

**SAFETY AND QUALITY
RELATIONSHIP
GUIDELINES**

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Abstract

The document provides guidelines for identifying quality management approaches, methods and procedures that could support the planning, development, implementation and improvement of a Safety Management System.

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EXECUTIVE SUMMARY

“Most people would have forgotten about Quality at this point, or just left it hanging suspended because they were getting nowhere and had other things to do.”

“A real understanding of Quality captures the System, tames it, and puts it to work for one's own personal use, while leaving one completely free to fulfil his inner destiny”

From *“Zen and the Art of Motorcycle Maintenance”*, Robert M. Pirsig

The “Safety and Quality Relationship Guidelines” identify the relationship between the terms safety and quality either from Quality Management System (QMS) point of view or in relation to the ATM.

The document recognises that Safety and Quality Management are both managerial tools with proactive and reactive elements embedded in performance and capability oriented processes.

Quality elements could help Safety achievement by a Total, Knowledge-based Approach, through Management Involvement driving Policy and Strategy, defining Processes, ensuring the Resources and strengthening the Safety Culture, Continuous Learning and Improvement.

European Foundation for Quality Management (EFQM) Excellence Model and ISO 9001:2000 are identified as key quality standards that could improve the Safety Management approach.

Three different methods for organising quality management system support to safety management are identified: Separate approach; Collaboration approach; Inclusion approach.

These three organisational variants do not represent an exhaustive list of possibilities. They just outline some already existing solutions in the space of all possible combinations.

Chapter 1

Introduction

1.1 *Purpose*

The purposes of these guidelines are:

- To highlight the mutual relationship between quality and safety and to underline the conventions regarding the usage of these terms in the context of a Safety Management Programme;
- To identify the quality management approaches, elements and procedures that could support the planning, development, implementation and improvement of a Safety Management System;
- To outline some possible methods for organising quality management system support to safety management system.

1.2 Scope

These guidelines refer to existing quality management approaches, procedures and practices, that could enhance the safety management approach.

This document does not recommend any specific organisational structure that could be referred to implement Safety Management and Quality Management Systems.

1.3 Structure of the Document

The structure of the document follows the objectives to reach as follows:

- Mutual relationship between the terms quality and safety;
- Commonalties between Safety and Quality Management;
- What we could learn from Quality Management and Quality Standards;
- Quality Management System as a support to Safety Management System.

Annexes A to D complement this guidance material.

Chapter 2

The Terms Quality and Safety

2.1 *The term Quality*

The International Standards Organisation (ISO 8402:1994) defines **Quality** as,

The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs.

In the quality field, **needs** are usually translated into **characteristics** with specified criteria.

Needs may include, for example, aspects of **performance, usability, dependability (availability, reliability, maintainability), safety, environment, economics and aesthetics.**

2.2 Safety as an Attribute of Quality

Safety as an attribute of the quality of a system describes the ability of this system to function without harm or damage to property or to the environment.

As an attribute of Quality, the term **Safety** in the ISO quality concept (ISO 8402:1994) is defined as:

State in which the risk of harm (to persons) or damage is limited to an acceptable level.

Safety as an attribute of the quality of a service or product describes the ability of this service or product to be provided or to function without unacceptable risk of harm or damage to property or to the environment.

2.3 Safety As The Main Attribute Of Air Navigation Services

Safety, as the main attribute of Air Navigation Services, is related to the risk of Air Navigation Services' contribution to aircraft accidents and incidents.

The Safety Objective of Air Navigation Services in the EATMP Safety Policy states:

While providing an expeditious service, the principal safety objective is to minimise the air navigation services' contribution to the risk of an aircraft accident as far as reasonably practicable.

The Major Safety Objective of the ATM STRATEGY FOR 2000+ states:

To improve safety levels by ensuring that the number of ATM induced accidents and serious or risk bearing incidents do not increase and, where possible decrease.

Safety, as the main attribute of Air Navigation Services, could therefore be defined as,

Freedom from unacceptable risk of aircraft accident and incident.

2.4 ***Risk-Based Approach***

The approaches towards safety, considering safety either as an attribute of quality or as the main attribute of Air Navigation Services, are risk-based approaches.

It is obvious that both approaches towards safety (quality assurance approach and safety management approach) are risk-based approaches.

Both definitions provide a framework in which safety is separated into two components: subjective and objective.

The subjective component is related to the judgement of risk acceptability.

The objective component is related to the application of risk analyses/assessment.

Chapter 3

Commonalties Between Safety and Quality Management Systems

The methods for accident prevention are similar to the methods for quality, cost and production control

As early as 1931, the safety pioneer H. W. Heinrich in his book "*Industrial Accident Prevention*" introduced 10 axioms of industrial safety: These axioms are given in Annex A.

Heinrich pointed out that the conditions that lead to accidents and injuries are in fact those that lead to excessive cost in production and poor quality. It can be find under Heinrich`s 7th axiom proposal to use similar methods for safety and quality management.

3.1 *Management tools*

Both Safety Management System and Quality Management System are managerial tools.

The four main elements of management are shown in Figure 1.

Both quality management and safety management systems require:

- ***Planning (Plan)*** – set policies, objectives and strategies which state what we aim to achieve through the quality and safety management systems. This also includes priorities, structure, job specifications, allocated responsibility and accountability for resources.
- ***Implementation (Do)*** - A Set of Procedures that describe the processes required to implement the quality management system and the processes required for achieving and ensuring safety. For QMS these include quality management system level procedures; procedures for the processes necessary to ensure product/service conformity; instructions that describe the operating practice and control of process activities.
- ***Monitoring (Check)*** - The organisation shall carry out objective audits in order to determine if the quality management system has been effectively implemented; Safety Monitoring and Safety Survey to provide assurance of the safety of activities and to detect safety related changes.
- ***Improvement (Act)*** - Corrective actions and continuous improvement, when appropriate.

Safety Management System aims to ensure the freedom of unacceptable risk in the provision of Air Navigation Services: it requires to identify hazards, to assess the associated risk and to implement risk mitigation means. It also provides assurance that this has been done.

Quality Management System aims to achieve customer satisfaction by meeting its requirements: it involves the identification of customer requirements, their satisfactory implementation by the prevention and correction of non conformities, and measurement of the achieved quality.

An example of the management process cycle applied for the risk management process is:

Plan – Establish hazard and risk classification schemes; Identify authorities responsible for reviewing and accepting identified risk; Define the precedence policy for the mitigation of identified risk; Ensure resources required.

Do – Identify hazards through safety assessment, occurrence investigation, survey, monitoring, lesson dissemination or reporting; Assess the risk associated with the hazard, Define the safety objectives, Allocate the necessary mitigation means,

Check –Monitor, measure and analyse the actual performance of the implemented risk mitigation means;

Act – Modify the risk mitigation means and/or improve the risk management process, if necessary.

3.2 *Performance and Capability*

Safety Management and Quality Management address both the Capability and Performance of the System.

- Capability refers to the ability to do something. The Capability dimension provides confidence in the Quality or Safety Management System itself;
- Performance refers to the outcome of the Quality or Safety Management System. The Performance dimension provide confidence in the achieved safety level or achieved quality level for the delivered service or product.

The system could be capable of doing something, but actual performance may be unacceptable.

Examples for the Quality Management capability side are:

- Quality Planning;

- Definition and documentation of the Policy for Quality ;
- Quality Management System as a mean to achieve Quality;
- Review to ensure Quality Management System continuing suitability and effectiveness;
- Quality Management System documentation – Quality Manual and Quality Procedures.

Examples for the Safety Management capability side are:

- Safety Planning;
- Safety Management System as a mean to achieve and maintain safety;
- Definition and documentation of Safety Policy ;
- Safety Organisation ;
- Safety Survey as a matter of routine to confirm conformance with applicable parts of Safety Management Systems;
- Safety Management System documentation – Safety Manual and Safety Procedures.

Examples for the Quality Management performance side are:

- Quality measurement ;
- Inspections and verifications of the product for conformance to the requirements.

Examples for the Safety Management performance side are:

- Quantitative safety levels;
- Safety surveys, to provide assurance to managers of the safety of activities ;
- Safety Monitoring.

3.3 *Proactive and Reactive*

Safety Management and Quality Management have both proactive and reactive elements.

In a broad sense SMS is proactive. EATMP Safety Policy Statement 3.1 Safety Management states:

The ECAC States participating in ETMP should adopt an explicit, proactive approach to safety management.

Even when safety occurrences are investigated it is for the purpose of preventing future similar events.

In a narrow sense, however, functions performed after the safety occurrence event are considered as corrective.

Safety management system proactive (preventive) functions are safety survey, safety monitoring, and system safety (risk) assessment. Lesson dissemination when is after safety survey, safety monitoring, system safety (risk) assessment is proactive function.

Quality management system proactive (preventive) functions are management review, internal audits, identification of potential nonconformity, causes, preventive action needed.

Safety management system reactive (corrective) function is safety occurrence investigation;

Quality management system reactive (corrective) functions are identification of nonconformity, customer complains, determination of the causes, evaluation of need of actions, implementation of actions.

3.4 ***Similar Implementation Approaches***

Safety Management and Quality Management have similar implementation approaches.

Safety and quality management have similar implementation approaches. They require:

- Strong top management support,
- Rigorous planning,
- Definition of high level policy, strategy and objectives,
- Traceable break down of this policy into particular procedures,
- Monitoring, measurement and corrective actions, when necessary.

Chapter 4

What Could We Learn From Quality Management Standards

4.1 Leadership

Leadership is the key factor for the success of a safety management program.

Safety management is part of the overall management of the organisation. As such the role of the top management is a key factor for success.

Top management should:

- Develop and facilitate the achievement of the safety policy;

- Specify objectives and establish a strategic plan for their achievement;
- Develop values required for the long term success and implement this via appropriate actions and behaviours;
- Ensure the availability of the required resources;
- Be personally involved in ensuring that the management systems are developed and implemented.

One practical questionnaire and supporting material for the top management involvement is described in Annex B.

4.2 Total Management

It is suggested ATM Safety Management to be based on a Total Safety Management Approach.

The BS 7850 Standard (Total Quality Management) defines Total Quality Management as:

"Management philosophy and company practices that aim to harness the human and material resources of an organisation in the most effective way to achieve the objectives of the organisation"

Total Quality Management is based on 10 fundamental concepts:

- Commitment,
- Customer Satisfaction,
- Quality Losses,
- Participation by All,
- Process Measurements,
- Continuous Improvements,
- Problem Identification,
- Alignment of Corporate Objectives and Individual Attitudes,
- Personal Accountability,

- Personnel Development.

Several policy statements and principles of the EATMP Safety Policy provide some adaptation of the fundamental concepts to safety. However, "People" aspects (e.g., "Participation by All" or "Personnel Development") of Total Quality Management could be used to enhance the safety management approach.

Annex C contains the ten steps to Quality Improvement from *Joseph M. Juran* in his famous "*Quality Control Handbook*" together with some other useful Quality management basics, which could find their application in Total Safety Management.

4.3 **Process Approach**

Management by a processes model could be applied in safety management.

"Process model" used for the management of quality could be applied also to safety management.

Safety Management is process, as well as all Safety Management Elements like Safety Planning, Safety Assurance, Safety Achievement, Safety Promotion and Safety improvement.

Process is defined as any activity or operation which receives inputs and converts them to outputs.

The general process model help to define the desired outputs of Safety Management or Safety Management Element, and what it takes to produce those outputs, by forcing orderly examination of the process elements.

Considering Safety Management as a process could help to streamline and focus this activity.

A Quality Management approach for Accident Investigation which include some process management elements is presented in Annex D.

The added value of the process approach to the Safety Management will be not only the streamlining but also identification and management of the interfaces between the elements.

Describing process as a chain of activities we can define how for example:

- Safety Occurrences Investigation will feed with the information the activities of Lesson Dissemination and Safety Improvement (training of the personal);

- What we have learned during safety assessment will help us for the Occurrences Investigation;
- To use data from investigation to reconsider Safety assessment:
- New potential causes of the hazard;
- New hazards;
- Reconsidered mishap severity;
- Reconsidered hazard possibility;
- Changing environment.

4.4 Knowledge Based Approach – Teamwork, Continuous Learning And Improvement

Knowledge based safety management encourages learning from the lessons and best practices, promotes teamwork and enhances safety culture. This is the fundamental for the process of continuous safety improvement.

To do our best in the future we have to learn from our past.

Learning is not only for the top decision makers – it is a broad system function called organisational learning.

What is important in the learning process is to transform passive knowledge into the active one. It means to translate knowledge into organisational behaviour. It is often found during the investigation that the problems were already known to somebody. One of the challenges of the organisational learning is to bring this knowledge to the “sharp end “of the operations.

To be successful the learning process must be built upon three important elements:

- Trust;
- Communication;
- Corporate responsibility.

Learning in the organisation is not enough to be only a posteriori – lessons from the past.

High-reliability organisation learn and increase safety awareness not only from the lessons – information for accidents, incidents and safety occurrences, but also from the best practices.

Best practice meetings, discussions and awareness help the process for continuous safety improvement and contribute to the safety culture.

Indeed, encouraging people to discuss, forward suggestions for safety improvement and recognising good organisational practice and behaviour points the right way towards the safety excellence. This approach is basic also for the strengthening the teamwork.

Recent researches point out that failures in teamwork and social conditions very often are amongst the contributing factors for the incidents. System approach for safety management translated into the language of teamwork is team resource management (TRM). TRM shows how teamwork is more than simple sum of the humans involved in the team.

4.5 **Resource Management**

Resource management shall provide in a timely manner the necessary conditions for the safety management by planing, assignment, competence assurance, training, qualification and awareness of human recourses, together with the provision of the enough information, infrastructure and appropriate working conditions.

Building and maintaining the appropriate Safety Management System is not an easy task. Strong top management effort is required together with the provision in a timely manner the required resources.

Resource is abroad concept encompassing:

- Human resources,
- Information,
- Infrastructure and
- Working environment.

Quality standards define under the requirements for human resources the elements for the planing, assignment, competence assurance, training, qualification and awareness.

This could be applied either to all staff or to the safety management staff. Lack of air traffic controllers or technical and supporting staff is danger for the safe service, but also lack of adequately trained and motivated safety management staff could compromise the implementation and functioning of Safety Management System.

People need also information necessary to control processes, infrastructure and the human and physical factors to achieve their goals.

4.6 Excellence Model

EFQM Model could be used to help Safety Management by measuring organisation position on the path to Excellence/Safety

Another Quality Management tool with the possible support for the Safety Management is European Foundation for Quality Management (EFQM) Excellence Model.

The EFQM Model is non-prescriptive framework and practical tool to help to establish an appropriate management system by measuring where we are on the path to Excellence.

It is not very difficult to make the comparisons:

- Excellence – Safety;
- Measuring organisation position on the path to Excellence – Measuring organisation position on the path to Safety

The Excellence model is based on the fundamental concepts of :

- Result Orientation,
- Customer Focus
- Leadership & Constancy of Purpose
- Management by Processes & Facts
- People development & Involvement

- Continuous Learning, Innovation & Improvement
- Partnership Development
- Public Responsibility

Emphasis is also set on the key role of leadership, visibility of performance and active involvement of all.

EFQM Excellence model could be of a help to safety management during the processes:

- Safety achievement – mainly but not limited to the process of staff motivation;
- Safety survey;
- Safety monitoring;
- Safety promotion – especially the process safety improvement.

Safety as the main deliverable have to be achieved by the Air Navigation System not compromising other deliverables as capacity, customer satisfaction effectiveness and efficiency. To reach this the organisation could develop some procedures for continuous improvement taking into account the EFQM model.

The methodological support for the processes of Safety Management could be to:

- Develop Safety Management Model (SMM) based on the principles of Excellence;
- Benchmark to extend the model to possible areas for addressing;
- Use of different type of questionnaires and procedures for contact with stakeholders, staff, partners and society;
- Development of the safety system performance indicators;
- Analysis of collected data and identification of corrective actions if needed.

4.7 ISO 9001:2000 Key Changes

ISO 9001 : 2000 with its focus on processes, customers, resources, continual improvement and top management involvement provides

good streamlined view for the safety management principles modification

More recently, major trends in the application of quality systems have occurred. The trends include the globalisation and change of the global economy, changes in organisation and technology, changes in global environmental status.

To respond to this trends ISO is now implementing a major revision of the quality standards ISO 9001, ISO 9002 and ISO 9003. The revision is focused on the needs of users of the standards for both existing and also new applications.

The key areas of change for incorporation into ISO 9001 : 2000 standard are:

- Develop only one standard to replace the existing three– with permissible exclusions;
- Process orientation – which connects the quality management system to organisational processes;
- Simpler presentation and more generic text;
- Less emphasis on documented procedures;
- Increased customer focus;
- Greater emphasis on top management involvement;
- Greater emphasis on resource management;
- Greater emphasis on continual improvement;
- Improved compatibility with other management systems;

These major changes in the ISO 9000 reflect the major new trends for supporting managerial activities. These trends have been integrated into our guidelines for improving the safety management approach.

Chapter 5

Organisational Aspects

5.1 *Differentiating the Approaches*

In order to differentiate different approaches, we consider two extreme point of views:

- Complementarism – Safety and other goals like effectiveness (expedite and maintain an orderly flow of air traffic) and efficiency (cost) are complementary objectives of the organisation.
- Trade-offism – Safety must be explicitly traded off against other goals. Effectiveness and efficiency are purely concurrence for the safety.

These two extreme approaches are illustrated on Figure 2.

Figure 2

Three different methods for organising quality management system support to safety management are identified: Separate approach; Collaboration approach; Inclusion approach

- Separate approach;
- Collaboration approach;
- Inclusion approach.

These 3 organisational variants do not represent an exhaustive list of possibilities. They just outline some already existing solutions in the space of all possible combinations.

Imagining these variants helps to decide what kind of organisation will fit better to the particular provider.

5.2 ***Separation Approach – Separated Systems***

Separation approaches establishes two different systems. Particular QMS and SMS collaboration are subject of case to case definition.

Separation approach establishes different systems for Quality Management and Safety Management - Figure 3.

Within this approach complete development of separate systems is needed.

The co-ordination and the communication between these two systems are not explicitly defined, but are part of the general organisation process of co-ordination and communication.

Figure 3

Example:

If the organisation is going to procure an automated ATM system there will be separate system quality management and system safety management, although they may be co-ordinated under the umbrella of system project management.

Safety management will specify all safety-related activities to be done to ensure and assure safety of this system.

Quality management will define on the other hand quality management activities towards such quality attributes as: availability, reliability, maintainability, environment, usability, and different aspects of performance and aesthetics.

However there is a need to specify the existing interfaces between quality and safety – some reliability information could be used as an input for safety analysis.

5.3 Collaboration Approach – Collaborative Systems

In a collaboration approach, common subjects might be implemented partially in a shared manner. It is usual for this approach SMS to be for new or additional threats to safety, while QMS to prevents any erosion of safety.

This approach suggests that common subjects might be implemented partially in a shared manner – Figure 4.

Within this approach Safety Management System is more proactively concentrated and Quality Management System is more reactively oriented. Safety Management is looking ahead for safety problems end ensuring they are addressed before an incident occurs whilst the Quality Management is checking what has not been done and correcting non conformances so that old problems do not recur.

Safety Management System is ever vigilant for new or additional threats to safety.

Quality Management System prevents any erosion of safety.

Figure 4

Example of collaboration system approach is the application of Collaborative Audit Procedure. Performing one audit for both safety and quality saves scares organisational resources like people and time. The joint auditing report provides top management with a good snapshot for the overall organisational performance, which enable the decision making process.

5.4 Inclusion Approach – Integrated Systems

Inclusion approach suggests either SMS to be implemented in QMS, or quality management elements to be added to SMS.

This approach suggests that common subjects might be implemented in whole in a shared manner.

Within this approach two variants are possible.

The first variant considers the existence of the Quality Management System in the organisation. Safety Management System is added at the top of QMS – Figure 5

Safety is managed within this approach as an attribute of quality.

All safety management principles, objectives, procedures and processes are included in the existing quality management elements.

However, identification of additional necessary procedures for SMS may be needed (e.g., risk management procedure).

There is a danger the required recourses to be underestimated because of the “one system” syndrome.

Figure 5

The second variant envisages some useful quality management elements and techniques together with the mandatory for the particular environment quality requirements to be added to the safety management system

Figure 6

Annex A

“Industrial Accident Prevention”

H. W. Heinrich

10 axioms of industrial safety:

- 1. The occurrence of any injury invariably results from a completed series of factors, the last one being the accident itself. The accident being due to the unsafe act of a person and/or mechanical or physical hazard.*
- 2. The unsafe acts of persons are responsible for the majority of accidents.*
- 3. The person who suffers an injury has probably had at least 300 narrow escapes when committing the same act.*

4. *The four basic motives for the occurrence of accidents are :*
 - *Improper attitude;*
 - *Lack of knowledge or skill;*
 - *Physical unsuitability;*
 - *Improper environment.*
5. *The four basic method of prevention of accidents are:*
 - *Engineering revision;*
 - *Persuasion and appeal;*
 - *Personnel adjustment;*
 - *Discipline.*
6. *The severity of an injury is largely fortuitous.*
7. *Methods of accident prevention are similar to methods of control of quality, cost and production.*
8. *Management has the best opportunity to initiate work of prevention and therefore must take responsibility for accident prevention.*
9. *The supervisor is the key man in accident prevention and can influence accident prevention by taking four steps; these are:*
 - *Identify the problem;*
 - *Find and verify the reason for the existence of the problem;*
 - *Select the appropriate remedy;*
 - *Apply the remedy.*
10. *The humanitarian incentive for preventing accidents is supplemented by two powerful economic factors:*
 - *The safe establishment is efficient;*
 - *The direct cost of an accident is about 1/5 of what the company eventually pays.*

Annex B

Management Style

B.1 Management Style Questionnaire

Management Style Questionnaire		YES	NO
1	Is the management personally and actively involved in the development of the organisation's mission, policies, strategies?		
2	To develop the organisation's mission, policies, strategies, does the management rely on internal resources? (as opposed to external consultancy)		
3	For the development of the organisation's mission, policies, strategies, does the management involve staff from different departments? (i.e., as opposed to involvement of only direct collaborators)		

4	Is the management personally and actively involved in identifying and planning improvement activities?		
5	Is the management ready to align the organisation's structure to support the implementation of its policies and strategies? (openness to organisational changes)		
6	Are the job descriptions of staff limited to main expected results?		
7	Is the management ready to create dedicated Task Force for implementing some improvement or analysing a identified problem?		
8	Is delegation of responsibility a normal practice in the organisation?		
9	Does the management prefer to rely on detailed and prescriptive procedures to implement the organisation's mission, policies, strategies?		
10	Is the management ready to stimulate and encourage improvement through collaboration within the organisation?		
11	When a person is tasked to perform some activities, is it explain "why" it has to be done in this way? (as opposed to "how" is to be performed)		
12	Does the organisation have a framework for measuring and analysing their performances, including safety performances?		
13	Does the management personally communicate the organisation's mission, policies and strategies?		
14	Are there barriers in the organisation for the internal communication? (e.g., social conflict)		
15	Does the management use team work as a communication means?		
16	Is the management accessible, actively listening and responding to people?		

B.2 Scoring Table

		Policy Making	Organising	Directing	Communicating
1	YES	1			
2	YES	1			
3	YES	1			
4	YES	1			
5	YES		1		
6	YES		1		
7	YES		1		
8	YES		1		
9	NO			1	
10	YES			1	
11	YES			1	
12	YES			1	
13	YES				1
14	NO				1
15	YES				1
16	YES				1
TOTAL					

If your score is:

- Between 1 and 5, you will favour an universal solution to SMS;
- Between 6 and 10, you will favour a context specific solution to SMS;
- Between 11 and 16, you will favour a dedicated solution to SMS.

B.3 Different Safety Management Implementation Approaches

	<i>We had 5 AIRPROXs in the last six months.</i>	<i>We had 5 AIRPROXs in the last six months. Is it good or bad?</i>	<i>We had only 5 AIRPROXs in the last six months. This corresponds to a 20% improvement in our safety performances.</i>
Safety Management Implementation Approach	<p>Universal Solution Safety is a universal value. Safety problems, their causes and solutions are the same everywhere.</p> <p>Safety Management implementation is based on a universal approach, with minor changes. It does not need to be tailored to a specific organisation. Only minor "cosmetic" changes.</p>	<p>Context Specific Solution Safety problems may exhibit similar symptoms, but they reflect different causes and therefore require specific solutions.</p> <p>Safety Management implementation is based on an existing model (i.e., current best practices). Detailed implementation integrates organisation particularities.</p>	<p>Dedicated Solution Safety problems are related to latent shortcomings in the organisation. Their solutions may require changes in the organisation.</p> <p>Safety Management implementation is customised to the culture of the organisation. Prevention is the major aim. Creativity and innovation are major means to improve safety.</p>
Reaction/Pro Action	<p>Mainly Reactive approach The main purpose of safety management is to correct identified safety shortcomings. The direct causes of safety shortcomings are mainly attributed to operational human errors (individuals) (correction of professional practices, that deviate from normal practices.</p>	<p>Reaction and Pro Action Combination Improvement actions could be initiated, but they are mainly based on incident investigation. Human error is considered as a symptom rather than a cause. Working conditions are taken into account (Team Resource Management)</p>	<p>Mainly Pro Action System approach. Safety shortcomings are due to deficiencies in the overall system (people, procedure and equipment). Understanding of human error is the major aim of incident investigation. The design of equipment and procedure will attempt to protect the system against human error.</p>

B.4 Examples of Safety Management Elements Implementation

Implementation	Could be based on existing implementation	Based on existing implementation, but with tailoring to organisation particularities	Based on organisation experience
Safety Management Organisation	Centralised	Combination	Local/matrix organisations Multidisciplinary teams
Safety Manual	Detailed and prescriptive procedures, at organisation level. Strict allocation of responsibilities	Local safety manuals Responsibilities oriented towards results	The safety manual is living document. Objective based.
Involvement of people for development and resources	Low. Consultants support without input from organisation personnel	Medium Consultants with support from organisation personnel	High (e.g., dedicated and multidisciplinary task forces to solve a safety problem) Organisation personnel with support from consultants
Safety Data Collection	Through "mandatory" reporting scheme	Voluntary reporting scheme	Automatic safety monitoring and safety assessment
Training Aspects	Only experts will be trained on a specific subject	Team training	Organisation training.

Principles	Universal	Customised	Dedicated
Competency	Focus on individual training Competency description for individual	Focus on team training Regular briefing at local unit levels Generic Team Resources Management	Continuous improvement Team Resources Management based on current experience of the organisation
Safety Occurrences	Mandatory	Voluntary	Automatic
Safety Levels	Empirical (based on current performances)	Improved knowledge of the levels	Based on risk assessment
Safety Assessment and documentation	Individual new system safety assessment and modifications of existing systems	A posteriori safety assessment of current operations	Safety Assessment for improvement Long term safety planning
Safety Surveys	Compliance	Support to best practices	Hazard identification
Safety Monitoring	Monitoring through incidents		Monitoring of normal operations
Lesson Dissemination	Based on results from investigation Could be based on other organisation investigation	Based on results from investigation, but based on organisation experience	Based on safety assessment. Promotion of improvement
Safety Improvement	Response from major risk from management analysis	Local improvement committees	Task Force creation for specific improvement

Annex C

Total Quality Management Guidance

C.1 ***JOSEPH M. JURAN*** ***“Quality Control Handbook”***

Ten steps to Quality Improvement:

1. Build awareness of the need and opportunity for improvement.
2. Set goals for improvement.
3. Organise to reach the goals (establish a quality council, identify problems, select projects, appoint teams, designate facilitators).
4. Provide training.

5. Carry out projects to solve problems.
6. Report progress.
7. Give recognition.
8. Communicate results.
9. Keep score.
10. Maintain momentum by making annual improvement part of the regular systems and processes of the company.

C.2 PHILIP B. CROSBY “QUALITY IS FREE”

Fourteen Steps to Quality Improvement

1. Make it clear that management is committed to quality.
2. Form quality improvement teams with representatives from each department.
3. Determine where current and potential quality problems lie.
4. Evaluate the quality awareness and personal concern of all employees.
5. Raise the quality awareness and personal concern of all employees.
6. Take actions to correct problems identified through previous steps.
7. Establish a committee for the zero defects programs.
8. Train supervisors to actively carry out their part of the quality improvement program.
9. Hold a "zero defects-day" to let all employees realize that there has been a change.
10. Encourage individuals to establish improvement goals for themselves and their groups.
11. Encourage employees to communicate to management the obstacles they face in attaining their improvement goals.
12. Recognise and appreciate those who participate.
13. Establish quality councils to communicate on a regular basis.

14. Do it all over again to emphasise that the quality improvement never ends.

C.3

W. EDWARDS DEMING

“Quality Productivity and Competitive Position”

Fourteen Points of Management Obligations:

1. Create constancy of purpose for improvement of product and service with a plan to become competitive and to stay in business. Decide to whom top management is responsible.
2. Adopt the new philosophy: we are in a new economic age. We can no longer live with commonly accepted levels of delays, mistakes, defective materials, and defective workmanship.
3. Cease dependence on mass inspection as a way to achieve quality; require, instead, statistical evidence that quality is built in.
4. End the process of awarding business on the basis of price tag. Instead, depend on meaningful measure of quality along with price. Eliminate suppliers that cannot qualify with statistical evidence of quality.
5. Find problems. It is the management's job to work continually on the system.
6. Institute modern methods of training on the job.
7. Institute improved means of supervision of production workers. The responsibility of supervisors must be changed from sheer numbers to quality, and improvement of quality will automatically improve productivity.
8. Drive out fear so that everyone can work effectively for the company.
9. Break down barriers between departments.
10. Eliminate slogans and targets asking for increased productivity without providing methods.
11. Eliminate work standards that prescribe numerical quotas.
12. Remove barriers that stand between the hourly worker and his or her right to pride of workmanship.
13. Institute a vigorous program of education and retraining.
14. Create a structure in top management that will push every day on the preceding 13 points.

Annex D

Management by Process

Quality Management for the Investigation

D.1 Why to model Safety Management by processes?

- “...This is a safety objective. Just do it...” - approach that falls short of objectives. Explicit approach is needed not only regarding the separation of safety from other activities, but also for the definition of the rationale and sequence of the activities;
- Management by processes is an systematic approach.
- Processes smoothly link Policy, Requirements and Objectives with Implementation;

- Processes provide staff with chronological model of the actions required;
- It is possible, by mapping the process, to make processes and actions traceable and streamlined;
- By defining the number of required key processes is easy to synchronise them - proper in support of consistency;

D.2 *What is management by processes?*

Management by processes is :

- systematic identification of the various processes used within an ATM service provider organisation;
- continuous improvement of the processes;
- control of these processes;
- identification and control of the interactions between such processes.

As a basic concept the output from one process would directly represent the input into the next process.

The process model is not supposed to describe the processes at the detailed level. However, it is a good conceptual presentation of the safety management system, integrating them into a net model of processes and demonstrating their interactions.

All elements of Safety Management like Occurrence Investigation, Safety Assessment, Lesson Dissemination etc. may be described as organisational activities with the particular purpose, inputs, outputs, responsibilities and controls

D.3 *Application to Incident Investigation*

Major Investigation Inputs, Operation, Output and Feedback as defined by *Ludwig Benner* and *Ira Rimson* in their paper "*Quality Management for Accident Investigation*" (1992) are:

- Occurrence Investigation Inputs:

- The occurrence;
- Investigation knowledge and skill;
- Data created during the accident;
- Observations;
- Occurrence Investigation Operations:
 - Acquire data;
 - Transform and organise the data;
 - Integrate data to synthesise a description of what happened;
 - Validate the description;
- Occurrence Investigation Output:
 - Forms;
 - Written descriptions;
 - Verbal descriptions;
 - Description of data that supports the description of what happened;
 - Other outputs,
- Occurrence investigation Feedback:
 - Implicit feedback – questioned outputs, demands to change outputs, controversy, litigation and hard feeling;
 - Explicit feedback – party review.

The authors of the paper proposed outputs to be the a conventional point to start enforcing quality standards; if inputs and operational processes are faulty, then outputs cannot be acceptable. Imposing output quality standards is the quickest first step toward identifying deficiencies of both inputs and investigative operations, and improving feedback.

What could be added to the above mentioned list is occurrence notification and recommendations as outputs. In fact they fall under the category “other outputs”.

D.4 Validation of data and reconstruction for the safety occurrence

Ludwig Benner and Ira Rimson are arguing:

Beware of Garbage In. Validity depends in great part on the investigator's integrity, and ability to observe and document truthfully, without distortion or misrepresentation, whether innocent or deliberate. It also depends on the methods used to acquire the data, and how the data are transformed for use and integrated. Ignoring a relevant input, or distorting data during documentation, have similar results: a warped view of what happened. Finally, the methods used to record and organise data to identify what happened are critical. A frequent invalidating deficiency occurs when the investigator records conclusions rather

than observations, thereby eliminating the basis for testing the hypothesis and the report...

... The investigator's objective should be to develop valid descriptions of accidents from which corrective actions can be proposed, planned and implemented to reduce future occurrences and risks. Invalid descriptions produce unacceptable consequences, including injustices to individuals and organisations, misdirected remedial efforts, needless controversies, and myriad other counterproductive problems. Fuzzy, qualitative quality safety of the aviation system are currently based.