISION No. 80: adopting the initial elements of the Safety Measurement and Improvement Programme.

Operational Requirements for EATCHIP Phase III. ATC Support Functions, Ref. OPR.ET1.ST03.4000-ORD-01-00, Brussels, Belgium, 1997.

EATMP Safety Policy, Ref. SAF.ET1.ST01.1000-POL-01-00,

EATMP Safety Policy: Implementation Guidance Material, Ref. SAF.ET1.ST01.1000-GUI-01-00, Brussels, Belgium, 1999.

Short Report on Human Performance Models and Taxonomies of Human Error in Air Traffic Management.

HEIDI Taxonomy,

EUROCONTROL ATS Occurrence Reporting Form. APDSG.

### **ICAO Documents:**

ICAO Annex 13 to the Convention on International Civil Aviation.

ICAO Manual of aircraft accident investigation. Ref: ICAO Doc 6920.

ICAO Accident prevention Manual. Ref: ICAO Doc 9422.

ICAO Air Traffic Services Planning Manual. Ref: ICAO Doc 9426.

Guidance on the reporting and analysis of ATS incidents, plus the ATS reporting form for pilots to report.

ICAO Accident Investigation and Prevention (AIG) Recommendations for SARPS (Aircraft Accident and Incident Investigation) Annex 13 to the Convention on International Civil Aviation, Ref. AN-WP/7472 (ANC Task No. AIG-9801), 1998.

**EU Directives:**

Draft proposal for a Council directive re-establishing a co-ordinated system of national mandatory occurrence reporting schemes in civil aviation. Council directive 94/56/EC of 21 November 1994.

CEC Directive L319

**JAA Documents:**

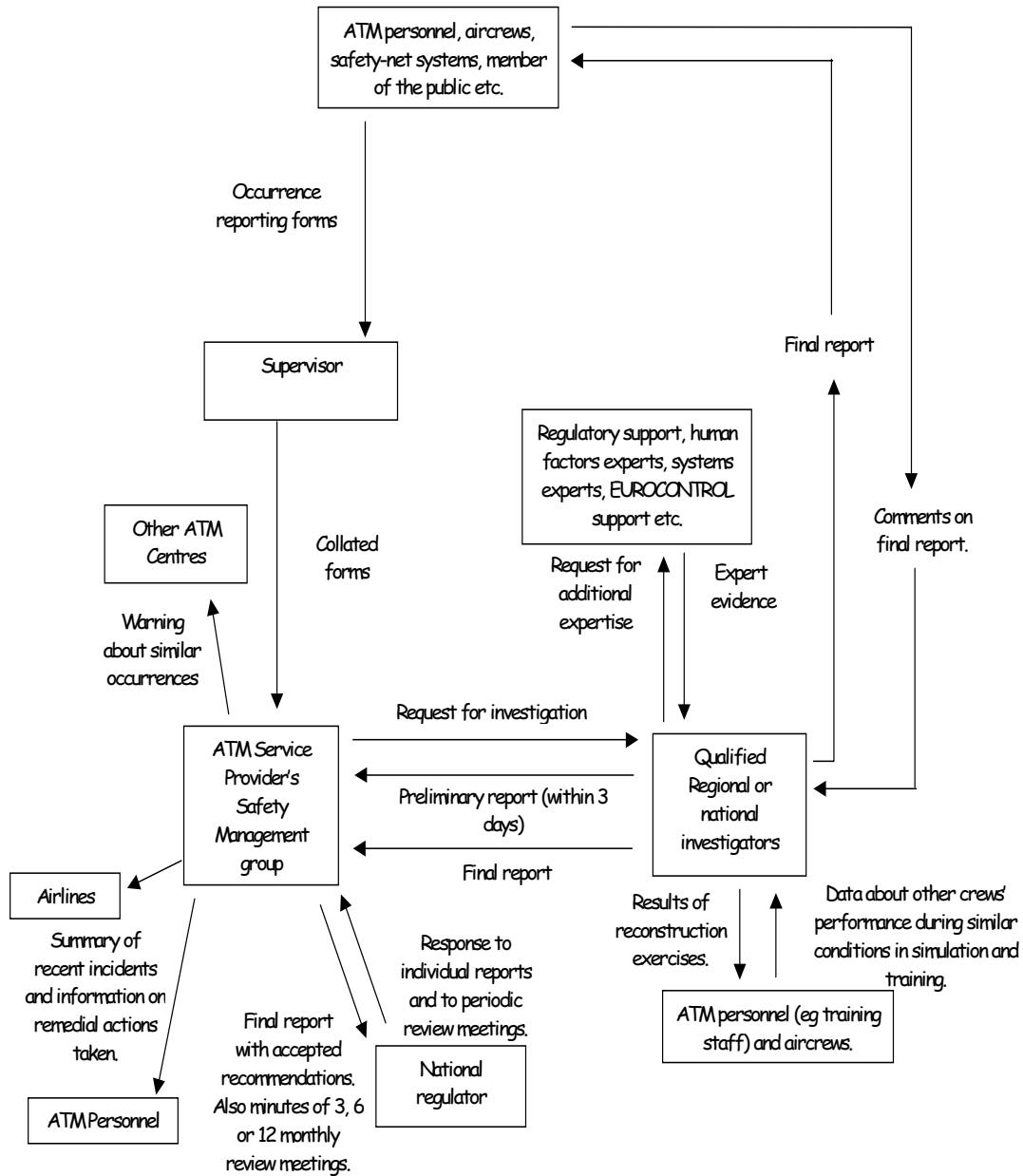
Advisory Material, Draft NPA 20-6 on occurrence reporting, Ref: ACJ 20.XX, 2000.

**ECAC documents:**

European Civil Aviation Conference, Experts on Accident Investigation Summary of Decisions. Ref: ACC/16(Inf.)-SD, Lisbon, Portugal, 1999.



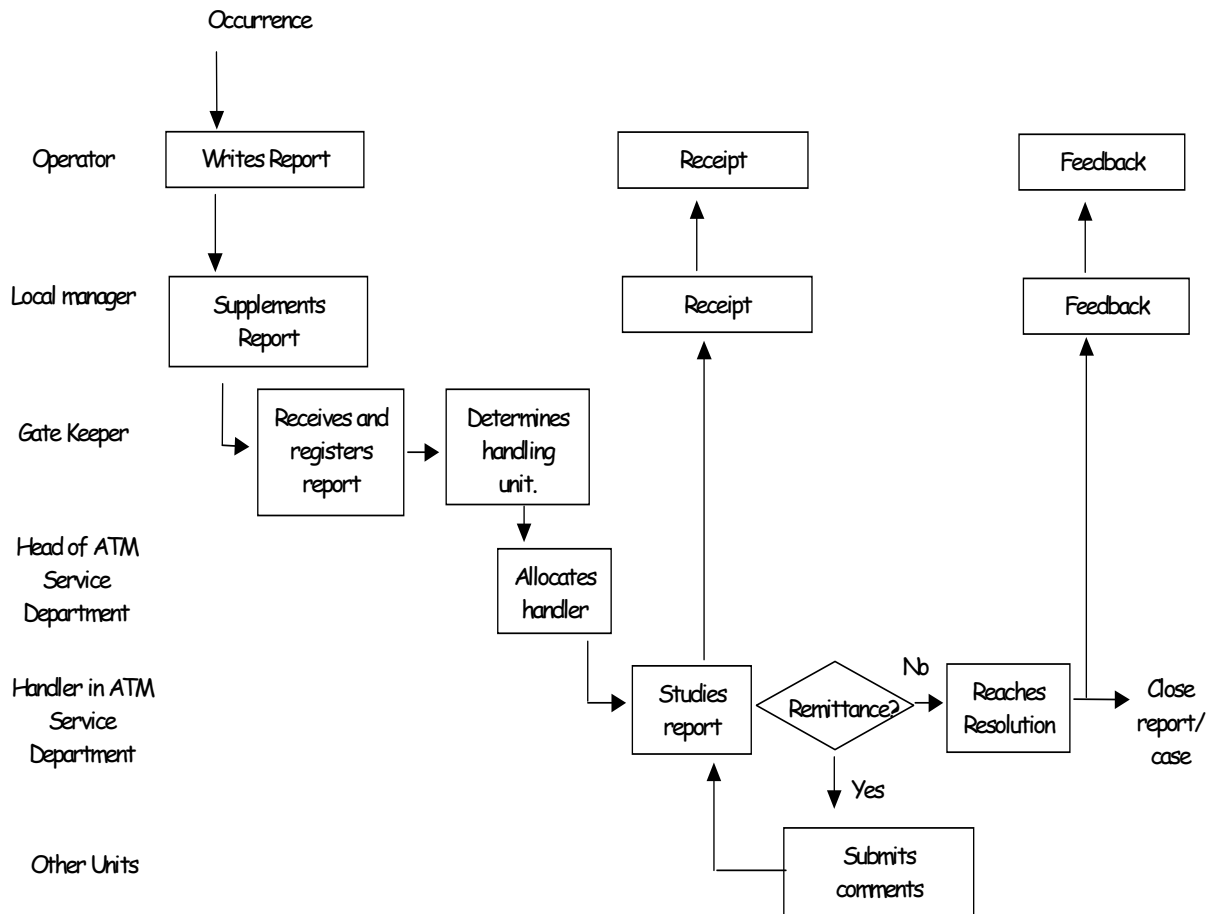
## Appendix A – Overview of Occurrence Reporting Process



This diagram provides an overview of the stages involved in one approach to occurrence reporting and investigation. This approach suggests that all reports may be investigated. In contrast, appendix B provides an overview of an existing ATM reporting system that relies upon the submission and filtering of occurrence reports by a gatekeeper before they are passed for further investigation.

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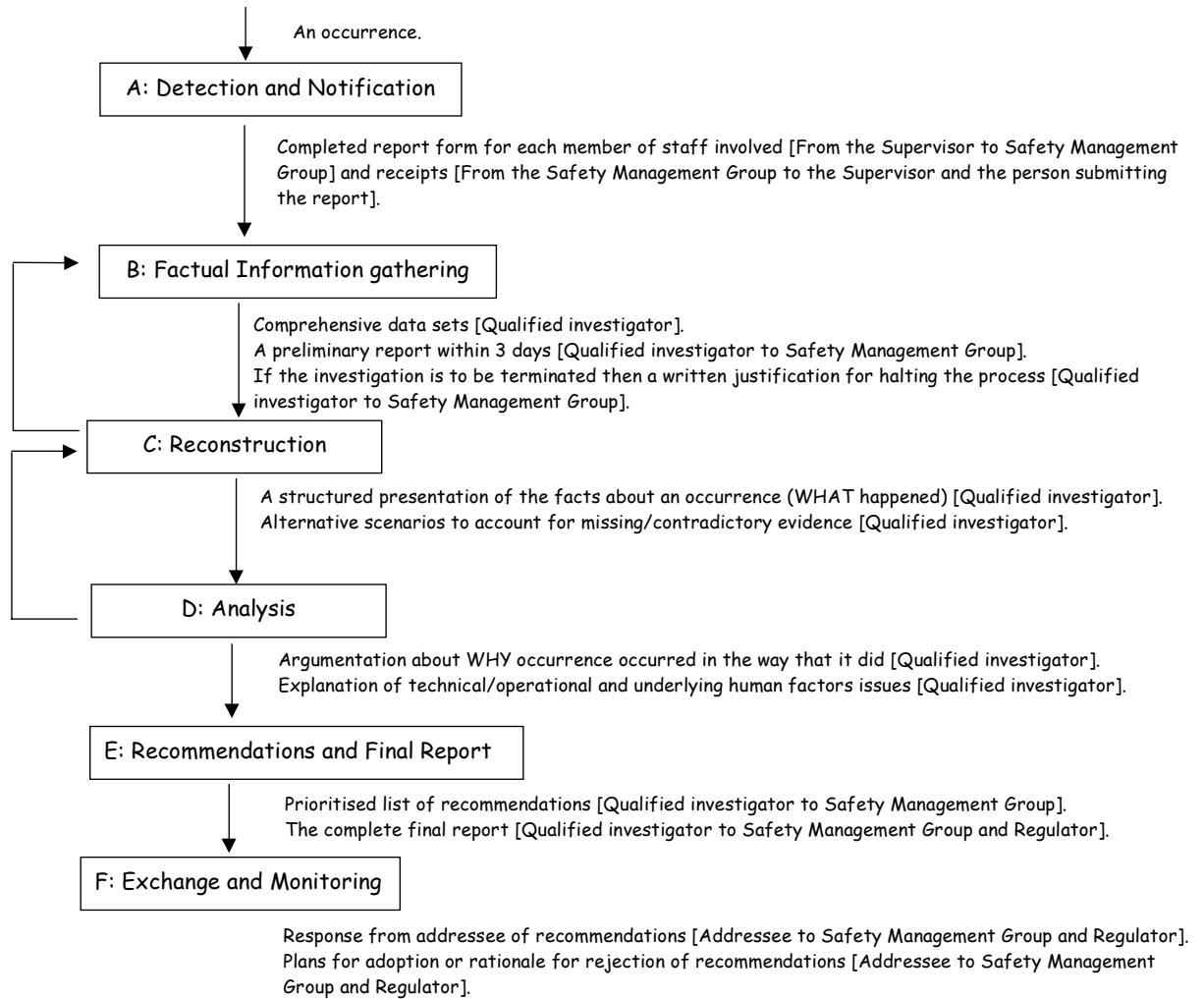
## Appendix B – Overview of Alternative Occurrence Reporting Process



This diagram illustrates how some ANSPs have integrated their occurrence reporting system into more general quality improvement systems. Here the definition of occurrences includes all forms of human, operational and technical failures even including incidents such as a failure of a light bulb. All reports are handled centrally by a number of specially trained gatekeepers who are responsible for filtering the reports and then passing them on to the relevant departments for action.

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## Appendix C – Inputs/Output of the Reporting Process



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## Appendix E – EUROCONTROL Guidelines for Completion of ATS Occurrence Reporting Form

Topic of question:	Examples of information requested
Identification information:	Name, working team or unit, control centre information, current status of license.
Shift information:	When did the occurrence occur? When was your last break and for how long was it? When did you last operate this shift pattern in this control position? Were you training (or being trained?).
Station configuration:	What was the station configuration/manning like at the time of the occurrence? What was the ATC display configuration? Were you working with headsets/telephones/microphone and speaker? Were there any technical failures?
Air Traffic Characteristics:	What was the traffic volume like in your estimation? What was your workload like immediately before the occurrence? Were there any significant meteorological conditions?
Detection and mitigation factors:	What made you aware of the occurrence (e.g. automated warning, visual observation of radar)? Were there any circumstances that helped to mitigate any potential impact of the occurrence?
Other factors:	Are there any personal (off the job) circumstances that might affect the performance of you or others during the occurrence?
Free-text description of the occurrence:	Describe the occurrence and your performance/role during it. Also consider any ways in which you think that the occurrence might have been avoided.

Use this Form to report an occurrence involving an aircraft or vehicle, your own or another ATS Unit, an alleged violation of ATS provisions or clearances, equipment and ATC Procedures shortcomings.

Fill in this form as soon as practicable after the occurrence.

Fill in as many Boxes (1 to 19) as possible. Fill in relevant information. If NOT RELEVANT, use N/R; or if NOT KNOWN, use N/K.

**Box 1:** Year (YY), Month (MM), Date (DD), hour (hh), minute (mm) of occurrence.

**Box 2:** Night: as defined nationally, or by ICAO.

**Box 3:** State location using latitude/longitude, a place name, aerodrome, bearing/distance from a NAVAID or significant point, etc.

**Box 4:** Use this Box only if aircraft affected or involved. Provides for details regarding up to two aircraft involved. Use Box 13 for additional aircraft.

**Type:** use ICAO aircraft designators; **ADEP/ADES:** use ICAO location indicators or plain language; **FL, altitude or height:** specify Flight Level (FL), altitude (A), height (H) in feet. If metric, add m. Insert altimeter setting if applicable; **Mode C:** if level information from the aircraft is available from other sources (e.g. Mode S, ADS, etc.) specify in Box 13; **Relevant route segment:** e.g. SID/STAR/ATS route (specify) / aerodrome traffic circuit (specify, e.g. downwind) / landing / taking-off) / taxiing / initial climb / etc.; mark flight rules.

**Box 5:** To assist in retention of relevant RTF and surveillance recordings.

**Box 6:** Mark the Class of ATS Airspace (A, B, C, D, E, F, G) within which the occurrence took place.

**Box 7:** Indicate the type of service provided, e.g. Area/Approach/Aerodrome - Control/Advisory/ Information - Procedural/Radar - etc. Use a combination of these for full description of service provided.

**Box 8:** Use this Box only if aircraft affected or involved, or if near-Controlled Flight Into Terrain (CFIT) event, to indicate distance aircraft/aircraft or aircraft/terrain.

**Box 9:** Specify if automated warning system(s) was/were involved (e.g. conflict alert, ACAS). If applicable, specify type and contents of warning and/or alert.

**Box 10:** Mark **YES** or **NO** if relevant.

**Box 11:** Self-explanatory.

**Box 12:** Mark **YES** or **NO**, if weather was considered relevant to the occurrence, include details in Box 13.

**Box 13:** Use free text to describe the occurrence, include diagram if necessary; Causes and factors believed to be relevant to the occurrence; Suggest changes and improvements, if appropriate; *You may wish to indicate that the Report reflects your subjective recollection of the facts*; Include relevant weather information. If necessary, use Box 13 of additional Forms, indicate sequential number of pages and total number of pages.

**Box 14:** Give your assessment of workload, taking into account complexity and other factors.

**Box 15:** Indicate the time period since your last rest break.

**Box 16:** Self-explanatory.

**Box 17:** Self-explanatory.

**Box 18:** Specify your duty position and/or responsibility at the time of the occurrence.

**Box 19:** Self-explanatory.

## Appendix F – The Investigator

Individual investigators are trained to conduct the more detailed analysis that is required following a major occurrence. They receive the notification from the supervisor. The team/investigator should then determine whether any further data acquisition is required, for instance by interviewing more people (see below) or by examining records from other automated logging equipment. The investigators should be trained in occurrence investigation techniques. This specialised training should accompany experience as a controller/instructor. It should also build on an in-depth knowledge of the technical issues that will arise during occurrence analysis; meteorological issues; navigation techniques; human factors expertise etc. The coherent and consistent investigation of occurrences will also require some pre-selection of investigators. They are responsible for drafting the final occurrence report and for submitting it to the appropriate regulatory authority. Recruitment should also focus on appropriate personality traits (meticulous, unbiased etc.).

<b>Skill/Knowledge Requirement</b>	<b>Available Tools/Techniques</b>
Air Traffic Control Domain Expertise	Ensure that team is led by a qualified ATC manager. This meta-level requirement hides a number of more detailed issues. They should understand the working practices of the team that noted the occurrence. They should have a clear view of relevant legislation, regulation and protocols. They should understand the patterns of traffic management etc leading to the occurrence. They should also be recognised and trusted by employee representatives.
Technical Expertise	This will be essential if equipment failure is an issue. It may also increasingly be important if increasing automation and the integration of advice giving systems (e.g., radar and flight plan information) play any part in an occurrence.
Human Factors Expertise	Given the increasing prominence of human factors in many occurrences and accidents, it may be necessary to identify a source of human factors expertise that teams can call upon. Alternatively, a number of analytical tools, such as HERA, can be used to enable ATC officers to perform some parts of the analysis themselves.

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## Appendix G – Interview Techniques

Supervisory staff may decide to conduct initial interviews. The following comments also apply to investigators who choose to conduct interviews during any subsequent factual information gathering. There are a number of alternative interview techniques that can be used:

1. Individual interviews (one to one). This has the benefit of being relatively informal. Questions can be asked to clarify any of the information that was uncertain from the form. It can also be used to elicit information that might be missing in the original submission. The problems are that the interview can be seen as combative and antagonistic if the interviewee lacks the support of their colleagues and workplace representatives. It is usually better to conduct interviews with two investigators present in the room and to allow the personnel involved to bring in a colleague or other representative.
2. Interview panels (many to one). This approach can avoid the inter-personal problems of a one-to-one interview. Several people, including friends and colleagues of the person being interviewed, can meet to discuss the occurrence. However, if such a meeting is not chaired correctly then it can appear to be an inquisition rather than a meeting to elicit necessary safety information.
3. Team-based interviews (one to many). In this approach, one interviewer meets with members of the shift during which an incident occurred. This reduces the inter-personal problems that can arise from a one-on-one interview. It may also help to uncover information from others who were present but not directly involved in an incident. The disadvantages include the practical problems of gathering everyone together but also the problems of accounting for group dynamics – the interview may be dominated by forceful personalities within the group. They may also compensate for the failures of one of their friends or exacerbate the weaknesses of those who are less popular.
4. Group discussions (many to many). This approach enables teams of investigators and works to get together to discuss an occurrence. This has the benefit that neither group need be seen to be “in control”. Conversely, of course, it can lead to a general meeting that produces few tangible results and which reduces to a very general discussion.

Irrespective of which approach is adopted, there are a number of key principles that should guide any interview process. Firstly, the interview should have a purpose. It may be a waste of everyone’s time if an interview simply repeats the questions on the reporting form. The purpose of the interview should be made clear to the person being interviewed. Secondly, the results of any interview should be recorded in either written or electronic form so that both the interviewer and the interviewee can subsequently review the products of the meeting. Thirdly, these results should be reviewed. There is little point in conducting such an exercise if it is not to be used as part of a subsequent enquiry. Finally, the findings from any interview should be documented in a formal way and (ideally) communicated to the interviewee. Otherwise, such meetings can increase stress on an individual and ultimately lead to rumour and discontent within a working group.

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## Appendix H – Guidelines List

1. Harmonised and consistent set of terms should be used for the occurrence investigation and reporting.

