EUROPEAN ORGANISATION
FOR THE SAFETY OF AIR NAVIGATION

SAFETY SURVEY COURSE REFERENCE MATERIAL Part 1 – General Principles

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Abstract

This document provides reference material for the SAF Survey Course and introduces a methodology for the conduct of Safety Surveys by Air Navigation Service Providers (ANSP). It is the first of two such documents. This document presents the General Principles (Level 1) of the ESARR3 requirement for ANSPs to conduct Safety Surveys as part of the Safety Assurance process. The second document provides amplifying reference on the methodology and techniques together with examples (Levels 2 & 3).

Keywords

Safety Management	Safety Survey	Organisational Factors
Periodic Safety Survey (PSS)	Local Workplace Factors	
Targeted Safety Survey (TSS)	Unsafe Acts	
Continuous Safety Survey (CSS)	Safety Assurance	

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CONTENTS

Executive Summary

This Safety Survey Reference (SURV) document has been developed to provide support for the Institute of Air Navigation Services' Safety Survey Course to assist in the conduct of Safety Surveys by Air Navigation Service Providers (ANSP). The material has been developed, inter alia, from a study into safety survey best practice within Air Traffic Management (ATM) and other industries.

This material consequently reflect the scalability of the Safety Survey process which will need to be adaptable to both large and small ANSP organisations, often with very different cultures.

This material consist of 2 Volumes:

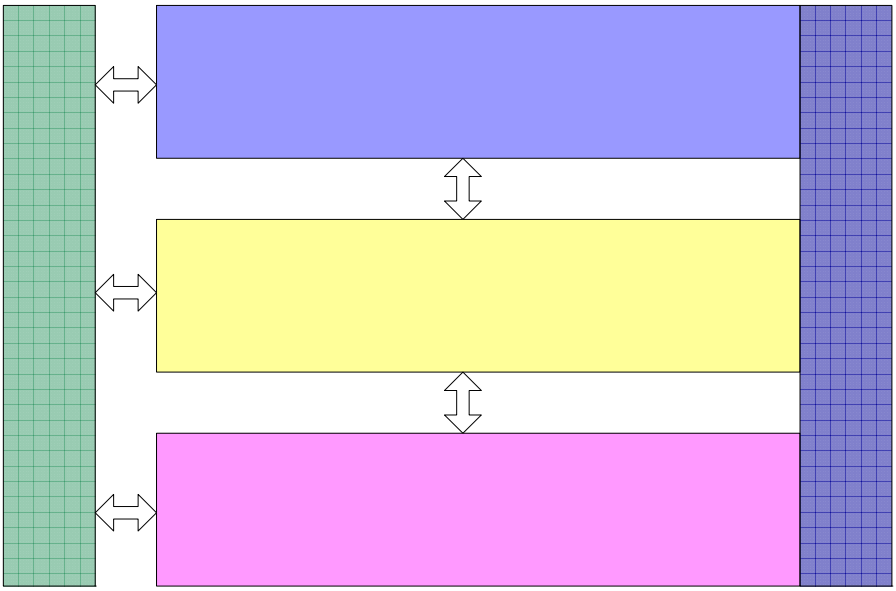
- Safety Survey Guidelines Volume 1 – General Principles.
- Safety Survey Guidelines Volume 2 – Guidance and Examples.

Readership:

Volume 1 - Provides an overview of the Safety Survey Methodology.

Volume 2 - Describes how to perform Safety Surveys.

This is the first of two such documents and presents the General Principles (Level 1) of the ESARR3 requirement for ANSPs to conduct Safety Surveys as part of the Safety Assurance process. The second document provides amplifying guidance on Safety Survey methods and techniques together with examples (Levels 2 & 3).



CHAPTER 1
CONTEXT

1.1 Safety Survey As A Key SMS Aim

1.1.1 A key aim of ATM Safety Management Systems (SMS) is to minimise the ATM contribution to accidents and incidents. Safety Management (SM) remains at the forefront of methods by which organisations can make aviation, already the safest form of travel, even safer. The SM approach can be characterised by the move beyond the traditional reactionary systems to one which tries to predict areas of exposure through assessment of any residual risk areas and supplements the process with operational knowledge and professional judgement.

1.2 Need For A Proactive Approach To Safety Management

1.2.1 Consequently, a key issue in SM is the need to adopt a proactive approach. The absence of such an approach has contributed in the past to a number of major accidents in transport and other areas of industry. In the case of the Piper Alpha oil platform disaster, for example, Lord Cullen observed that:

> "*Senior management were too easily satisfied that the…system was being operated correctly, relying on the absence of any feedback of problems as indicating that all was well*."[1]

[1] The Hon Lord Cullen, *'Public Inquiry into the Piper Alpha Disaster'* (Department of Energy, London: HMSO, 1990). p33.

CHAPTER 2
ANSP SAFETY SURVEYS

2.1 The Importance of Effective Safety Survey

2.1.1 Most organisations operate within a safety 'envelope' which is limited at one extreme by a boundary beyond which it would be unsafe to continue. A boundary at the other extreme indicates the region beyond which limitations would be so restrictive that operations or production could not proceed. This is illustrated at Figure 1[2].

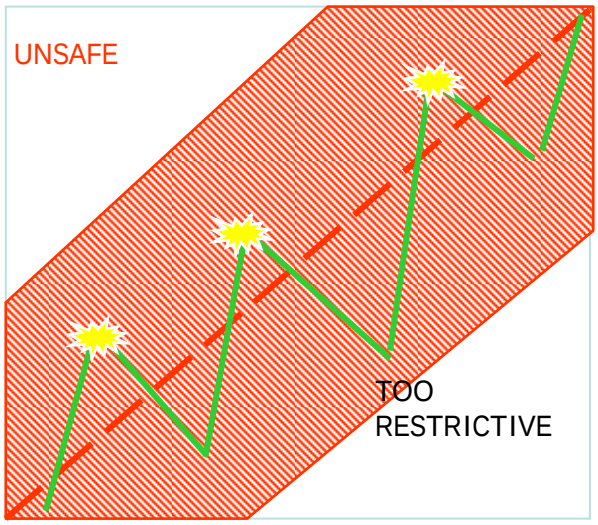


Figure 1- The Operating Envelope Of An Organisation - The Balance Between Production & Protection

2.1.2 In the case of manufacturing industries or industrial processes where low-consequence accidents and serious incidents occur relatively routinely the organisation's activities can be seen to react by 'tightening up' the rules each time an accident or serious incident occurs. As memory of the most recent accident fades, safety standards relax until the next occurrence and so on, as Fig 1 illustrates. In such organisations, it is relatively straightforward, at any given stage, to assess the standard of safety performance and identify, for example, negative trends.

2.1.3 For ANSPs, where there is potential for high-consequence but very infrequent safety events, the absence of this pattern means that it can be extremely difficult to identify safety trends, as illustrated at Figure 2. For example, how is the senior management of an ANSP able to determine whether safety standards are improving or declining from year to year?

[2] From Reason J, *'Managing The Risks Of Organisational Accidents'* , Ashgate, London, 1997.

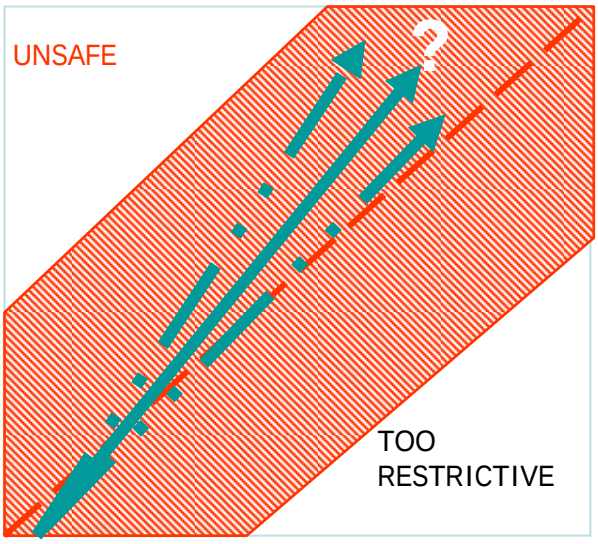


Figure 2 - The Difficulty In Assessing Safety Performance In Organisations Such As ANSPs

2.1.4 An ANSP needs to be proactive in the absence of actual accidents and search for evidence of safety performance by conducting regular and effective Safety Surveys.

2.1.5 Safety Survey is, therefore, one of the few means by which an ANSP can identify trends in safety performance without the trigger of a formal safety occurrence and all the associated connotations of blame. Safety Survey therefore has the advantage of being proactive and can allow safety trends to be reversed before adverse events occur. This means that the Safety Survey is a particularly important activity.

2.2 The Safety Regulatory Requirement

2.2.1 Safety Survey Purpose

2.2.1.1 The overall objective of European ATM (EATM) Safety Policy and principles is to ensure that all safety issues within the provision of an ATM service have been addressed in a satisfactory manner, and to a satisfactory conclusion. This is reflected in the SMS diagram at Figure 3.

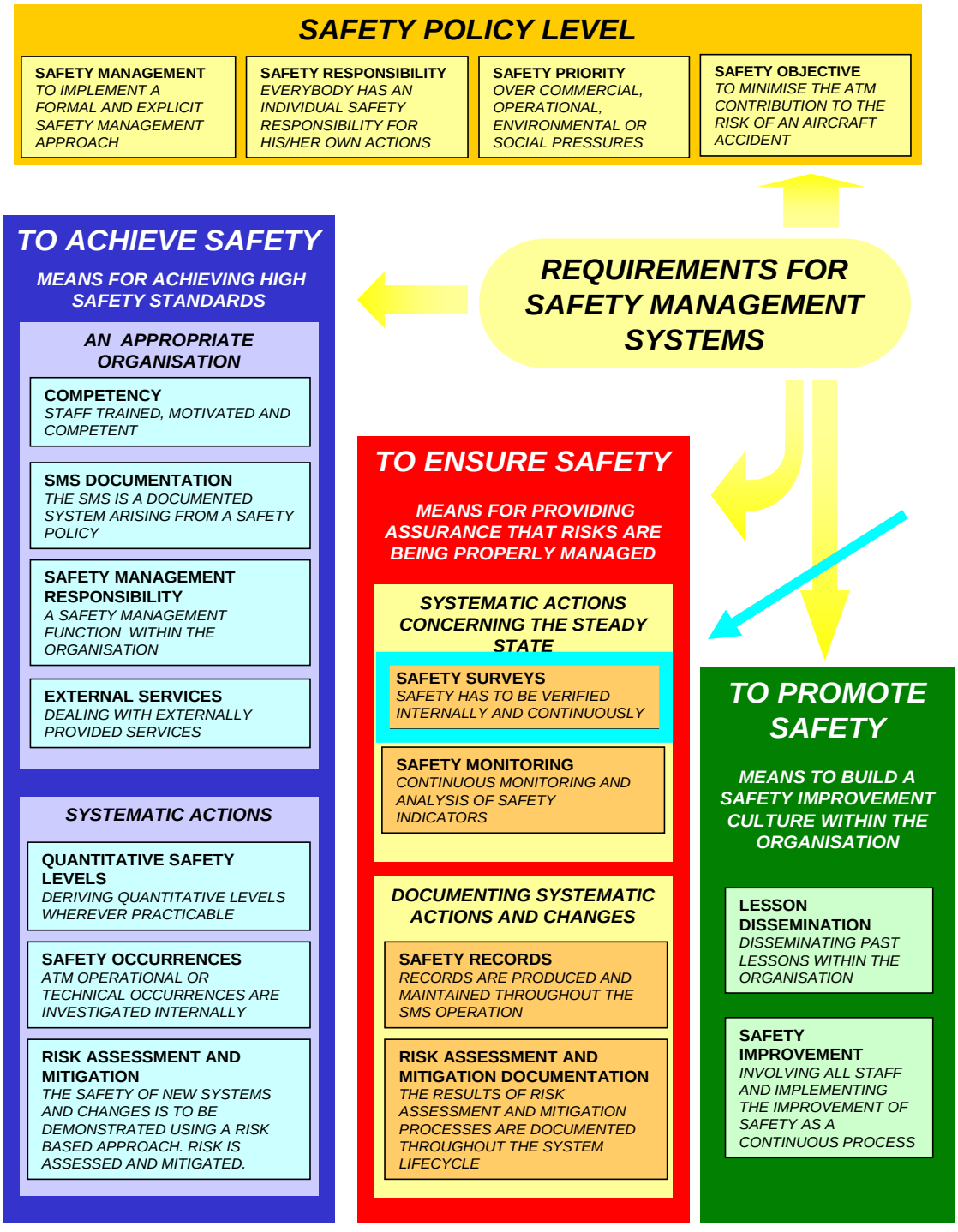


Figure 3 - EATM Safety Policy and Principles

2.2.2 **Safety Survey Definition**

2.2.2.1 ESARR 3[3] defines Safety Survey as:

"*A systematic review, to recommend improvements where needed, to provide assurance of the safety of current activities, and to confirm conformance with applicable parts of the Safety Management System*."

2.2.3 **Safety Survey As A Routine ANSP Activity**

2.2.3.1 ESARR 3 requires that ANSPs have in place an SMS which will ensure that Safety Surveys are carried out as a matter of routine as an integral part of their safety assurance activity. Section 5.3.1 of ESARR 3 stipulates that:

"*Within the operation of the SMS, the ATM service-provider shall ensure that Safety Surveys are carried out as a matter of routine to recommend improvements where needed, to provide assurance to managers of the safety of activities within their areas, and to confirm conformance with applicable parts of their SMS."*

2.2.3.2 EATM Safety Policy[4] makes it clear that Safety Surveys are intended to serve the purpose of both highlighting areas of weakness and of promoting best practice.

"Safety Surveys simultaneously serve several purposes in that they are:

a) A means for hazard identification, to spot potential safety problems and to recommend some preventive or corrective actions;

b) A means for promoting best practices, to determine the effectiveness and suitability of an implemented SMS.

c) A preventive activity, the main purpose of which is to confirm that an existing situation is satisfactory.

d) A routine activity to identify problems and facilitate the definition of remedial actions when problems are identified or suspected."

[3] EUROCONTROL Safety Regulatory Requirement - ESARR 3 Use of Safety Management Systems by ATM Service Providers.

[4] SAF.ET1.ST01.1000-POL-01-00

2.2.3.3 EAM 3/GUI - 1 Explanatory Material on ESARR 3 Requirements explains that Safety Surveys should:

a) Be conducted as a matter of routine to provide safety assurance for the steady state of the ATM system.

b) Provide assurance that risks are being properly managed.

c) Be carried out by ATM Service providers in a systematic and organised way.

2.2.3.4 In this context it should be noted that Safety Survey can also provide a useful means of verifying the results of Safety Assessments which have previously been made in support of changes. This is one means of providing ANSP management with additional assurance that the steady state of ATM activities has not been adversely influenced by the cumulative effects of individual changes.

2.2.4 **Complementary To Safety Regulatory Audits**

2.2.5 Moreover, Safety Survey is an internal process which must be conducted in addition to Safety Regulatory Audits as a complementary activity. The safety regulatory audits and inspections which are conducted by National Safety Regulatory bodies as part of their ESARR 1[5] safety oversight responsibilities cannot therefore be considered as a substitute for the ESARR 3, Safety Survey requirement[6]. An important difference is that Safety Survey must be a proactive activity which goes well beyond the mere checking for conformance of working practices against regulations which is only one aspect of the Safety Survey process.

2.2.6 **Complementary To Incident Investigation**

2.2.6.1 ANSP Safety Surveys are also required to be complementary to incident investigation, since they examine systems under normal conditions to identify weaknesses that have not yet been seen to contribute directly or indirectly to an occurrence.

[5] ESARR 1 Safety Oversight in ATM.

[6] National ATM Safety Regulatory Framework, Policy Document 3.

2.2.7 **Complemented By Quality Audit Activities**

2.2.7.1 ANSP Safety Surveys may fulfil a role similar to that performed by Quality Audits (QA) in Quality Management Systems (QMS). Both Safety Survey and QA activities are conducted to check compliance with standards (or targets) and procedures, detect problems and facilitate the identification of solutions and improvements. However, ANSP Safety Surveys are required to be proactive activities which go beyond the mere checking for conformance of working practices against procedures (this is only one aspect of the Safety Survey process).

2.2.7.2 QA methodologies can, however, be used for designing Safety Survey processes. Furthermore EAM 3/GUI 4 – 'Mapping between ISO 9001:2000 and ESARR 3' makes provision for ESARR 3 Safety Surveys to be considered as a "suitable method" to achieve the objectives stated in ISO 9001:2000 as regards SMS processes. ISO Audits may therefore assist in defining the ESARR 3 Safety Survey objectives.

2.2.8 **Summary of Regulatory Requirement for ANSP Safety Surveys**

2.2.8.1 The basic Regulatory requirement for ANSP Safety Surveys may therefore be summarised such that ATM service providers should normally establish processes to carry out Safety Surveys as a matter of routine to review operational units and significant areas of activity. Such surveys should examine the safety performance of the whole unit in general and in some specific areas. Specifically, they should look at the safety performance of the SMS.

2.2.8.2 Safety Surveys, therefore, must also perform a key role in providing feedback to ANSP management on the effectiveness and efficiency of the SMS as it is implemented locally. For this reason it is important that the scope of Safety Surveys reflects the need also to evaluate the functioning of the SMS itself as it is applied to the various ATM functions being performed.

2.2.8.3 Although internal activities, Surveys should be carried out by personnel who are independent of the function which is being examined and should be performed in a planned and systematic way. Key aspects of Safety Survey are:

a) Identification of weaknesses and strengths of the system

b) The identification of corrective actions

c) The recording of results, and

d) The initiation and follow-up of corrective actions

2.2.9 Aspect of Focus for Regulators

2.2.9.1 The ATM Service providers' arrangements for Safety Survey will be an important aspect of focus for Regulators. For example, in proposing Areas For Consideration In Safety Regulatory Audit Protocols, EAM 3 / GUI 3 – 'ESARR 3 And Related Safety Oversight' provides Regulators with a number of audit topics relating to the provider's conduct of Safety Surveys such as 'Who determines the scope of a safety audit/review/survey?' and 'Is there a systematic programme of safety audits/reviews/surveys?'

2.3 Relevant Terminology

2.3.1 The Need for Clarity

2.3.1.1 A wide number of terms are commonly used to describe safety processes which, though broadly similar, can have markedly different objectives and styles. Such terms include Audit, Survey, Monitoring, Inspection, Review and Study. In order to remove potential ambiguity for those who are required to demonstrate compliance with Safety Surveys, these Guidelines serve to clarify the key terms.

2.3.2 Safety Assurance

2.3.2.1 As can be seen from the SMS diagram at Figure 3, Safety Survey is one of the means of achieving Safety Assurance. Safety Assurance is defined as:

> *"All planned and systematic actions necessary to provide adequate confidence that a product, a service, an organisation or a system achieves acceptable or tolerable safety"*[7].

[7] ESARR 3 - Use of Safety Management Systems by ATM Service Providers

2.3.2.2 As Figure 4 shows, Safety Assurance embraces both Safety Survey and Safety Monitoring.

2.3.2.3 Safety Monitoring is defined as:

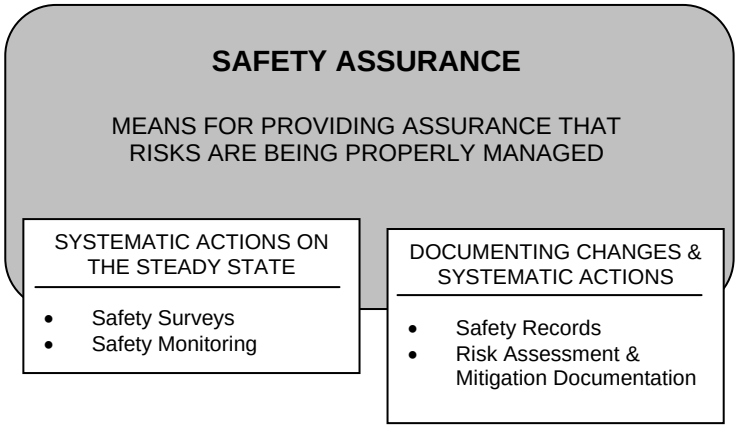


Figure 4 - The Safety Assurance Process

"A systematic action conducted to detect changes affecting the ATM System with the specific objective of identifying that acceptable or tolerable safety can be met."[8]

2.3.3 Proactive Versus Reactive Safety Assurance

2.3.3.1 The boundaries between Safety Monitoring and Safety Survey can become somewhat blurred. The key distinction, however, is that whereas Safety Monitoring is a reactive process in which data, such as safety occurrence reports and equipment failure reports etc, is gathered on a routine basis in order to be able to detect changes, Safety Survey is a proactive process.

2.3.3.2 Safety Surveys, therefore involve positive action to identify areas of interest, to gather specific information, to analyse that information and to make arrangements to act upon it. They require positive planning and subsequent action which is over and above the mere monitoring of routine activity. Safety Survey is a methodological activity which must be conducted in accordance with a clear plan, rather than being sporadic or randomly organised.

2.3.3.3 The relationship between the proactive and reactive internal Safety Assurance and external Safety Regulation activities is summarised diagrammatically at Figure 5.

[8] ESARR 3 - Use of Safety Management Systems by ATM Service Providers

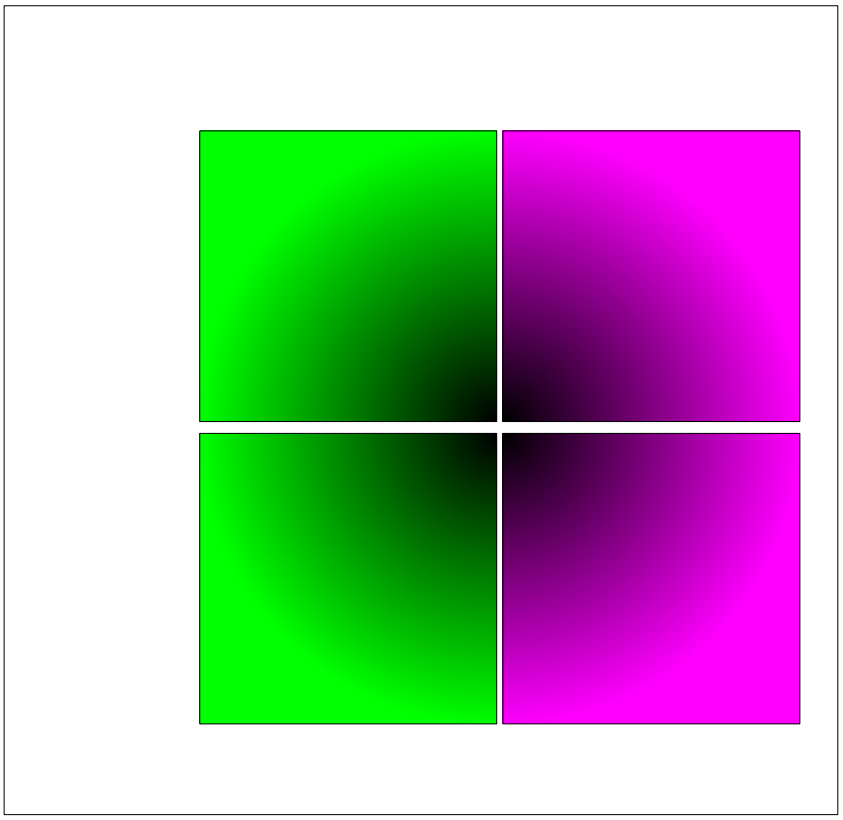


Figure 5 - The Relationship between Proactive & Reactive External and Internal SM Activities

2.3.4 Specific Use of Safety Survey Terms

2.3.4.1 The ESARR 3 definition for Safety Survey has already been given as: 'A systematic review, to recommend improvements where needed, to provide assurance of the safety of current activities, and to confirm conformance with applicable parts of the Safety Management System'.

2.3.4.2 This document will later introduce a number of Safety Survey methods which can be used to satisfy different parts of the basic ESARR 3 requirement. These methods are described more fully in Volume 2, however for the purposes of clarity the terms to be used have been defined specifically for use in the context of this Safety Survey material as follows:

a) Inspection. The physical examination of arrangements for the conduct and support of ATM including scrutiny of arrangements for the management of safety and which may also include the verbal and/or written questioning of staff.

b) Safety Review. The retrospective examination of general and/or specific arrangements for the safe conduct and support of ATM including detailed scrutiny of documented SM activity.

c) Study. The dedication of investigative effort to acquiring information and knowledge of specific ATM arrangements together with the development of conclusions and, where appropriate, recommendations for further action.

d) Staff Survey. The systematic gathering of information, verbally or in writing, from internal staff and/or personnel from external organisations relating to specific aspects of ATM safety.

e) Observation. The accurate watching and recording of activity relating to ATM safety as it occurs, particularly with regard to cause and effect.

f) Self-Assessment. The estimation of the extent and/or quality of factors which influence ATM safety positively or negatively, by individuals responsible for providing an ATM service or associated support.

CHAPTER 3
MEANS OF COMPLIANCE – THE NEED FOR A COMPREHENSIVE AND SYSTEMATIC APPROACH

3.1 ANSP Safety Surveys Must Be Comprehensive

3.1.1 Scope of Safety Surveys Within ANSPs

3.1.1.1 As has been outlined in earlier sections, ESARR 3 requires that ANSPs have in place an SMS which will ensure that Safety Surveys are carried out as a matter of routine as an integral part of their safety assurance activity. Broadly, a Safety Survey can be said to be a means of validating (developing correct processes) and verifying (compliance with those processes) the continuing Safety Assurance provided by the management and operations of an organisation.

3.1.1.2 The safe operation of an ANSP within the ATM system involves the complex interaction of suitably trained people (both operations staffs and technical personnel), the organisations in which they work, the procedures they are required to follow and the equipment they must maintain and operate. This is illustrated diagrammatically at Figure 6.

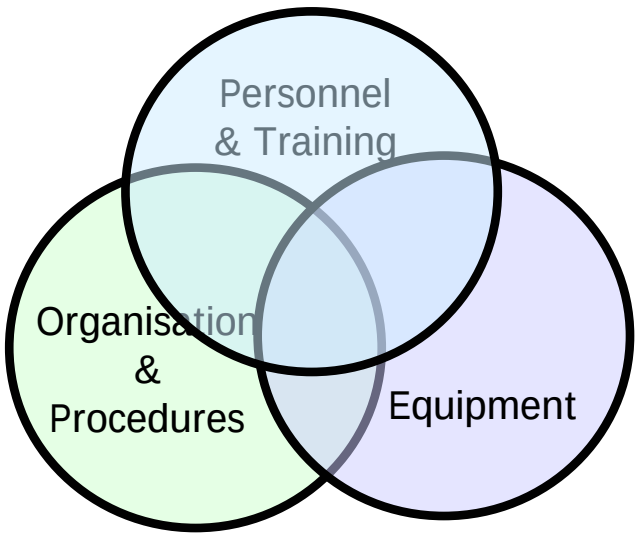


Figure 6 - Complex Interactions Involved In Safe ATM Activities

3.1.1.3 It follows, therefore, that ANSPs must ensure that their Safety Survey activities encompass all facets of operations and maintenance activity and are not confined, for example, just to operations issues.

3.1.1.4 Moreover, given that the wider aim is to provide ANSP senior management with a safety 'health check', it follows that Safety Surveys should be conducted in a manner which is sufficiently comprehensive to allow the early identification of the kinds of potential safety shortfalls which could ultimately lead to an accident together with the confirmation of the continued effectiveness of safety barriers and mitigation.

3.1.1.5 It is necessary therefore to ensure that Safety Survey methods and techniques are employed which provide sufficiently comprehensive coverage. A recognised model of Accident Causation is used within these Guidelines for this purpose.

3.1.2 Accident Causation

3.1.2.1 When considering the nature of factors which could contribute to accidents involving an ATM organisation the Accident Causation Model (ACM)[9] shown in Figure 7, is particularly useful and forms the basis for a Safety Survey Model which will be introduced later.

3.1.2.2 The upper part of Figure 7 shows that, interposed on the trajectory toward an Accident, is a series of Defences or Barriers to the potentially adverse effects of Hazards. In what has become famously known as the 'Swiss Cheese Model', Reason likens each of the Defences to a layer of Swiss cheese which, rather than being intact, has weaknesses and gaps which are represented as holes. The necessary condition for an organisational accident is the rare conjunction of a set of holes in successive defences allowing Hazards to come into damaging contact with people and assets.

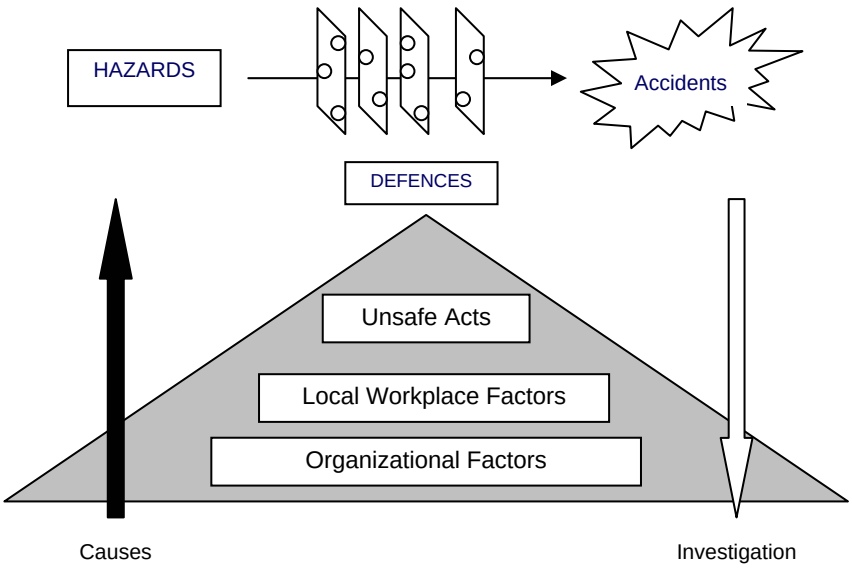


Figure 7 – Accident Causation Model

[9] Reason, J, *'Managing the Risks of Organisational Accidents'*, Ashgate, London, 1997, p17.

3.1.2.3 The defences fail both because of errors and violations made by those at the 'sharp-end' such as air traffic controllers and pilots (Reason uses the term 'Active Failures') and because of less proximal organisational factors such as poor design, gaps in supervision, unworkable procedures, shortfalls in training, etc often arising from decisions made elsewhere within the organisation. Reason uses the term 'Latent Conditions' for these.

3.1.2.4 The lower part of Figure 7 depicts the system which can produce the conditions for organisational accidents. The model has three levels: the person (unsafe acts), the workplace and the organisation. The causal chain begins with organisational factors such as policies, procedures and decisions which are communicated to workplaces within the organisation (e.g. control room, maintenance department) and manifest themselves as factors likely to promote unsafe acts by humans (e.g. ATCOs, ATC Assistants, Technicians). Typically, large numbers of unsafe acts will be made but only a few will penetrate the layered system defences in place to prevent hazardous events from becoming accidents.

3.1.2.5 Generally, the human referred to when an accident is ascribed to human error is an individual or team working at the 'sharp end' of the system. Safety Managers and Accident Investigators often consider only the unsafe acts of individuals without considering the contribution of either the workplace or organisational factors and their effect on the constraints and resources acting on the practitioners at the 'sharp end'. ANSP Safety Surveys must take a wider view.

3.1.2.6 A review of Safety Survey best practice within ATM and some other industrial areas concluded that organisations used a variety of Safety Survey methods which could be categorised into 3 types, namely:

a) Periodic Surveys. Surveys which addressed workplace or organisational (safety) procedures, personnel and training and equipment issues. Periodic surveys were often, but not always, linked to the QA process.

b) Targeted Surveys. Surveys which focused on specific areas of the organisation's operations or maintenance and were likely to be triggered by observations of unsafe acts from other types of survey, external influences or the internal monitoring of safety occurrences.

c) Continuous Surveys. Surveys which looked at workplace or organisational factors including normal operations and identified the things that were effective, such as barriers, as well as those which failed.

3.1.2.7 Each of these survey types has strengths in different areas and, in order effectively to discharge the ESARR 3 requirement for a comprehensive approach to Safety Survey, it is necessary to show how the accident causation factors from the ACM can best be countered through the most effective application of Safety Survey general principles.

The survey methods, and techniques associated with each type are covered in greater depth in the guidance material at Part 2 of this document

3.1.3 Organizational Factors

3.1.3.1 Firstly, the ANSP Safety Survey activities need to identify the factors which operate at the organisational level, most distant from the 'sharp end' of ATM delivery. These Organisational Factors can contribute to a breakdown in safety leading ultimately to conditions which make an accident more likely. Such factors could include, for example, strategic decisions, forecasting, budgeting, allocating resources, planning, scheduling, communicating, managing, etc. These factors are likely to be influenced by the culture of the ANSP organisation and can be communicated to control rooms, maintenance facilities, etc, where they can lead to the development of Local Workplace Factors likely to promote unsafe acts.

3.1.3.2 The most suitable form of Safety Survey to discover and highlight such Organisational Factors is the Periodic Safety Survey. This is a survey type which, over a prescribed period, usually a year, seeks to examine all the facets of an ANSP's activities. As Figure 8 illustrates, a Periodic Survey is a wide, but shallow survey type. In other words, a Periodic Survey is unlikely, for example, to highlight specific unsafe acts conducted on ATC consoles, and can only examine parts of an organisation in 'snap-shot' – it does not provide continuous monitoring.

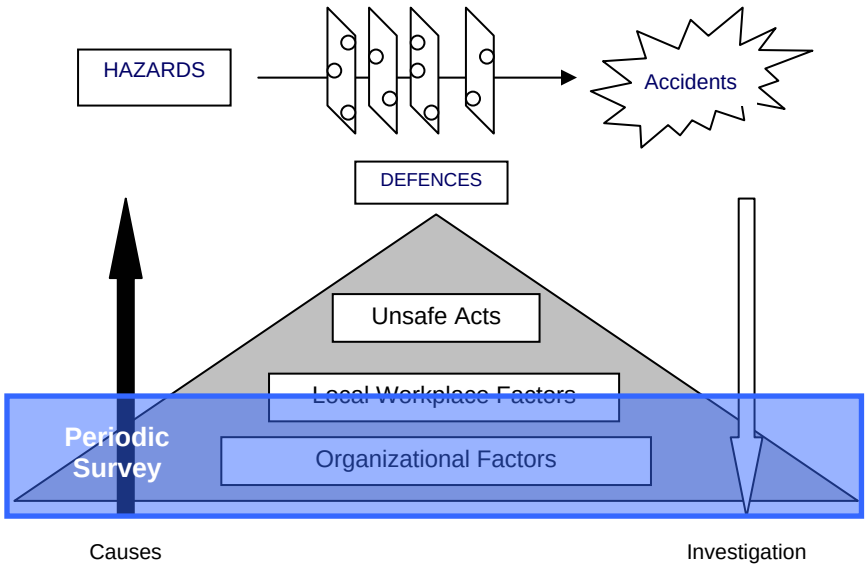


Figure 8 – Periodic Safety Surveys

3.1.3.3 Local Workplace Factors

3.1.3.3.1 Shaped by the aforementioned Organisational Factors, Local Workplace Factors could manifest themselves at the local workplace within an ANSP, in the form of, for example, undue time-pressure, inadequate equipment, poor Human Computer Interfaces (HCI), insufficient training, under manning, unworkable or ambiguous procedures etc. It is important that ANSP Safety Survey activity is sufficiently comprehensive to highlight these Local Workplace Factors as, if un-checked, they can combine with natural human behaviour to lead to Unsafe Acts committed by individuals such as ATCOs and Engineers at the 'sharp-end'.

3.1.3.3.2 As Figure 8 illustrates, some of these factors may be highlighted through effective use of Periodic Safety Surveys, however, deeper analysis is more likely to yield information which will be of use in developing safety improvement strategies. As Figure 9 shows, an effective vehicle for both uncovering and analysing potentially unsafe Organisational Factors and, more significantly, Local Workplace Factors is the Targeted Safety Survey. This is a 'narrow and deep' form of survey which yields specific information about a nominated area of interest such as, for example, 'runway incursions', or 'G/A communications quality' and provides information of sufficient depth upon which to base decisions about remedial action.

3.1.3.3.3 Targeted Surveys are focussed in particular areas and may not reveal weaknesses in other parts of the Organisation or at other workplaces from that studied. It is, of course, also first necessary to know where to look and this may be guided by trends in incident reporting, the open reporting of occurrences or, for example, by the findings of a Periodic Safety Survey.

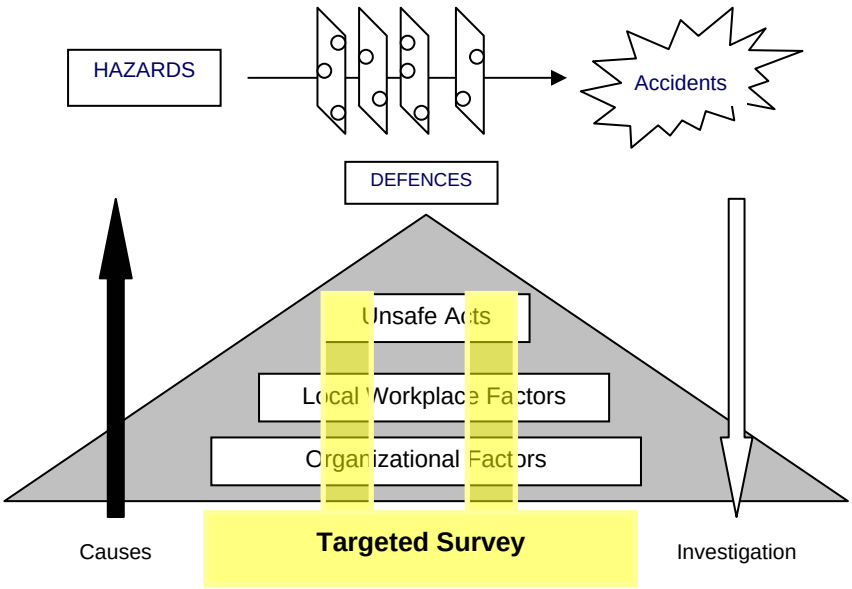


Figure 9 – Targeted Safety Surveys

3.1.3.4 Unsafe Acts

3.1.3.4.1 At the 'sharp-end', the consequences of Organisational Factors being communicated into Local Workplace Factors can promote the occurrence of Unsafe Acts. Such acts can manifest themselves as the final stage in the creation of an accident. Examples could be uncorrected read-back errors, misplaced label displays, incorrectly marked flight strips etc. However, the vast majority of such acts are counteracted by other defences or are 'self-corrected' such that they are rendered inconsequential.

3.1.3.4.2 Unless such acts lead to an incident report or coincidentally occur whilst a Periodic or Targeted Safety Survey is actually in progress, they will not be known about. Significantly, given the relatively low occurrence rate of incidents in the ATM domain, it is difficult to gather statistically-significant safety information from the study of incidents alone.

3.1.3.4.3 A Safety Survey type which can be used effectively in this area is the Continuous Safety Survey. This is a form of observation-based survey in which either an observer monitors routine ATC or Engineering activity in order to record events for later analysis, or individual controllers and technicians are required, on a routine basis, to complete survey forms at the conclusion of activity periods.

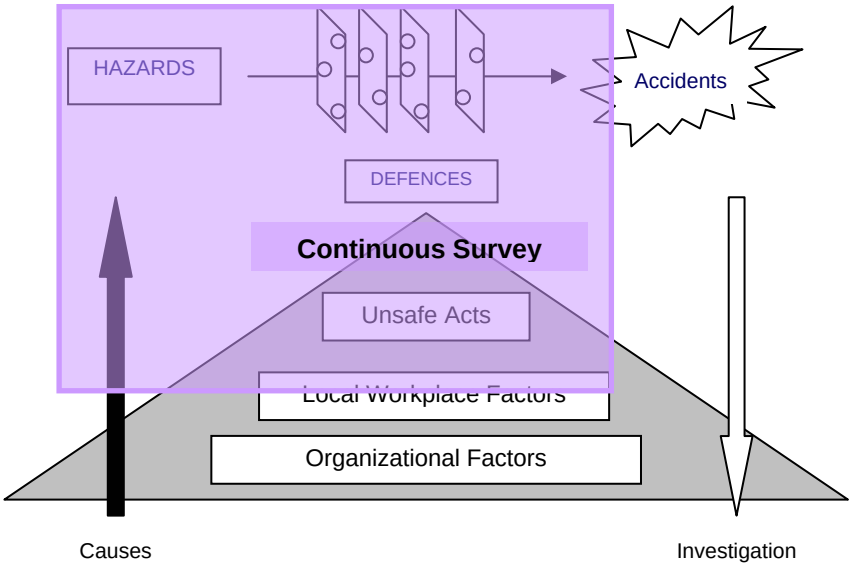


Figure 10 – Continuous Safety Surveys

3.1.3.4.4 Continuous Surveys, as illustrated at Figure 10, are 'wide and shallow' in that they record events such as threats and errors at the workplace which can help in targeting safety improvement activity. Such surveys often use some form of model of safety threats or a taxonomy of key safety performance attributes. They provide a very good means of surveying the safety 'health' of an ATM organisation at the point of delivery. They are also very useful in

measuring the effectiveness of defences and barriers in overcoming the effects of potentially unsafe acts and can provide useful guidance in shaping the further development of safe operating practices.

3.1.3.4.5 A continuous Survey method to be known as Normal Operations Safety Survey (NOSS) is being developed for ATM use by ICAO. When this development work is complete, it is anticipated that NOSS will provide a rigorous and approved observation-based survey methodology for ANSPs.

3.1.3.5 Comprehensive Survey Coverage

3.1.3.5.1 The best chance of minimizing the ATM contribution to organizational accidents or incidents is to investigate beyond the unsafe acts by considering all the accident causal factors. This philosophy must be adopted for both reactive and proactive means of assuring system safety and, in order to be effective, ATM Safety Surveys must therefore address unsafe acts, workplace and organizational causal factors.

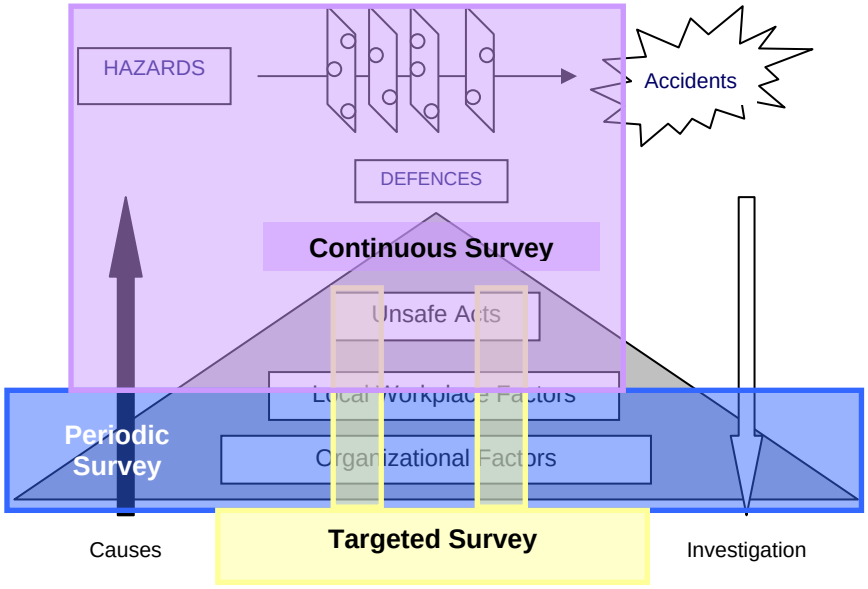


Figure 11 – Comprehensive Survey Coverage

3.1.3.5.2 Figure 11 shows full coverage of the Accident Causation factors (Organizational, Workplace and Unsafe Acts) by the different types of Safety Survey (Periodic, Targeted and Continuous) identified by the Safety Survey best practice investigation.

3.1.3.5.3 Using this taxonomy of survey types, a general Safety Survey Model (SSM), shown in Figure 12, has been derived for validating and verifying the continuing safety assurance provided by the management and operation of an ANSP.

3.1.3.5.4 The SSM in Figure 12 shows the three survey types and their interactions along with their interaction with the Safety Monitoring process. It can be seen that the different survey types inform each other so, for example, a Periodic Survey may reveal findings that require an additional Targeted Survey to be undertaken to address a specific safety issue. Conversely, a Targeted Survey may reveal that safety managers need to include certain additional attributes into their Periodic Surveys to ensure that safety is maintained continuously.

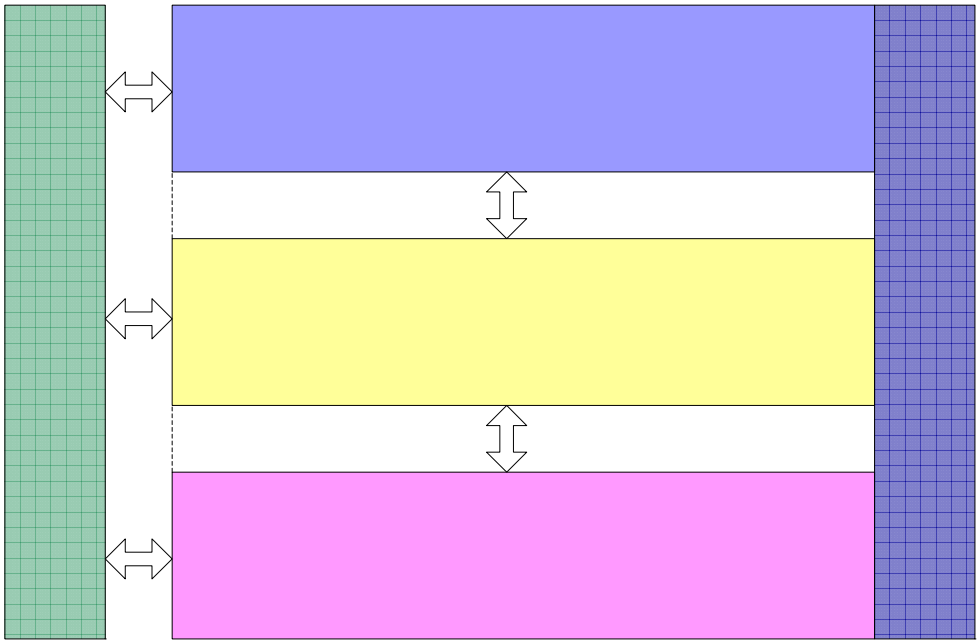


Figure 12 - Safety Survey Model (SSM)

3.1.3.5.5 Figure 12 also shows that the three survey types are undertaken by using different survey methods which in turn are dependent upon specific survey techniques.

3.1.3.5.6 The diagram at Figure 13 reinforces the principle that Safety Survey should be a proactive Safety Assurance process and should be applied to both operational and technical aspects of ANSP activity.

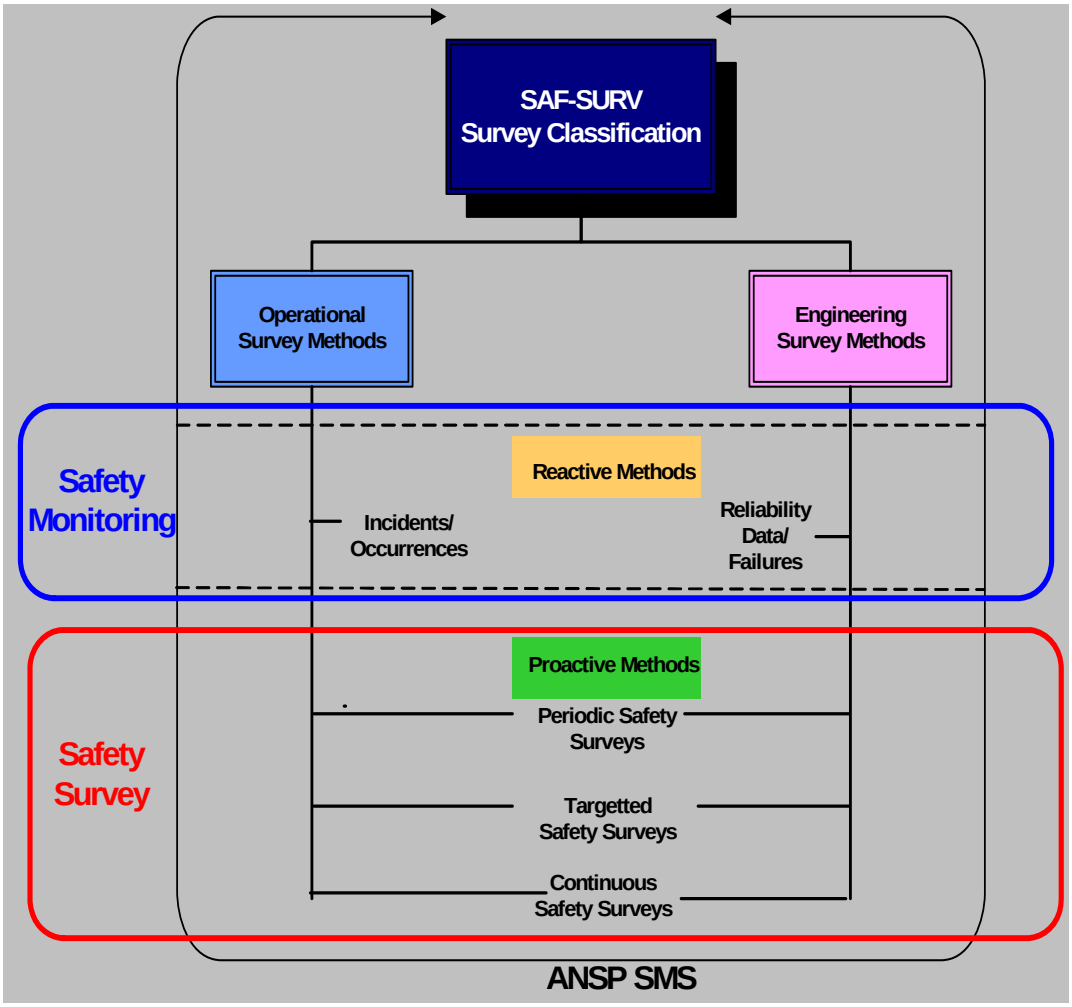


Figure 13 – The Place Of Safety Survey Within the Safety Assurance Process

3.2 ANSP Safety Surveys Must Be Planned And Conducted Systematically

3.2.1 The Need for a Systematic Safety Survey Process

3.2.1.1 The foregoing has shown that, in order to be sufficiently comprehensive, ANSP Safety Surveys should be based around the use of a combination of three Safety Survey types: Periodic, Targeted and Continuous, each of which has merits which are appropriate to different combinations of accident causation factors. Comprehensiveness, though important, is not enough. In order to be effective, ANSP Safety Surveys need to be methodological and must be conducted in accordance with a clear plan, rather than being sporadic or randomly organised.

CHAPTER 4
BASIC SAFETY SURVEY METHODOLOGY

4.1 Survey Types, Methods and Techniques

4.1.1 Although we have so far categorised Safety Surveys into the three broad types: Periodic, Targeted and Continuous, it is necessary to differentiate between the more detailed methods and techniques which are included in the reference material. The hierarchical relationship between survey types, methods and techniques is explained as follows.

4.1.2 The hierarchical relationship and differentiation between survey types, methods and techniques is summarised as:

Survey Type → Survey Method(s) → Survey Technique(s)

> More detailed discussion on methods and techniques is inappropriate to this Level 1 General Principles document and is therefore to be found in the Level 2 Guidance material.

4.1.3 In general terms, however, ANSPs should normally use qualitative techniques for data collection and quantitative techniques for data analysis. Methods and techniques should be chosen to suit specific data collection or analysis requirements and practicalities. However, as a general guide, Table 1 shows the broad range of Safety Survey methods and data collection techniques appropriate to each of the survey types from which ANSPs can select the most suitable according to their size, culture and other local requirements.

<table>
<tr><th colspan="4">SAFETY SURVEY</th></tr>
<tr><th rowspan="2">Types</th><th rowspan="2">Methods</th><th colspan="3">Techniques</th></tr>
<tr><th>Data Collection</th><th>Data Analysis</th><th>Dissemination Of Findings & Recommendations</th></tr>
<tr><td>Periodic</td><td>Inspection</td><td>Checklist-guided physical observation.
Staff Interviews</td><td rowspan="5">Expert Identification of potential/actual safety shortfalls and Safety Best Practice

Reviewing collated documents and expert analysis of adequacy/coverage.

Management/Peer review and analysis of documentation

BrainstormingStatistical Analysis of trends and norms

Baselining of trends over time</td><td rowspan="5">Report with findings and associated recommendations for management

Safety Awareness material leaflets/CDs/ posters/intranet

Safety briefings/presentations (physical/video/web-based)</td></tr>
<tr><td></td><td>Safety Review</td><td>Collection of Safety Management documentation mandated by procedure</td></tr>
<tr><td>Targeted</td><td>Bespoke Study</td><td>Physical observation
Additional and temporary Mandatory Reporting
Checklist-guided verbal questioning
Staff Interviews</td></tr>
<tr><td></td><td>Staff Survey</td><td>Written questionnaire
Staff interviews</td></tr>
<tr><td>Continuous</td><td>Over The Shoulder Observation</td><td>Performance Evaluation (using an assessment Proforma)</td></tr>
<tr><td></td><td></td><td>Self-Assessment Proforma</td><td>Post Activity Safety Assessment Proforma</td><td></td></tr>
</table>

Table 1 - Broad Categorisation of Safety Survey Types Methods and Techniques

4.2 SURVEY PROCESS

4.2.1.1 A generic Safety Survey process for ANSPs is shown at Figure 14. There are three basic top-level processes namely: survey inputs, survey design and survey outputs.

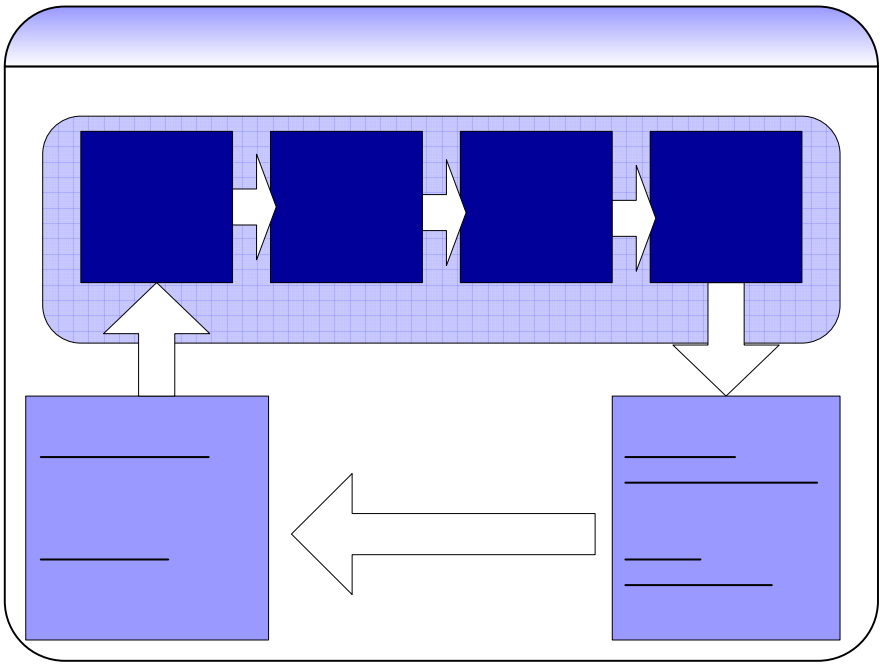
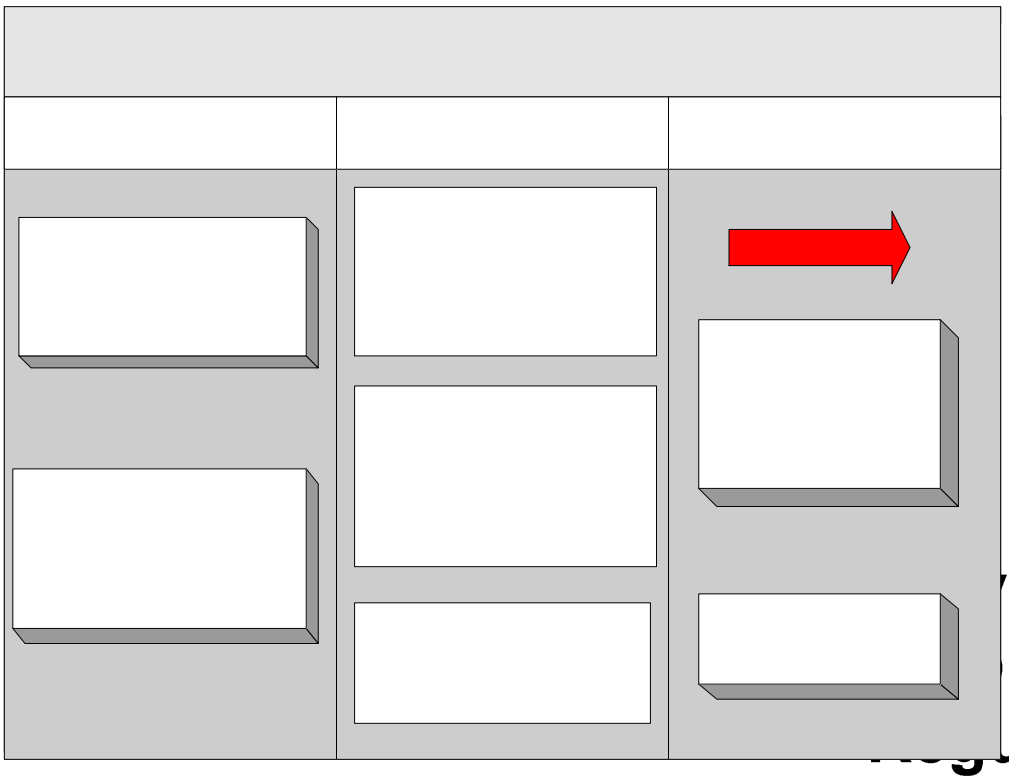


Figure 14 – Safety Survey Process

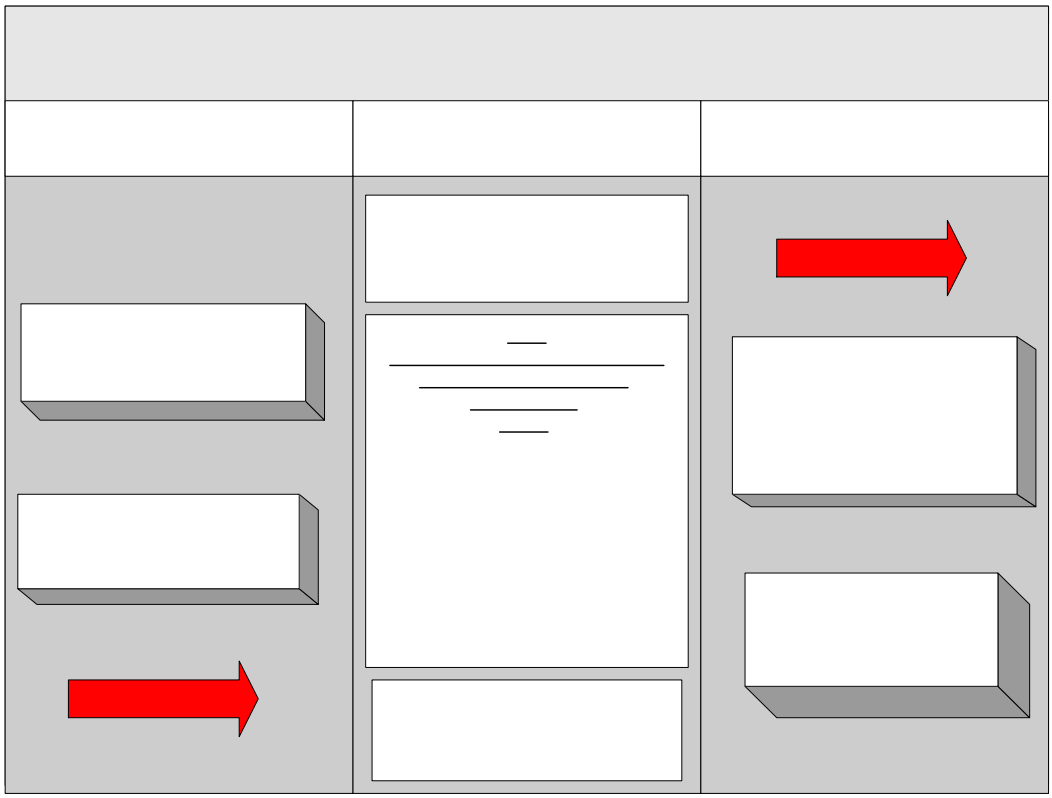
4.2.1.2 A step by step guide to the basic Safety Survey Methodology is provided in tabular form at Table 2 at the end of this Volume. This is intended to summarise, at a high level, the steps which need to be taken in order to develop and run a comprehensive and effective Safety Survey regime.

4.2.1.3 The detailed steps themselves are explained fully for Safety Survey practitioners in Volume 2 of these Guidelines. Each step of the basic process is also summarised briefly and illustrated in the following paragraphs.



4.3 SURVEY INPUTS

4.3.1 Whereas Survey initiators are the stimulus or initiators of a Safety Survey regime, Survey inputs are generally different depending upon the survey type selected. For example, a Targeted Survey could be initiated by a specific outcome from an SMS safety monitoring process while a Periodic Safety Survey would normally be initiated as part of a rolling annual programme of such surveys.



4.4 SURVEY DESIGN

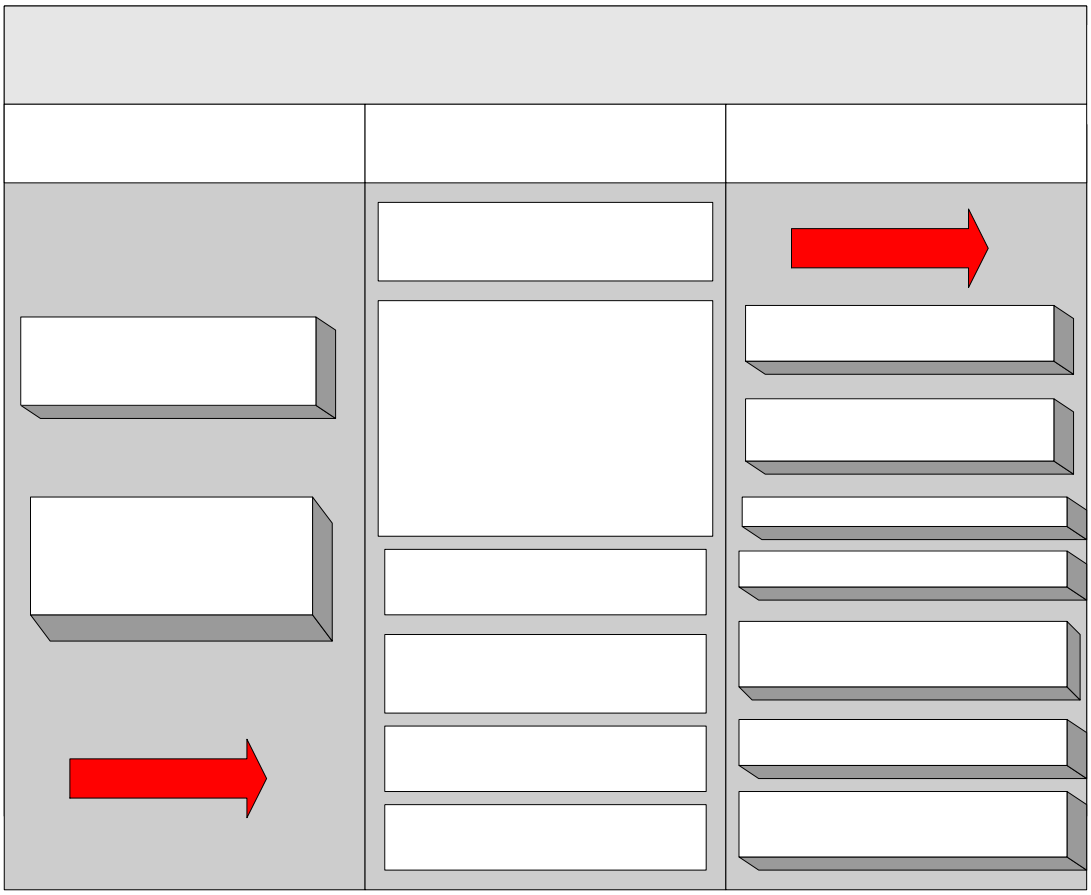
4.4.1 Figure 14 also depicts the individual steps involved in Survey Design which are: Planning, Data Collection, Data Analysis and Derivation of Findings. Each individual survey design stage can use different survey methods and techniques depending on the survey type and the specific survey aim. Each stage of the safety survey process is described further in Volume 2 of these guidelines

4.4.2 However, it is important at this stage to gain a general appreciation of the process used by surveyors during the data collection, data analysis, and derivation of survey findings in particular. A summary of each survey design stage follows.

INPUT

4.5 SURVEY PLANNING

4.5.1 The survey planning stage involves normal planning activities such as identification of survey tasks and resources, and scheduling to ensure that the survey aims and objectives are achieved. Numerous planning methods and techniques can be adopted depending upon the organisation. ATM and other organisations frequently use relatively simple computerised planning tools from the Microsoft Office suite.

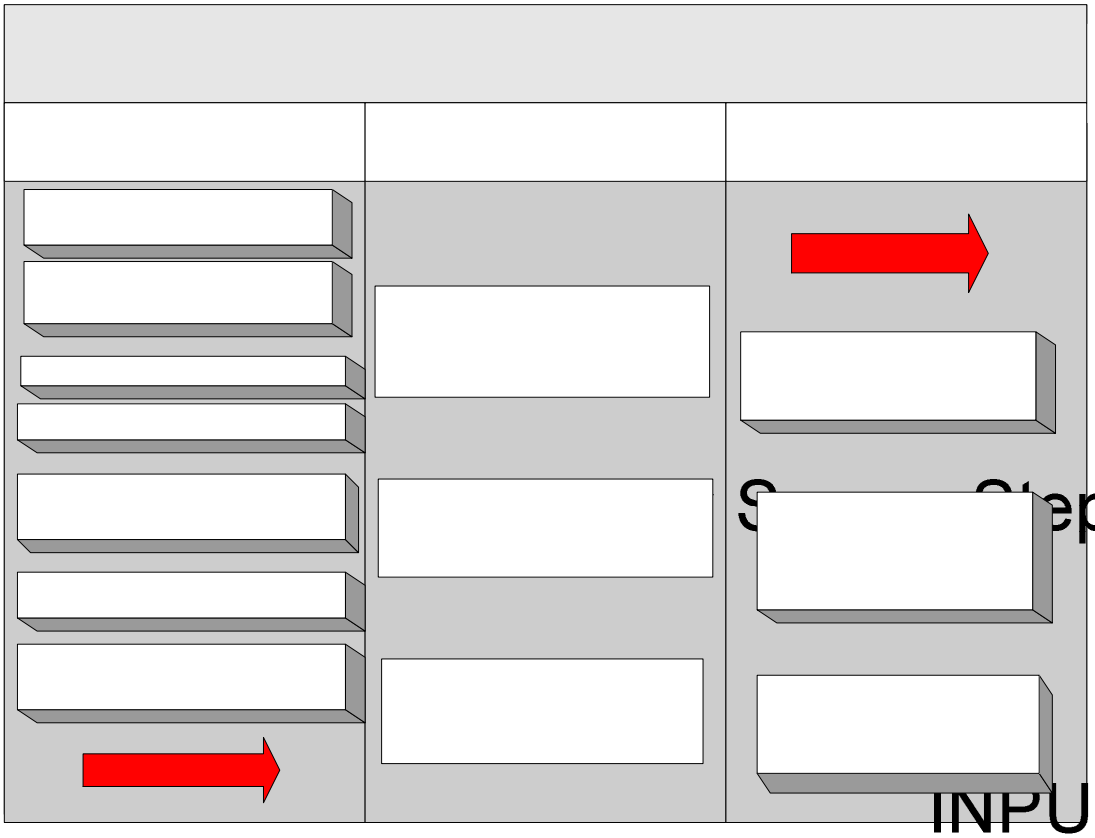


4.6 DATA COLLECTION

4.6.1 Data collection is the stage when the specific qualitative or quantitative data are collected by the surveyor from the organization, department or individual subject to survey. Many different techniques and supporting tools can be used for survey data collection dependent upon the surveyor's preferences and familiarity with the specific technique or tool. These are detailed in the reference material at Volume 2

Safety Survey Step - SU

INPUT



4.7 DATA ANALYSIS

4.7.1 Data Analysis is the stage where the specific qualitative or quantitative data are analysed by the surveyor and initial findings are suggested. Again, the investigation has shown that many different techniques and supporting tools are used for survey data analysis and no consistency in choice was identified.

4.7.2 Analysis of qualitative data is not simple, and although it does not require the often complicated statistical techniques of quantitative analysis, it is nonetheless difficult to handle the usually large amounts of data in a thorough, systematic and relevant manner. Marshall and Rossman offer this excellent description:

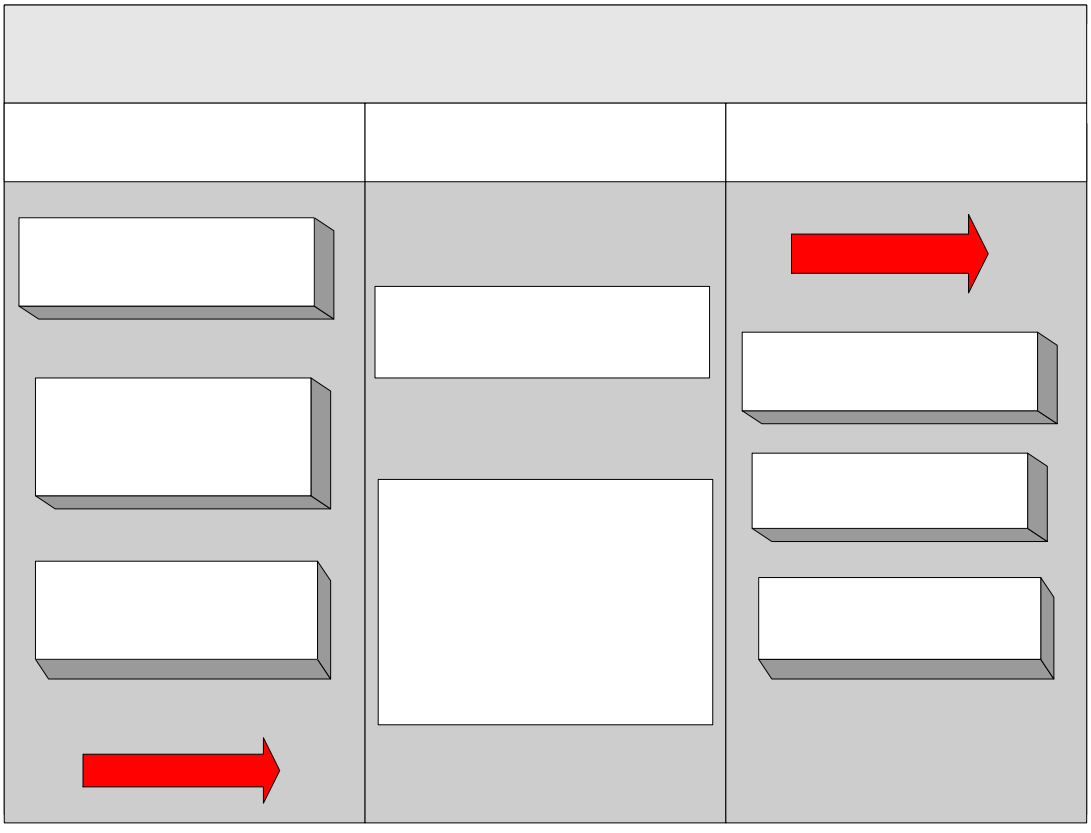
> *"Data analysis is the process of bringing order, structure and meaning to the mass of collected data. It is a messy, ambiguous, time-consuming, creative, and fascinating process. It does not proceed in a linear fashion; it is not neat. Qualitative data analysis is a search for general statements about relationships among categories of data."*[10]

Detailed timetable for
Safety Survey Activities
Specific Objectives for ea
Safety Survey
Trained Safety Surveyo
PSS Inspection Checklis
CSS Taxonomies/self-
assessment Proforma

[10] Marshall and Rossman, 1990:111

4.7.3 The purpose of analysing data is to obtain usable and useful information from which conclusions and recommendations can be drawn. Irrespective of whether the data is qualitative or quantitative, data analysis will:

- Describe and summarise the data;
- identify relationships between variables;
- compare variables;
- identify the difference between variables;
- forecast outcomes.

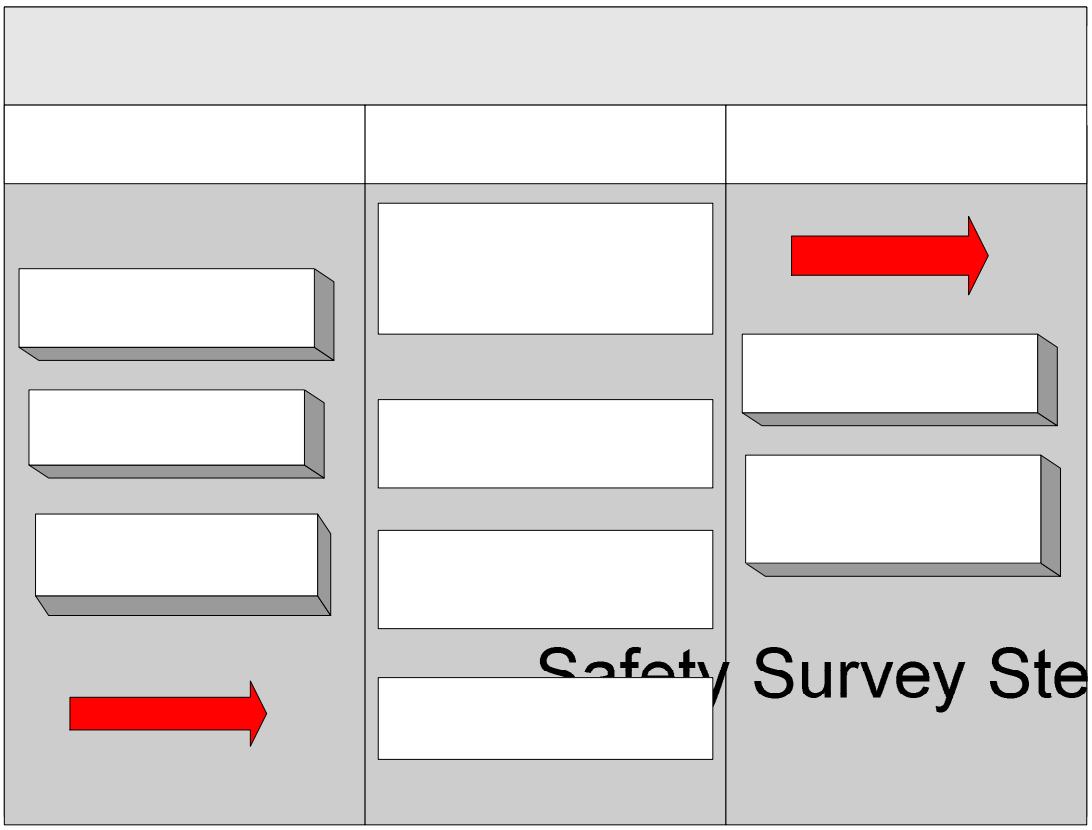


4.7.4 The general principle adopted within these guidelines is that processes involving complex statistical analysis are neither necessary nor desirable for the majority of ANSP survey activities. This is because Safety Survey is an internal activity which must generally be carried out within the experience and competence of ATM service providers. Accordingly, Volume 2 of these guidelines provides information on simple means to analyse data from Safety Surveys which are intended to be of basic practical use to ANSP staff.

4.8 DERIVATION OF FINDINGS

4.8.1 The last stage of surveying is to derive the survey findings from the available survey data. Various automated and manual tools and techniques can be

used to derive findings, particularly from quantitative data, or they might simply be derived inductively from the data by the surveyor.



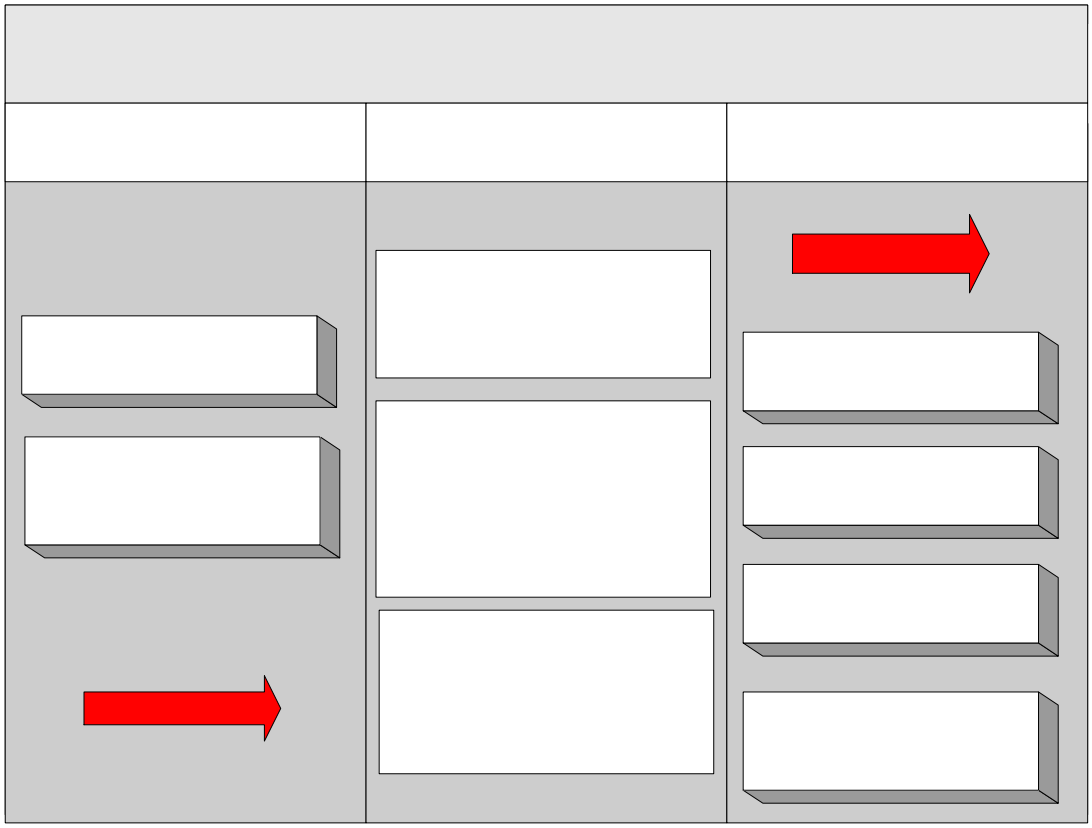
4.8.2 Each stage of the Safety Survey process is equally important to the success of the individual survey and the overall SMS Survey process. Different methods and techniques can be used for the different survey stages as appropriate. Guidance will be given on the selection and use of the different survey methods and techniques and this general guidance will be related to each of the survey sub-process shown in Figure 14.

4.9 SURVEY OUTPUTS

4.9.1 Survey Outputs are the conclusions and recommendations from the survey findings that must be disseminated throughout the organization. This is actually the most important stage in the overall process but, regrettably, is often the stage which is conducted in the least structured manner and can result in valuable safety improvements being overlooked or delayed. Various means of dissemination are available and the most suitable must be used to ensure that the principle of continuous improvement is implemented and that, where appropriate, safety is adequately promoted throughout the organization.

4.9.2 Recommendations from each of the 3 main survey types which together constitute a comprehensive ESARR 3 Safety Survey regime should additionally be forwarded to those with the power and responsibility to implement safety improvements in the form of a simple Safety Survey Action Report which may be attached to the more detailed survey report itself. A suggested format for such an action report which may be used with PSS, CSS and TSS is provided as a template in Volume 2

4.9.3 Such Action Reports should be retained on file as an audit trail which shows the Provider's progression of remedial action and continuous safety improvement. These records may be examined during Safety Regulatory Audits.



4.9.4 Moreover, the collated results of the ATM service providers Safety Survey activities should normally be forwarded to senior management in the form of an Annual Safety Survey report. Such reports should be tailored to the specific needs of each organisation but, as a guide, should cover the following areas:

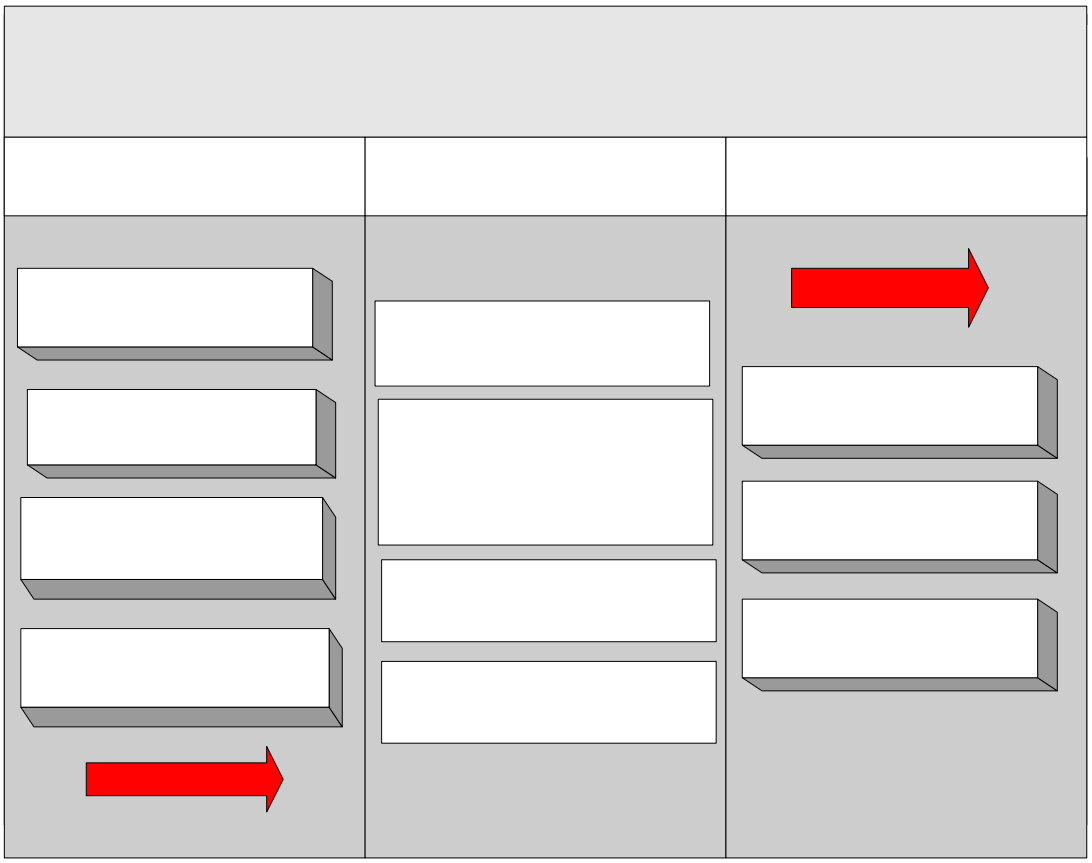
- Safety Survey Activity Since Previous Annual Report
- Summary of Safety Survey Findings
    - Safety Management System (SMS) Issues (including occurrence trends)
    - Organisational Issues
    - Procedural Issues
    - Personnel & Training Issues
    - Equipment Issues
    - Other Relevant Issues

- Conclusion
- Summary Of Safety Survey Recommendations

4.9.5 A suggested format for such reports is also provided as a template at Volume 2.

4.10 FEEDBACK

4.10.1 The outcome from each type of Safety Survey can be fed back into the system in such a way that it may provide a trigger for special attention to be paid to particular aspects of ATM operations or maintenance within another survey activity. Figure 14 shows that survey lessons learned must be fed into the evaluation of survey initiators (producing a closed-loop system) which informs the initiation of future surveys. The output from Safety Surveys can also be used as part of the Safety Assurance process to inform and update the relevant Safety Cases and their associated Hazard Logs



4.10.2 .Each stage of the Safety Survey process is equally important to the success of the individual survey and the overall SMS Survey process. A number of different techniques are offered in the reference material at Volume 2 and this properly reflects the scalability of the Safety Survey process which must be adaptable to both large and small ANSP organisations, and to different cultures.

CHAPTER 5
CONCLUSION

5.1 Conclusion

5.1.1 This Safety Survey reference material outlines principles requiring that ANSPs should be proactive in conducting internal Safety Surveys which are comprehensive enough to be able to address each of the main categories of accident causation, namely: Organisational Factors, Local Workplace Factors and Unsafe Acts together with effective safety barriers, by using an appropriate combination of survey methods.

5.1.2 The Safety Assurance regime therefore needs to incorporate a Safety Survey regime made up of a combination of 3 Safety Survey types:

a) Periodic Safety Surveys.

b) Targeted Safety Surveys.

c) Continuous Safety Surveys.

5.1.3 In order to provide the required degree of assurance, ANSPs need to demonstrate that their Safety Survey arrangements have been planned, designed and conducted in accordance with a comprehensive and logical process which includes an effective means of disseminating and following-up results. A step by step illustration of a Basic Safety Survey Methodolgy is outlined at Table 2

5.1.4 Within these General Principles, ANSPs should select from the reference material provided at Volume 2, the Safety Survey methods and techniques which are most appropriate to their size, culture and other local requirements.

	SAFETY SURVEY STEP	OBJECTIVES	INPUT	PROCESS	OUTPUT
SURVEY INPUTS	**Survey Initiation**	• To initiate and shape the overall Safety Survey regime.	• Regulatory (ESARR 3) Requirement for a comprehensive & systematic process of Safety Survey. • Specific Triggers from Safety Monitoring, Incident trends, other Safety Surveys etc which shape survey scope and timescales.	• Gather the ESARR3 and Safety Survey Guideline documentation, together with more specific trigger information. • Develop an overall Safety Survey regime which is specifically focussed on identifying and recording the key safety factors - Organisational factors;Local Workplace Factors;Unsafe Acts and Effective Defences. • Decide the high level survey objectives and relative balance between each of the Safety Survey Types, PSS, CSS and TSS in conducting the annual safety survey programme.	• Annual Safety Survey plan which identifies high level objectives and shows how they are to be met using the 3 survey types. • Initial timetable for Safety Survey Activities.
	Individual Survey Inputs	• To initiate and shape each individual Safety Survey activity.	• Annual Safety Survey plan which identifies high level objectives and shows how they are to be met using the 3 survey types. • Initial timetable for Safety Survey Activities.	• Gather more detailed background information which can be used to plan individual Safety Survey activities: • Organisation & Procedures. Operating/Maintenance Procedures; Operational/organisational trends; Airspace charts, Approach Plates, Airfield Diagrams. • Personnel & Training. Manning Lists; Watch Rosters; Training/Qualification records, . • Equipment. Technical Manuals; Equipment Manuals; Performance /Coverage diagrams. • SMS. Specific outputs from Safety Monitoring (Incident/accident trends); External accident/incident trends; Safety Case information (Hazard Log); Outputs from Regulatory & QA Audits; Outputs from past Safety Survey activity. • Identify key areas of significance to be addressed by Safety Survey.	• Summary of Organisational, Procedural, Personnel, Training, Equipment and SMS background information which can be used for detailed planning of Safety Survey. • List of key areas (functions, departments, individuals etc) to be addressed by Safety Survey.
SURVEY DESIGN	**Survey Planning**	• To schedule and resource each Individual Safety Survey activity.	• Summary of Organisational, Procedural, Personnel, Training, Equipment and SMS background information which can be used for detailed planning of Safety Survey. • List of key areas (functions, departments, individuals etc) to be addressed by Safety Survey.	• Review the gathered background planning information. • Decide and record: • What is to be surveyed? (Prioritise departments/functions/individuals into Essential/Desireable) • Who is to survey it? (manpower & training requirements) • When is it to be surveyed? (Detailed Scheduling) • How is the survey to be conducted? (Select PSS, CSS, TSS Methods & Techniques) • How are the survey results to be analysed and used ? (Qualitative vs Quantitative - decide how Safety Survey data is to be collated & stored) • Produce detailed timetable for Safety Survey Activities • Develop and/or modify specific Safety Survey Checklists, Taxonomies, Proformas, • Arrange appropriate training for Safety Surveyors. • Develop appropriate filing system/database.	• Detailed timetable for Safety Survey Activities. • Specific Objectives for each Safety Survey • Trained Safety Surveyors • PSS Inspection Checklists • CSS Taxonomies/self-assessment Proformae • Safety Survey Questionnaires • Safety Survey data storage system
	Survey Data Collection	• To collect Safety Survey Data for subsequent analysis and action.	• Detailed timetable for Safety Survey Activities. • Specific Objectives for each Safety Survey • Trained Safety Surveyors • CSS Taxonomies/self-assessment Proformae • Safety Survey Questionnaires • Safety Survey data storage system	• Conduct PSS by Inspection and/or Review Method., • Conduct CSS by Observation or Self-assessment Method • Conduct TSS by Bespoke Study or Attitude Survey Method.	• Completed PSS inspection/review checklists. • Completed CSS Observation Sheets/proformas. • Completed TSS Study observation report/questionnaires.
	Survey Data Analysis	• To analyse the Safety Survey data collected in order to give meaning.	• Completed PSS inspection/review checklists. • Completed CSS Observation Sheets/proformas. • Completed TSS Study observation report/questionnaires.	• Gather the collected Safety Survey data • Analyse (brainstorm?) the data in order to: • Categorise the data in terms of safety significance. • Draw actionable conclusions from the data gathered.	• Completed CSS Analysis sheets • Summary of categorised data. • List of Safety Survey conclusions
	Derivation Of Survey Findings	• To derive findings from the data upon which appropriate recommendations can be made.	• Completed CSS Analysis sheets • Summary of categorised data. • List of Safety Survey conclusions	• Identify emerging safety trends Unsafe Acts, Local Workplace Factors, Organisational Factors and Effective Defences • Identify areas for continuous improvement. • Develop prioritised recommendations for management action. • Identify material for inclusion in Safety Promotion activity.	• Prioritised list of Safety Survey Recommendations. • Prioritised list of material which can be used for safety Promotion.
SURVEY OOUTPUT	**Dissemination Of Survey Findings**	• To disseminate Safety Survey findings and recommendations for action	• Prioritised list of Safety Survey Recommendations. • Prioritised list of material which can be used for safety Promotion.	• Generate Safety Survey Action Reports and distribute to those who have the authority and responsibility to implement recommendations. • Compile Annual Safety Survey Report which summarises conclusions and any outstanding recommendations drawn from safety survey programme and forward to senior management for action. • Incorporate Findings into Safety Promotional material which can be used for internal (and possibly external) Safety Awareness programmes	• Individual Safety Survey Reports • Safety Survey Action Report • Annual Safety Survey Report • Material for Internal (and external) safety awareness programmes.
	Survey Feedback	• To feed the outcome of Safety Survey activity back into the SMS and influence future SM activity (including future surveys)	• Completed CSS Analysis sheets • Summary of categorised data. • List of Safety Survey conclusions • Prioritised list of Safety Survey Recommendations.	• Gather the collected safety survey data and findings • Incorporate information on changed risk, new hazards, and the effectiveness of defences into appropriate Safety Cases and Hazard Logs. • Retain data for use in initiating and planning future Safety Survey activities • Retain data for inspection by Safety Regulatory Auditors.	• Updated Safety Cases & Hazard Logs. • Triggers for future Safety Survey activity. • Evidence for Regulatory Audit purposes.

Table 2 – Step-By-Step Illustration Of The Basic Safety Survey Methodology

References

Safety Surveys in ATM – A Review Of Best Practice, (DAP-SAF/IANS) Issue 1 dated 28 January 2005.

SAF.ET.ST01.1000-POL-01-00, EATM Safety Policy,.

SRC POLICY DOC 3, National ATM Safety Regulatory Framework, Ed 1.0, 27 February 2002

EUROCONTROL Safety Regulatory Requirement - ESARR 1 Safety Oversight in ATM.

EUROCONTROL Safety Regulatory Requirement - ESARR 3 Use of Safety Management Systems by ATM Service Providers.

EAM 3/GUI 1 Explanatory Material on ESARR 3 Requirements.

EAM 3/GUI 2 - Safety Regulatory Aspects of The ESARR 3 Implementation In Small Organisations

EAM 3 / GUI 3 - ESARR 3 and Related Safety Oversight

EAM 3/GUI 4 - Mapping between ISO 9001:2000 and ESARR 3

EUROCONTROL Auditor Training Programme Student Notes, February 2003.

Reason, J.: 'Managing the risks of organisational accidents' (Ashgate, London, 1997)'

Cox, S. Jones, B. (Lancaster University) and Rycraft, H. (BNFL) ‘Behavioural Approaches to Safety Management within Reactor Plants.’ Elsevier Ltd. Safety Science 42 (2004) 825-839

Klinect, J R., Wilhelm, J A. and Helmreich, R L. (University of Texas Team Research Project) ‘Threat and Error Management: Data from Line Operations Safety Audits. In Proceedings of the Tenth International Symposium on Aviation Psychology (pp 683-688). Columbus, OH: The Ohio State University (1999)

Auditing the ISO 19011 Way, British Standards Institution, 2003

Leedy, P. D, ‘Practical Research Planning and Design’, 5th Ed., New York, Macmillan Publishing, 1993.

GLOSSARY AND LIST OF KEY ABBREVIATIONS{ TC “glossary” \l1 }

ACM	Accident Causation Model	
ANSP	Air Navigation Service Provider	
ATC	Air Traffic Control	
ATCO	Air Traffic Control Officer	
ATM	Air Traffic Management	
EATM	European ATM	
ECAC	European Civil Aviation Conference	
ESARR	EUROCONTROL Safety Regulatory Requirement	
ICAO	International Civil Aviation Organisation	
Inspection	The physical examination of arrangements for the conduct and support of ATM including scrutiny of arrangements for the management of safety and which may also include the verbal and/or written questioning of staff.	Original
Observation	The accurate watching and recording of activity relating to ATM safety as it occurs, particularly with regard to cause and effect	Original
QA	Quality Assurance	
QMS	Quality Management System	
Safety	Freedom from unacceptable risk of harm.	ESARR 3

Safety Assurance	All planned and systematic actions necessary to provide adequate confidence that a product, a service, an organisation or a system achieves acceptable or tolerable safety	ESARR 3
Safety Monitoring	A systematic action conducted to detect changes affecting the ATM System with the specific objective of identifying that acceptable or tolerable safety can be met .	ESARR 3
Safety Regulatory Audit	A systematic and independent examination conducted by the ATM safety regulator to determine whether processes and related results comply with required arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.	EAM 3 / GUI 2
Safety Review	The retrospective examination of general and/or specific arrangements for the safe conduct and support of ATM including detailed scrutiny of documented SM activity.	Original
Safety Survey	A systematic review, to recommend improvements where needed, to provide assurance of the safety of current activities, and to confirm conformance with applicable parts of the Safety Management System.	ESARR 3
Self-Assessment	The estimation of the extent and/or quality of factors which influence ATM safety positively or negatively, by individuals responsible for providing an ATM service or associated support.	Original
SISG	Safety Improvement Sub-Group	

SM	Safety Management	
SMM	Safety Management Manual	
SMS	Safety Management System	
SRC	Safety Regulatory Commission	
SSAP	Strategic Safety Action Plan	
Staff Survey	The systematic gathering of information, verbally or in writing, from internal staff and/or personnel from external organisations relating to specific aspects of ATM safety.	Original
Study	The dedication of investigative effort to acquiring information and knowledge of specific ATM arrangements together with the development of conclusions and, where appropriate, recommendations for further action	Original
System	A combination of physical components, procedures and human resources organised to perform a function.	ESARR 3