Guidance Material for BCAR ATM/ANS

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RECORD OF AMENDMENTS AND CORRIGENDA

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TABLE OF CONTENT

FOREWORD

This document is issued by Bhutan Civil Aviation Authority (BCAA) to provide guidance to Air Navigation Service Providers (ANSP) subject to certification in understanding and fulfilling the certification requirements contained in Bhutan Civil Aviation Authority Requirements for Air Traffic Management and Air Navigation Services (BCAR ATM/ANS).

While this manual is published for use by the ANSPs, the personnel of relevant divisions within the BCAA and any organizations and their employees contracted to ANSPs, will be notified of its publication. This document will be updated regularly to incorporate further amendments.

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Director
Bhutan Civil Aviation Authority (BCAA)
Date: 1st February 2021

CHAPTER III: COMMON REQUIREMENTS FOR SERVICE PROVIDERS
(PART-ATM/ANS.OR)

SUBPART A — GENERAL REQUIREMENTS (ATM/ANS.OR.A)

GM1 ATM/ANS.OR.A.001 Scope

DEFINITIONS AND SCOPE IN RELATION TO SERVICE PROVIDERS

a) To recognise which of the chapters applies to which service provider, it is necessary to understand how services are defined. These definitions have determined the structure and the content of Chapter III to XIII, of BCAR ATM/ANS.

b) It should, be noted that ATM/ANS include more services than 'Air Traffic Management' and 'Air Navigation Services' together.

c) Figure 1 below provides a pictorial representation of the services and how they interrelate through the various definitions.

d) Figure 1 indicates both a further breakdown of ATS into air traffic control services (ATC), alerting services, air traffic advisory services, and flight information services and groupings of:
1) air traffic management (ATM): comprising ATS, ASM, and ATFM;
2) air navigation services (ANS): comprising ATS, CNS, MET, and AIS; and
3) airspace design (ASD) and data provision (DAT) and ATM network functions.

e) It is important to note that ATS is included in ATM and ANS.

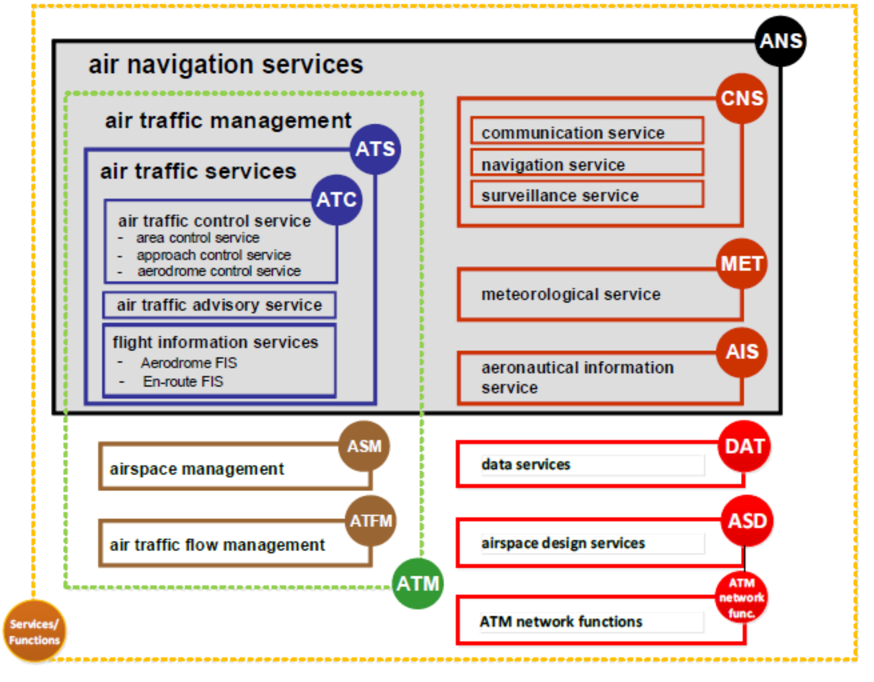


Figure 1: The scope of the services

SERVICES

a) Chapter III (Part-ATM/ANS.OR) of BCAR ATM/ANS applies to the service providers, as relevant, and contains the common requirements for the service providers. This Chapter is broken down into four subparts:
   1) Subpart A — General requirements (ATM/ANS.OR.A);
   2) Subpart B — Management (ATM/ANS.OR.B);
   3) Subpart C — Specific organisational requirements for service providers other than ATS providers (ATM/ANS.OR.C); and
   4) Subpart D — Specific organisational requirements for ANS and ATFM providers and the Network Manager (ATM/ANS.OR.D).

b) Subpart D applies only to ANS and ATFM providers and the Network Manager (and not to ASM and DAT providers).

c) Thereafter, each specific requirement for various service providers is allocated to a chapter (Chapter IV to XII) which contains specific requirements for that service provider. Table 1 below indicates which chapters are applicable to each service provided.

d) Chapter XIII contains requirements for service providers regarding personnel training and competence assessment *(reserved for now).*

AIR TRAFFIC SERVICES FOR FLIGHT TEST

a) When the flight tests have one of the following characteristics:
   1) frequent changes in levels and headings, depending on the tests which are carried out with certain unpredictability;
   2) unless necessary for the purpose of the flight tests, navigation in general (route/destination, etc.) is not the primary objective of these flights;
   3) specific aircraft configurations sometimes resulting in reduced ability to maneuver;
   4) technical constraints, including airborne and ground testing facilities;
   5) airborne equipment is not proven to be up to the required certification level; and
   6) the planning for conducting flight tests can be of a very ad hoc nature giving little timing for carrying out strategy or pre-tactical air traffic flow management. (e.g. the need to test under specific weather conditions which would require flexibility for allocation of slots for these flight tests), then the air traffic services provider providing services to this type of flight testing may need a specific privilege within the certificate issued by the competent authority because of the specificities of the air traffic services to be provided to this type of operations and because of the need to ensure safe operations in the airspace in which flight tests are being conducted.

b) Given the characteristics in (a), flight tests can be made in cohabitation with other airspace users in controlled or non-controlled airspace, and sometimes in temporarily reserved areas when necessary.

	BCAR ATM/ANS													
	Chapter III Part ATN/ANS.OR				Chapter IV (Part ATS)	Chapter V (Part MET)	Chapter VI (Part AIS)	Chapter VII (Part DAT)	Chapter VIII (Part CNS)	Chapter IX (Part AFTM)	Chapter X (Part ASM)	Chapter XI (Part ASD)	Chapter XII (Part Nm)	Chapter XIII (Part PERS
ATS (See note 1)	Subpart A	Subpart B	Subpart C	Subpart D	X									
MET	X	X		X		X								
AIS	X	X	X	X			X							
Data service	X	X	X					X						

CNS	X	X	X	X					X					
ATFM service	X	X	X	X						X				
Airspace Management service	X	X	X								X			
Airspace Design service	X	X	X									tbd*		
Network manager	X	X	X	X									X	
Service providers (See note 2)														X

Table 1: Applicability of chapters in BCAR ATM/ANS to service providers

X = Applicable chapters for each service provider.

Note 1: Section 3 of Chapter IV (Part-ATS) only applies to providers of air traffic control services and not to providers of alerting, air traffic advisory, and flight information services.

Note 2: The applicability of Chapter XIII is dependent upon the scope as specified within each of the subparts of Chapter XIII.
* to be introduced under RMT.0445, as necessary

GM1 ATM/ANS.OR.A.015(b)(1) Declaration by flight information services providers.

MODEL TEMPLATE OF DECLARATION OF COMPLIANCE

DECLARATION OF COMPLIANCE FOR THE PROVISION OF FLIGHT INFORMATION SERVICES
in accordance with BCAR ATM/ANS

Provider of flight information service
Name:
Principal place of operation and, if any, registered office:
Name and contact details of the accountable manager:

Flight Information Service

Starting date of provision of flight information services/applicability date of the change:

Scope of flight information services:
☐ Aerodrome flight information services (AFIS)
☐ En-route flight information services (En-route FIS)

List of alternative means of compliance with references to the AMCs they replace (to be attached to the declaration)

Statements

☐ The management system documentation, including the operations manual, complies with the applicable requirements set out in Part-ATM/ANS.OR and Part-ATS.

☐ The provision of flight information services will be carried out in accordance with the requirements of BCAA Regulations, and the procedures and instructions specified in the operations manual.

☐ All personnel are qualified, competent and trained in accordance with the applicable requirements.

☐ (If applicable)
The provider of flight information services has implemented and demonstrated conformance to an officially recognised industry standard.

Reference of the standard:

Certification body:

Date of the last conformance audit:

☐ Any change in the provision of flight information services that affects the information disclosed in this declaration will be notified to the competent authority.

☐ The provider of flight information service confirms that the information disclosed in this declaration is correct.

Date, name, and signature of the accountable manager

GM1 ATM/ANS.OR.A.040(b) Changes — general

PROCEDURE FOR CHANGES NOT REQUIRING PRIOR APPROVAL

The procedure agreed by the service provider and the competent authority may also include the process for the reaction by the service provider to an unplanned change that may arise with the need for urgent action that would normally require prior approval of the competent authority. This is the case in which the service provider responds immediately to a safety problem as required in ATM/ANS.OR.A.060 or when an emergency situation arises in which the service provider has to take immediate action to ensure the safety of the services.

GM1 ATM/ANS.OR.A.045(a) Changes to a functional system

NOTIFICATION

a) A change should be notified as soon as the data defined in AMC1 ATM/ANS.OR.A.045(a) of BCAR ATM/ANS is available. The decision to review a change by the competent authority will be based, in most circumstances, on the notification data. Exceptions to this are cases where the competent authority is not familiar with the type of change or the complexity of the change requires a more thorough consideration.

b) Early and accurate notification facilitates the interactions between the provider and the competent authority and, thus, maximizes the likelihood of introducing a change into service in due time and according to the service provider's initial schedule when the competent authority has decided to review an assurance case. Therefore, it is advisable that the change description identified in AMC1 ATM/ANS.OR.A.045(a) is completed as soon as possible and contains the following data:
   1) Purpose of the change;
   2) Reasons for the change;
   3) Place of implementation;
   4) New/modified functions/services brought about by the change;
   5) High-level identification of the constituents of the functional system being changed, and what is modified in their functionality;
   6) Consequence of the change, i.e. the harmful effects of the hazards associated with the change — see (f) below and also the definition of 'risk' in Chapter I (100) of BCAR ATM/ANS.

c) The information provided in (b) may expedite the decision whether to review or not the proposed change, because it will allow the competent authority to gain complete knowledge of the change and, consequently, reduces the need for additional information. However, lack of some of this data should not delay the service provider's submission of the notification if to do so is likely to impede the introduction of the change. It should be noted that early interaction with its competent authority may help to complete the missing data.

d) The service provider should take into account that an early, clear and accurate change notification will assist the competent authority in making the decision to review or not the change and may prevent any inconvenience such as:

   1) the competent authority having to ask for more information about the change in order to make its decision as required in ATM/ANS.OR.A.045(a)(2);

2) the competent authority deciding to review a change unnecessarily because the notification is not clear enough; or

3) the delay in the competent authority deciding whether to review a change, caused by the lack of information, having an impact on the proposed date of entry into service.

e) It is recognized that the understanding of the change will improve as the change process progresses and the interaction between the competent authority and the service provider strengthens. The service provider should notify the competent authority when the information provided in the previous notification is no longer valid or when the information previously missing becomes available. When additional information — other than the data specified in AMC1 ATM/ANS.OR.A.045(a) — is supplied at the competent authority's request, then no update of the notification is required.

f) For air traffic services (ATS) providers, the consequences of the change specified in (b)(6), should be expressed in terms of the harmful effects of the change, i.e. the effects of the hazards associated with safety risks. These could be the result of a preliminary safety assessment, if available, or an early hazard analysis that concentrates on the service level effects. For service providers other than air traffic services providers, the consequences should be expressed in terms of what aspects of the performance of the service are impacted by the change.

g) The point of contact, as required in point (j) in AMC1 ATM/ANS.OR.A.045(a), provides a focal point for the competent authority to contact when seeking complementary information about the change when required. The aim is to improve communications between the provider and the competent authority about the change.

h) All notified changes should be unambiguously identified. The service provider and its competent authority should agree on a means of referencing so as to associate a unique identifier to a given notified change.

i) For routine changes, the notification to the competent authority may be done in a simpler manner, e.g. using forms less detailed than those specified in AMC1 ATM/ANS.OR.A.045(a) or notifying these changes collectively after being implemented at regular periods of times agreed between the provider and the competent authority. A service provider and its competent authority should coordinate so as to reach a common agreement on these types of changes that may not be reviewed by the competent authority. The list of such changes should be documented and formalised. The formalised agreement becomes part of the change management procedures identified in ATM/ANS.OR.B.010. Consequently, the list will be reviewed by the competent authority as part of the audits it performs that are described in ATM/ANS.AR.C.010(a) of BANRs. The relevant audit activity is detailed in AMC1 ATM/ANS.AR.C.010(a)(a)(2) of BANRs.

GM2 ATM/ANS.OR.A.045(a) Changes to a functional system

NOTIFICATION — SOFTWARE CRITICALITY

Depending on the complexity of the change to the functional system and the criticality of the software, the depth of the evaluation may vary. The service provider should coordinate as soon as possible with the competent authority in order to define a software oversight strategy as part of the change review activities, if a decision for change review is taken.

GM1 ATM/ANS.OR.A.045(a)(3) Changes to a functional system

DEDICATED PUBLICATION FOR PROPOSED CHANGES

The final users of services potentially affected by a change to a functional system may not be known by the service provider proposing the change. However, this should not prevent the service provider from using other means for notification than direct communication with the interested parties. In that case, the changes may be published in a dedicated website where the users of the service can periodically check for current proposed changes to the functional system that may affect them.

GM1 ATM/ANS.OR.A.045(c); (d) Changes to a functional system

TRANSITION INTO SERVICE

a) No matter whether the competent authority has decided to review the notified change or not, the service provider should not start the implementation of any part of the change that has the potential to affect the safety of any of the services it provides, e.g. the functions performed or the performance of the services, until it has produced a valid argument in accordance with ATS.OR.205(a)(2) or/and ATM/ANS.OR.C.005(a)(2) of BCAR ATM/ANS, as appropriate.

b) Implementation of the change, which means the creation and installation of the items to be used in the changed operational system may or may not affect the performance of the current services offered by the service provider. For example, much of the implementation of equipment and procedures can be performed 'off line', i.e. in development facilities that do not interact with the operational services and installation may be started, provided the items are not connected to the operational system and their presence in the operational environment does not affect the current services. However, these items must not be introduced into the operational system, i.e. they must not affect the behaviour of any operational service, until a valid assurance case exists and, if the change is subject to competent authority review, before the competent authority has approved the change.

c) The installation of an artefact may have an impact on services other than the service being changed. This can happen where the installation involves disrupting these other services, e.g. aerodrome operations may be disrupted because runways or taxiways are being used by constructor's vehicles or are being interfered with. In this case, the scope of the change includes these other services (please refer to ATM/ANS.OR.C.005(a)(1)(iii) & (iv) or ATS.OR.205(a)(1)(iii) & (iv), as appropriate) and the assessment of the change includes the effects installation may have on them, including where the installation does not go according to plan.

GM1 ATM/ANS.OR.A.045(e) Changes to the functional system

CHANGES AFFECTING MULTIPLE SERVICE PROVIDERS AND AVIATION UNDERTAKINGS — GENERAL

a) Any change proposed by a service provider as defined in ATM/ANS.OR.A.045(a) of BCAR ATM/ANS affects other service providers and/or aviation undertakings when:

   1) the proposed change may alter the service delivered to other service providers and aviation undertakings as users of that service; or

   2) the proposed change may alter the operational context in which the services of other service providers and aviation undertakings are delivered or in which the aviation undertakings are operating.

b) The changes referred to in ATM/ANS.OR.A.045(e) could be considered 'multi-actor changes' and are those changes that require coordination between the service provider(s) proposing the change and any service providers and aviation undertakings affected by the change(s) due to the presence of dependencies between the service providers that planned the change and other affected service providers and/or other aviation undertakings. This coordination is essential to ensure a correct safety (support) assessment when there are dependencies.

c) A single-actor change is one that is limited to those cases where a change to a service provider's functional system alters neither the service nor the operational context of other service providers and aviation undertakings.

GM2 ATM/ANS.OR.A.045(e) Changes to the functional system

AFFECTED STAKEHOLDERS — SERVICE PROVIDERS AND AVIATION UNDERTAKINGS

a) 'Other service providers' mentioned in ATM/ANS.OR.A.045(e) of BCAR ATM/ANS refers to Bhutanese service providers other than the service provider proposing the change, that are regulated in accordance with BCAA regulations and requirements;

b) Aviation undertakings affected by the change included in ATM/ANS.OR.A.045(e) can be understood as the stakeholders and professional associations with dependencies with the changed service, and may include the following:
   1) service providers that do not fall under the remit of BCAA regulations and requirements, e.g. non-Bhutanese service providers;
   2) aerodrome operators;
   3) aircraft operators;
   4) airframe and equipment manufacturers;
   5) maintenance organisations;
   6) other bodies not regulated by BCAA regulations and requirements, e.g. power suppliers or military authorities.

GM3 ATM/ANS.OR.A.045(e) Changes to the functional system

CHANGE AFFECTING MULTIPLE SERVICE PROVIDERS AND AVIATION UNDERTAKINGS — COORDINATION

a) ATM/ANS.OR.A.045(e) of BCAR ATM/ANS applies to all the affected service providers involved in the change, and, therefore, they should coordinate dependencies as well as shared assumptions and shared risk mitigations. They should only use the agreed and aligned assumptions and mitigations that are related to more than one service provider or aviation undertaking in their safety or safety support cases, as required by ATM/ANS.OR.A.045(f).

b) Assumptions and risk mitigations used during the assessment of the change that are not shared by the affected service providers, can be handled independently by each service provider, and do not need agreement.

c) This coordination means that the affected service providers:
   1) have jointly identified the scope of their responsibilities with regard to the change, and in particular their safety responsibilities, e.g. what part of the change will be covered in whose safety (support) assessment case;
   2) have jointly identified the dependencies;
   3) have jointly identified the hazards associated with the change in the common context;
   4) have mutually agreed on the assumptions for the change that jointly relate to them; and
   5) have mutually agreed on the mitigations for risks that require joint implementation.

d) Service providers would need to achieve a common understanding about:
   1) consequences in the shared operational context; and

2) chains of causes/consequences.

e) Service providers would jointly need to identify their dependencies to be able to assess the change to their functional systems.

f) Where necessary in relation to the dependences identified in accordance with GM1 ATM/ANS.OR.A.045(e)(1), the service providers may perform together:
1) identification of hazards/effects;
2) assessment of risks;
3) evaluation of risks;
4) planning and assessment of risk mitigations; and
5) verification.

g) The level of interaction and coordination between service providers and aviation undertakings will vary depending on the particular needs of the change at hand.

GM4 ATM/ANS.OR.A.045(e) Changes to a functional system

COORDINATION WITH AFFECTED AVIATION UNDERTAKINGS

a) The aviation undertakings are the entities, persons or organisations as defined in point 41 of Chapter I to BCAR ATM/ANS and thus, ATM/ANS.OR.A.045(e) does not apply to them. However, any service provider affected by a change should seek the participation of aviation undertakings when assumptions and risk mitigations used in the safety (support) assessment are shared with those aviation undertakings.

b) When the number of aviation undertakings affected by the change is large, the service providers may not need to involve every individual stakeholder. If a body can represent the views of a group of affected aviation undertakings, it may suffice to involve that representative body to obtain the supporting evidence to move forward with the assessment of the change.

GM1 ATM/ANS.OR.A.045(e)(2) Changes to a functional system

CHANGE AFFECTING MULTIPLE SERVICE PROVIDERS AND AVIATION UNDERTAKINGS — ASSUMPTIONS AND RISK MITIGATIONS

In order to satisfy ATM/ANS.OR.A.045(e)(2) of BCAR ATM/ANS, the affected service providers coordination will identify those assumptions and risk mitigations that relate to:
a) more than one service provider;
b) a service provider and one or more aviation undertakings; or
c) multiple service providers and aviation undertakings.

GM1 ATM/ANS.OR.A.045(f) Changes to a functional system

LACK OF COORDINATION

a) If an aviation undertaking decides not to cooperate, the service provider, who has identified dependencies with the aviation undertaking, in accordance with ATM/ANS.OR.A.045(e)(1) of BCAR ATM/ANS, needs to consider the impact of having the assumptions and risk mitigations not agreed with that aviation undertaking. It should propose a way forward by doing one or more of the following:
1) making the assumptions themselves and providing evidence that supports them;

2) adding additional mitigating measures so that the change remains acceptably safe;
3) modifying the scope of the change, or even reconsidering and cancelling the change.

b) The service provider affected by a lack of cooperation with an aviation undertaking may wish to inform its competent authority about those aviation undertakings that are not participating and its form of non-participation, in order to seek the assistance of the competent authority in trying to persuade the aviation undertaking to participate.

GM1 ATM/ANS.OR.A.050 Facilitation and cooperation

AUDITS — SOFTWARE ASSURANCE PROCESSES BY THE COMPETENT AUTHORITY

(a) The assessment of an effective application of the documented software assurance processes may necessitate a technical evaluation of the evidence and arguments produced for the software assurance by the competent authority when reviewing a notified change. In this context, the service provider should ensure access to the configuration management system for the competent authority, which may need to verify:
   1) the consistency of all the evidence; and
   2) the fact that all the evidence is derived from a known version of the software (i.e. all evidence and arguments are actually available and can be traced without ambiguity to the executable version).

(b) The service provider should:
   (1) anticipate the possibility for on-site audits or inspections by the competent authority; and
   (2) when evidence and arguments are developed by contracted organisations, include the corresponding rights of the competent authority to assess said organisations during onsite audits or inspections.

GM1 ATM/ANS.OR.A.055 Findings and corrective actions

GENERAL

a) Corrective action is the action taken to eliminate or mitigate the root cause(s) and prevent the recurrence of existing detected non-compliance or other undesirable condition or situation.

b) The proper determination of the root cause is crucial for defining effective corrective actions.

GM1 ATM/ANS.OR.A.065 Occurrence reporting

GENERAL

The reporting to the organisations defined in the ATM/ANS.OR.A.065 of BCAR ATM/ANS does not affect the need to report to other organisations with which the service provider interfaces, and which might be involved in or be affected by the reported event (e.g. other service providers involved in an occurrence, aerodrome operators, etc.).

GM1 ATM/ANS.OR.A.065(b) Occurrence reporting

SYSTEMS AND CONSTITUENTS

a) When determining which failures of systems and constituents are to be reported, a degree of practicality is required as it is not intended that every failure is reported. Only those that have or may have an impact on the safety of the provision of services are reported.

b) When nothing is defined in BCAA regulations and requirements, the determination of the failures of systems and constituents that need to be reported is done by the service provider and needs to be approved by the competent authority. This determination can be done as a result of an assessment of the installations or changes to the systems and constituents.

c) The organisation responsible for the design of the systems and constituents may no longer exist or may no longer support the design. In this case, the service provider will have made arrangements to ensure that the safety of the systems and constituents can be assured by appropriate and practical means. In many cases, this means that the service provider has taken over the design responsibilities.

GM1 ATM/ANS.OR.A.070 Contingency plans

GENERAL

The contingency plan may include the definition of the measures, the coordination with other actors (i.e. the State, the competent authorities, possibly the other service providers, the insurance companies, aerodrome operators, as applicable) and alternative services needed in case of degradation or interruption of the services, while the applicability of emergency response planning may be attributable to or affected by an aviation safety occurrence.

SUBPART B — MANAGEMENT (ATM/ANS.OR.B)

GM1 ATM/ANS.OR.B.001 Technical and operational competence and capability

TECHNICAL AND OPERATIONAL CAPACITY

Technical and operational capacity should include a sufficient number of personnel to perform its tasks and discharge its responsibilities.

GM1 ATM/ANS.OR.B.005 Management system

DEFINITIONS AND CONCEPT OF MANAGEMENT SYSTEM

a) ISO 9000:2005 defines a management system as a 'set of interrelated or interacting elements to establish policy and objectives and to achieve those objectives'.

b) Another available definition of management system is the following: ‘The structure, processes and resources needed to establish an organisation's policy and objectives and to achieve those objectives.'

c) Traditionally, separate management systems were developed to address issues such as safety, quality, environment, health and safety, finance, human resources, information technology and data protection. However, it is foreseen that more and more the services providers will establish integrated management systems following the harmonised set of requirements.

d) The Regulation does not require that the different management systems are integrated but it facilitates their integration.

GM2 ATM/ANS.OR.B.005 Management system

RELATIONSHIP BETWEEN THE TYPE OF SERVICE AND SAFETY MANAGEMENT — QUALITY MANAGEMENT

a) All service providers are required to establish and maintain a management system. However, only an air traffic services provider can have managerial control over functions directly affecting the safety of the flight (e.g. the ATCO to separate aircraft from each other). Hence, the management system requirements in Chapter III, which apply to all service providers, are more broadly associated with the quality of the service rather than the safety of the service. Chapter IV (Part-ATS) has specific safety management requirements for the provision of air traffic services. Therefore, only the air traffic services provider (that providing air traffic control, alerting service, air traffic advisory service or flight information service) is required to have a safety management system and undertake safety assessment of changes to the functional system.

b) Service providers other than the air traffic services provider can still affect the safety of the flight through functions or services they provide, but this will always be influenced by the way in which the air traffic services provider or airspace user are using those functions or services. Therefore, service providers other than air traffic services providers have a management system which manages the performance of service (rather than the safe use of their services for flight navigation and the control which is beyond the managerial control of the service provider). This performance of the service refers to such properties of the service provided such as accuracy, reliability, integrity, availability, timeliness, etc.

c) It is quite likely that air traffic services providers have contractual arrangements in place with other service providers, whose services they use, specifying the required performance and requiring the service provider to inform, in a timely manner, the air traffic services provider of any impact on the performance of services supplied.

d) When the service provider other than an air traffic services provider provides services or functions directly to a flight (e.g. MET) without involving air traffic services, then the safe use of those services is the responsibility of the users of those services.

e) When the air traffic services provider also provides other services, it may choose to combine the necessary performance and safety management activities into an integrated management system covering all services.

GM1 to AMC1 ATM/ANS.OR.B.005(a) Management system

GENERAL

ISO 9001 Certificate(s) covers (cover) the quality management elements of the management system. Other elements required by BCAR ATM/ANS in reference to the management system that are not covered by the ISO 9001 certificate issued by an appropriately accredited organization should be subject to oversight by the competent authority.

GM2 to AMC1 ATM/ANS.OR.B.005(a) Management system

GENERAL — FOR ATS PROVIDERS

An ISO 9001 certificate may not give the presumption of compliance with the provisions of ATS.OR.200 'Safety management system'.

GM1 ATM/ANS.OR.B.005(a)(1) Management system

RESPONSIBILITIES AND ACCOUNTABILITIES

a) Senior management should ensure that responsibilities and accountabilities are defined and communicated within the service provider and documented within the management system. In the context of this rule, 'responsibilities' refers to obligations that can be delegated and 'accountabilities' refers to obligations that cannot be delegated.

b) The appointment of an accountable manager who is given the required authorities and responsibilities, requires that the individual has the necessary attributes to fulfil the role. The accountable manager may have more than one function in the organisation. Nonetheless, the accountable manager's role is to ensure that the management system is properly implemented and maintained through the allocation of resources and tasks.

GM1 ATM/ANS.OR.B.005(a)(2) Management system

POLICY FOR AIR TRAFFIC SERVICES PROVIDERS VS POLICY FOR ALL OTHER SERVICE PROVIDERS

If a service provider does not undertake the provision of air traffic services, then the policy will be recognisable more as a quality policy that is concerned with the performance of the service and conformance to the service provision requirements supporting the achievement of the highest level of safety in the airspace where the service is provided. Should the service provider undertake the provision of air traffic services, then ATS.OR.200 of BCAR ATM/ANS also applies and the policy will need to be expanded to include both the safety and the quality of the service.

GM2 ATM/ANS.OR.B.005(a)(2) Management system

POLICY — NON-COMPLEX SERVICE PROVIDERS

The policy is the means whereby the service provider states its intention to maintain and, where practicable, improve performance levels in all their activities and to minimize their contribution to the risk of an aircraft accident as far as is reasonably practicable.

GM3 ATM/ANS.OR.B.005(a)(2) Management system

SAFETY CULTURE

The policy should actively encourage effective safety reporting and, by defining the line between acceptable performance (often unintended errors) and unacceptable performance (such as negligence, recklessness, violations or sabotage), provide fair protection to reporters. A safety or just culture may not, however, preclude the 'criminalisation of error', which is legally, ethically and morally within the sovereign rights of the State, provided that national law and established international agreements are observed. A judicial investigation, and consequences of some form, may be expected following an accident or serious incident especially if a system failure resulted in lives lost or property damaged, even if no negligence or ill intent existed. A potential issue could, therefore, exist if voluntary hazard reports, which relate to latent deficiencies of a system or its performance, are treated in the same way as those concerning accident and serious incident investigations. The intent of protecting hazard reports should not challenge the legitimacy of a judicial investigation or demand undue immunity.

GM1 to AMC2 ATM/ANS.OR.B.005(a)(3) Management system

SAFETY SURVEYS — COMPLEX AIR TRAFFIC SERVICES PROVIDER

a) An air traffic services provider should:

 1) initiate safety surveys and ensure that all safety-related activities within its scope are addressed periodically;

 2) appoint an appropriate survey leader and survey team whose expertise is in accordance with the particular requirements of the intended survey, taking due account of the desirability of including staff from outside areas where relevant, and being mindful of the opportunity such an activity provides for staff development and engagement;

 3) define an annual safety survey plan;

 4) take immediate remedial action as soon as any safety-related shortcomings are identified;

 5) ensure that the actions identified in the action plans are carried out within the specified timescales; and

 6) ensure that examples of lesson learning and good practice arising from safety surveys are disseminated and acted upon.

b) The survey leader should:
 1) carry out the survey;
 2) record the results;
 3) make recommendations; and
 4) agree actions with the relevant operational management.

c) The survey team should assist the survey leader in fulfilling their responsibilities as determined by the survey leader.

d) Safety surveys may be initiated by a number of means such as occurrence reports, safety performance, suggestions from members of staff, etc.

e) Safety surveys may be documented in a safety survey report which should also contain the specific actions that will be taken to address the recommendations. The actions should specify those responsible for completion and the target dates. The actions should be tracked to closure through an action plan. This action plan may be implemented as part of an existing locally or centrally managed action tracker.

f) A typical safety survey report would require the following content:
 1) Front sheet:
  I. reference number;
  II. title;
  III. survey period;
  IV. team members and team leader; and
  V. survey initiator;
 2) Survey description:
  I. introduction;

II. objective;
III. scope;
IV. record of results;
V. conclusions; and
VI. recommendations and actions.

g) Survey leader

The survey leader should be adequately trained and competent for the subject of the survey. Where this is not possible, at least one member of the survey team should be competent in the subject of the survey.

h) Survey team

It is advantageous for the survey team to be multi-disciplined and, where possible, be drawn from differing parts of the air traffic services provider's organization.

GM1 ATM/ANS.OR.B.005(a)(3) Management system

SAFETY PERFORMANCE MONITORING AND MEASUREMENT — ATS PROVIDER

a) The means to monitor performance is often through one or more leading or lagging indicators.

b) Indicators and performance measures provide feedback on what is happening so that the air traffic services provider can take appropriate actions to respond to changing circumstances. The indicators provide information on:
   1) what is happening around the air traffic services provider;
   2) how well the air traffic services provider is doing;
   3) what has happened so far; and
   4) warning of impending problems or dangers that the air traffic services provider may need to take action to avoid.

c) Although 'lagging' performance indicators that measure the final outcomes resulting from the air traffic services provider's activities are often considered as the most interesting, lagging indicators themselves may not provide enough information to guide the air traffic services provider's actions and ensure success.

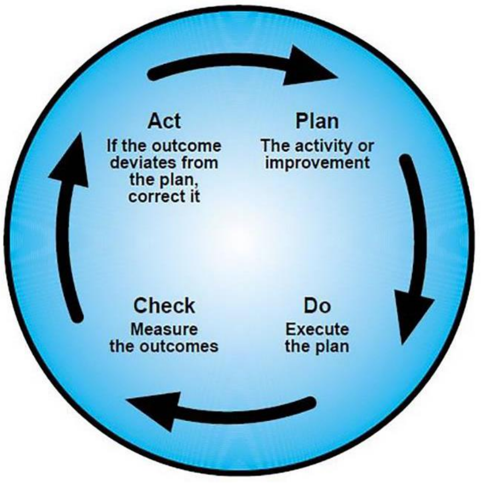
d) By measuring the inputs to a process, leading performance indicators can complement the use of lagging indicators and compensate for some of their shortcomings. Leading indicators can be used to monitor the effectiveness of control systems and give advance warning of any developing weaknesses before problems occur. One purpose of leading performance indicators is, therefore, to show the condition of systems before accidents, incidents, harm, damage or failure occurs. In this way, they can help to control risks and prevent mishaps.

e) There is good evidence that when leading performance indicators are used correctly, they are effective in improving performance. However, there is also good evidence that they can be misused.

f) For leading performance indicators to play an effective role in the improvement process, there should be an association between the inputs that the leading performance indicators measure and the desired lagging outputs. There needs to be a reasonable belief that the actions taken to improve leading performance indicators will be followed by an improvement in the associated lagging output indicators.

g) The process for effective use of leading performance indicators can be summarised as:

1) Identify where there are potential weaknesses or opportunities for improvement;
2) Identify what can be done to counter weaknesses or deliver improvement;
3) Set performance standards for the actions identified;
4) Monitor performance against the standards;
5) Take corrective actions to improve performance; and
6) Repeat the process by using the following continuous improvement model:



h) For any performance indicator to be effective, it is important that it is:
   1) objective and easy to measure and collect;
   2) relevant to the air traffic services provider whose performance is being measured;
   3) capable of providing immediate and reliable indications of the level of performance;
   4) cost-efficient in terms of the equipment, personnel and additional technology required to gather the information;
   5) understood and owned by the air traffic services provider whose performance is being measured;
   6) related to activities considered to be important for future performance;
   7) amenable to intervention/influence by the air traffic services provider whose performance is being measured;
   8) related to something where there is scope to improve; and
   9) a clear indication of a means to improve performance.

GM2 ATM/ANS.OR.B.005(a)(3) Management system

PERFORMANCE MONITORING AND MEASUREMENT — SERVICE PROVIDER OTHER THAN ATS PROVIDER

A performance indicator (PI) is a type of performance measurement. An organisation may use PIs to evaluate its success, or to evaluate the success of a particular activity in which it is engaged. Sometimes success is defined in terms of making progress towards strategic goals, but often success is simply the repeated, periodic achievement of some level of operational goal (e.g. zero defects). Accordingly, choosing the right PIs relies upon a good understanding of what is important to the organisation. Since there is a need to understand well what is important, various techniques to assess the present state of the business, and its key activities, are associated with the selection of PIs. These assessments often lead to the identification of potential improvements, so performance indicators are routinely associated with 'performance improvement' initiatives. When PIs have performance targets associated with them, they are known as key performance indicators (KPIs).

GM1 ATM/ANS.OR.B.005(a)(4) Management system

IDENTIFICATION OF CHANGES TO FUNCTIONAL SYSTEMS

This process is used by the service provider to correctly identify proposed changes. The changes dealt within this GM are the proposed changes to the functional system. These can be triggered internally by changing circumstances that are related to the service provider of concern or externally by changing circumstances that are related to others or to the context in which the service operates, i.e. in situations where the service provider does not have managerial control over them. The triggers are called 'change drivers'.

a) Identification of internal circumstances

1) The procedure to identify changes needs to be embedded in all parts of the organisation that can modify the functional system, i.e. the operational system used to support the services provided. Examples of proposed changes to the functional system as a response to changing circumstances under the control of the organisation, therefore, include:
   - I. changes to the way the components of the functional system are used;
   - II. changes to equipment, either hardware or software;
   - III. changes to roles and responsibilities of operational personnel;
   - IV. changes to operating procedures;
   - V. changes to system configuration, excluding changes during maintenance, repair and alternative operations that are already part of the accepted operational envelope;
   - VI. changes that are necessary as a result of changing circumstances to the operational context under the managerial control of the provider that can impact the service, e.g. provision of service under new conditions;
   - VII. changes that are necessary as a result of changing circumstances to the local physical (operational) environment of the functional system; and
   - VIII. changes to the working hours and/or shift patterns of key personnel which could impact on the safe delivery of services.

2) These changes are often identified by the service provider using business processes, which will be used to identify changes planned for the medium and long term. Such processes can include:
   - I. annual business plans;
   - II. strategic safety boards;
   - III. equipment replacement projects;
   - IV. airspace reorganization plans;
   - V. introduction of new operational concepts, e.g. Free Flight;
   - VI. accident and incident investigation reports; and
   - VII. safety monitoring and safety surveys.

a) Identification of external circumstances

The service provider should have processes in place to react appropriately to notifications received from those service providers that supply services to them. In addition, changes to the context that can impact on the service provided and are not under the managerial control of the service provider should be identified and treated as potential triggers. Furthermore, the service provider should negotiate contracts with unregulated service providers in accordance with ATM/ANS.OR.B.015 'Contracted activities' that place a responsibility on such organisations to inform them of planned changes to their services.

GM1 ATM/ANS.OR.B.005(b) Management system

SERVICE PROVIDER'S MANAGEMENT SYSTEM DOCUMENTATION

a) It is not required to duplicate information in several manuals. The information may be contained in the service provider's manuals (e.g. operations manual, training manual), which may also be combined.

b) A service provider may also choose to document some of the information required to be documented in separate documents (e.g. procedures). In this case, it should ensure that manuals contain adequate references to any document kept separately. Any such documents are then to be considered an integral part of the service provider's management system documentation.

c) A service provider's management system documentation may be included in a separate manual or in (one of) the manual(s) as required by the applicable subpart(s). A cross reference should be included.

GM1 ATM/ANS.OR.B.005(c) Management system

COMPLIANCE MONITORING ORGANISATIONAL SET-UP

a) The role of the compliance monitoring may be performed by a compliance monitoring manager to ensure that the activities of the service provider are monitored for compliance with the applicable regulatory requirements and any additional requirements established by the service provider, and that these activities are being carried out properly under the supervision of other relevant nominated postholders and line managers.

b) The compliance monitoring manager should:

   1) be responsible for ensuring that the compliance monitoring programme is properly implemented, maintained, and continually reviewed and improved;

   2) have direct access to the accountable manager;

   3) not be one of the line managers; and

   4) be able to demonstrate relevant knowledge, background and appropriate experience related to the activities of the service provider, including knowledge and experience in compliance monitoring.

c) The compliance monitoring manager may perform all audits and inspections himself/herself or appoint one or more auditors by choosing personnel having the related competence as defined in point (b)(iii), either from within or outside the service provider.

d) Regardless of the option chosen, it needs to be ensured that the independence of the audit function is not affected, in particular in cases where those performing the audit or inspection are also responsible for other activities within the service provider.

e) In case external personnel are used to perform compliance audits or inspections:

   1) any such audits or inspections are performed under the responsibility of the compliance monitoring manager; and

   2) the compliance monitoring manager remains responsible for ensuring that the external personnel has relevant knowledge, background and experience as appropriate to the activities being audited or inspected, including knowledge and experience in compliance monitoring.

f) A service provider retains the ultimate responsibility for the effectiveness of the compliance monitoring function, in particular for the effective implementation and follow-up of all corrective actions.

GM1 ATM/ANS.OR.B.005(f) Management system

GENERAL

Within the scope of BCAR ATM/ANS, only the air traffic services provider can identify hazards, assess the associated risks and mitigate or propose mitigating measures where necessary. This requirement implies that all service providers (air traffic services and non-air traffic services) establish formal interfaces (e.g. service level agreements, letters of understanding, memorandum of cooperation) between the relevant services providers themselves or between the service providers and other aviation undertakings (e.g. aerodrome operators) so as to ensure that hazards associated with the use of the services they provide are identified and the risks assessed and whenever needed mitigated. It does not imply that this has to be done by the service providers themselves (e.g. MET or AIS providers cannot do this by themselves) as only the air traffic services provider can, but they need to establish the interfaces with those service providers (ATS providers) or other aviation undertaking (e.g. aerodrome operators) who are able to do so. The formal interfaces could address the mitigation means put on the different providers (e.g. via requirements in a service level agreement).

GM1 to AMC1 ATM/ANS.OR.B.010(a) Change management procedures

COMPLIANCE MATRIX

The following example of a matrix could be used by the service provider to document the compliance status of its change management procedures.

Service provider	**[Name of the provider]**								
Provided service	ATS: ☐	C: ☐	N: ☐	S: ☐	MET: ☐	AIS: ☐	DAT: ☐	ASM: ☐	ATFCM: ☐
Date	DD/MM/YYYY								
Version of the form	Vx.y								
Submitted procedure(s)	Procedure ‘XYZ’ — version ‘a.b’ of MM/DD/YYYY								
	Procedure ‘JKL’ — version ‘c.d’ of MM/DD/YYYY								
	[…]								

Requirement in the Regulation	**AMC**	**Procedure**	**Rationale**	**Status**	**Competent authority comment**
ATM/ANS.OR.A .045(c)	None	Procedure ‘ JKL ’ — version ‘ c.d ’ — Paragraph 4	Paragraph 4 states that the transition into operation of any functional change will occur following the completion of the activities required by the procedures XYZ, MNO, and ABC	Non-approved	To be assessed
ATM/ANS.OR.A .045(d)	AMC1 ATM/ANS.OR.A.045(d)	Procedure ‘ XYZ ’ — version ‘ a.b ’ — Paragraph 3	Paragraph 3 stresses that a change subject to competent authority review should not be allowed to be put into service before formal approval has been granted.	Approved	None

GM1 ATM/ANS.OR.B.010(a) Change management procedures

GENERAL

a) The change management procedures for changes to functional systems should include:
   1) the identification and notification of proposed changes;
   2) the identification of the scope of the change, i.e. the identification of what parts of the functional system are to be changed or are affected by the change;
   3) the assessment and assurance of the change;
   4) the approval of the change; and
   5) the establishment of the monitoring criteria to ensure that the change will remain acceptable as long as it is in operation (acceptably safe for air traffic service providers or acceptably trustworthy for other service providers). The monitoring of the changed system is part of the activities related to the management system of the service provider. It is not covered by the change management procedures themselves.

b) The procedures that manage changes to functional systems do not include the processes to identify the circumstances that will trigger the change. These should be part of the management system(s) as laid down in ATM/ANS.OR.B.005 and/or ATS.OR.200 of BCAR ATM/ANS, as applicable.

c) The change management procedures should address the following:

   1) procedural-oriented content, which details:
      i. the roles and activities with regard to change management, safety assessment and safety support assessment;
      ii. the identification of the parts of the functional system affected by the proposed change;
      iii. the type of safety assessment or safety support assessment that has to be used for the identified type of changes;
      iv. the competence of the persons performing change management, safety assessments and safety support assessments;
      v. the identified triggers for performing a safety assessment and a safety support assessment;
      vi. the means of change notification; ‘means’ includes the form of notification;
      vii. the means of identifying any organisations or aviation undertakings using the service that are potentially affected by the change; and
      viii. the means of informing those identified in (vii).

   2) Method-oriented content, which details description of the safety assessments and safety support assessments methods and mitigation methods used by the service provider.

d) For each change management procedure or part of a change management procedure approved, the agreement on notification of any change over them should be documented and formalised. In any case, the service provider should keep records of these changes.

GM1 ATM/ANS.OR.B.015 Contracted activities

GENERAL

a) A service provider may contract certain activities to external organisations. ‘Contracted activities’ means those activities within the service provision conditions attached to the service provider’s certificate that are performed by other organisations either themselves certified to carry out such an activity or if not certified, working under the service provider’s oversight. The scope of the service provider's oversight covers the contracted activities performed by the external organisation that is not itself certified in accordance with BCAR ATM/ANS.

b) Activities contracted to external organisations for the provision of services may include areas such as:
   1) aeronautical information services;
   2) meteorological services, etc.

c) In the case of activities contracted, the service provider should define relevant management responsibilities within its own organisation.

d) The ultimate responsibility for the services provided by contracted organisations should always remain with the contracting service provider.

GM2 ATM/ANS.OR.B.015 Contracted activities

RESPONSIBILITY WHEN CONTRACTING ACTIVITIES

a) A contract could take the form of a written agreement, letter of agreement, service letter agreement, memorandum of understanding, etc. as appropriate for the contracted activities.

b) A service provider's assurance process could be included into the service provider's management system and compliance monitoring programmes.

c) In order to ensure that the contracted organisation is able to perform the contracted activities, the service provider may conduct a prior audit of the contracted party.

GM3 ATM/ANS.OR.B.015 Contracted activities

RESPONSIBILITY WHEN CONTRACTING ACTIVITIES

a) Regardless of the approval status of the contracted organisation, the service provider is responsible for ensuring that all contracted activities are subject to compliance monitoring as required by ATM/ANS.OR.B.005(b) of BCAR ATM/ANS, and in the case of air traffic services provider, also to hazard identification and risk management as required by ATS.OR.200(2).

b) If a service provider requires a contracted organisation to conduct an activity which exceeds the privileges of the contracted organisation's certificate, this will be considered as the contracted organisation working under the approval and oversight of the contracting service provider

GM4 ATM/ANS.OR.B.015 Contracted activities

RESPONSIBILITY WHEN CONTRACTING ACTIVITIES

Table 4 below illustrates the responsibilities when contracting.

	Contracted activity — **subject to certification; and** — **the contracting service provider certified for that activity**	**Contracted activity** — **subject to certification; and** — **contracting service provider NOT certified for that activity**
Contracted external organisation certified to provide the activity	A contracting service provider undertakes compliance monitoring of the contracted external organisation and should at least check that the certificate effectively covers the contracted	A contracting service provider undertakes compliance monitoring of the contracted external organisation and should at least check that the certificate effectively covers the contracted

	activities and that it is valid.	activities and that it is valid.
Contracted external organisation NOT certified to provide the activity	The contracted external organisation works under the oversight of the contracting service provider.	The activity cannot be contracted to the external organisation.

Table 4: Responsibility when contracting activities

GM1 ATM/ANS.OR.B.020(a) Personnel requirements

ACCOUNTABLE MANAGER

Depending on the size, structure and complexity of the organisation, the accountable manager may be:

a) the chief executive officer (CEO);
b) the chief operating officer (COO);
c) the chairperson of the board of directors;
d) a partner; or
e) the proprietor.

GM1 ATM/ANS.OR.B.020(b) Personnel requirements

COMBINATION OF NOMINATED POSTHOLDERS RESPONSIBILITIES

a) The acceptability of a single person holding more than one post, possibly in combination with being the accountable manager, should depend upon the service provider's organisation and the complexity of its activities. The two main areas of concern should be competence and an individual's capacity to meet his or her responsibilities.

b) As regards competence in different areas of responsibility, there should not be any difference from the requirements applicable to persons holding only one post.

The capacity of an individual to meet his or her responsibilities should primarily be dependent upon the complexity of the service provider's organisation and its activities. However, the complexity of the service provider's organisation or of its activities may prevent or limit the combination of posts.

GM1 ATM/ANS.OR.B.030 Record-keeping

GENERAL

The record-keeping provision is intended to address the management system records rather than operational data which is covered by other record-keeping applicable requirements.

SUBPART C — SPECIFIC ORGANIZATION REQUIREMENT FOR SERVICE PROVIDER OTHER THAN ATS PROVIDER (ATM/ANS.OR.C)

GM1 ATM/ANS.OR.C.005(a)(1) Safety support assessment and assurance of changes to the functional system

GENERAL

a) The safety support assessment should be conducted by the service provider itself. It may also be carried out by another organisation, on its behalf, provided that the responsibility for the safety support assessment remains with the service provider.

b) A safety support assessment needs to be performed when a change affects a part of the functional system managed by a service provider other than an air traffic services provider and it is being used in the provision of its services. The safety support assessment or the way it is conducted does not depend on whether the change is a result of a business decision or a decision to improve the service performance.

GM2 ATM/ANS.OR.C.005(a)(1) Safety support assessment and assurance of changes to the functional system

SAFETY SUPPORT ASSESSMENTS BY PROVIDERS THAT ARE ALSO ATS PROVIDERS

a) Only air traffic services providers can perform a safety assessment. Service providers other than air traffic services providers can only perform a safety support assessment to determine that the new or changed service behaves only as specified in a specified context.

b) A safety support assessment should be carried out for changes that cross the organisation's boundary.

c) An air traffic services provider may choose not to perform a safety support assessment of changes to its functional system when the changes do not cross the organisation's boundary. In this specific case, the safety assessment of changes to the functional system should be performed.

GM3 ATM/ANS.OR.C.005(a)(1) Safety support assessment and assurance of changes to the functional system

SAFETY SUPPORT ASSESSMENT

a) A safety support assessment is needed whenever the functional system of a service provider other than an air traffic services provider changes. This may be as a result of:
   1) the provider proposing a change to:
      i. its functional system;
      ii. the services it provides;
      iii. the context in which its functional system operates; or
      iv. the context in which the service is provided;
   2) the services used by the provider in the delivery of its services being planned to change; or/and
   3) a change to the context in which the service provider's functional system operates as a result of a proposed change by another service provider, another organisation regulated by the BCAA or an unregulated body.

b) The granularity of the safety support case report will depend on:
   (1) the scope of the change;
   (2) the nature and number of arguments; and
   (3) the necessary and sufficient evidence needed to provide appropriate confidence that the safety support assurance is valid (complete and correct).

GM4 ATM/ANS.OR.C.005(a)(1) Safety support assessment and assurance of changes to the functional system

SCOPE OF THE CHANGE

(a) The description of the elements being changed includes the nature, functionality, location, performance, maintenance tasks, training and responsibilities of these elements, where applicable. The description of interfaces and interactions, between machines and between humans and machines, should include communication means, e.g. language, phraseology, protocol, format, order and timing and transmission means, where applicable. In addition, it includes the description of the context in which they operate.

(b) here are two main aspects to consider in evaluating the scope of a change:
1) The interactions within the changed functional system.
2) The interactions within the changing functional system, i.e. those that occur during transitions from the current functional system to the changed system. During such transitions, components are replaced/installed in the functional system. These installation activities are interactions within the changing functional system and are to be included within the scope of the change.

As each transition can be treated as a change to the functional system, the identification of both the above has a common approach described below.

(c) The scope of the change is defined as the set of the changed components and affected components. In order to identify the impacted components and the changed components, it is necessary to:
1) know which components will be changed;
2) know which component's (components') behaviour might be affected by the changed components, although it is (they are) not changed itself (themselves); and
3) detect indirectly affected components by identifying:
   i. new interactions introduced by the changed or directly affected components;
   ii. interactions with changed or directly affected components via the context.

Furthermore, directly and indirectly impacted components will be identified as a result of applying the above iteratively to any directly and indirectly impacted components that have been identified previously.

The scope of the change is the set of changed, directly impacted and indirectly impacted components identified when the iteration identifies no new components.

(d) The context in which the changed service is intended to be provided (see ATM/ANS.OR.C.005(a)(1)(iii) of BCAR ATM/ANS) includes the interface through which the service will be delivered to other service providers.

GM5 ATM/ANS.OR.C.005(a)(1) Safety support assessment and assurance of changes to the functional system

TRAINING

If the change modifies the way people interact with the rest of the functional system, then they will require training before the change becomes operational. Care should be taken when training operational staff before the change is operational, as the training may change the behaviour of the operational staff when they interact with the existing functional system before any other part of the change is made, and so the training may have to be treated as a transitional stage of the change. For example, as a result of training, ATCOs may come to expect information or alerts to be presented differently. People may also need refreshment training periodically in order to ensure that their performance does not degrade over time. The training needed before operation forms part of the design of the change, while the refreshment training is part of the maintenance of the functional system after the change is in operation.

GM6 ATM/ANS.OR.C.005(a)(1) Safety support assessment and assurance of changes to the functional system

INTERACTIONS

The identification of changed interactions is necessary in order to identify the scope of the change because any changed behaviour in the system comes about via a changed interaction. Changed interaction happens via an interaction at an interface of the functional system and the context in which it operates. Consequently, identification of both interfaces and interactions is needed to ensure that all interactions have identified interfaces and all interfaces have identified interactions. From this, all interactions and interfaces that will be changed can be identified.

GM1 to AMC2 ATM/ANS.OR.C.005(a)(2) Safety support assessment and assurance of changes to the functional system

COMPLETENESS OF THE ARGUMENT

(a) Sufficiency of specifications

The way the service specification is arrived at is not of particular interest in a safety support case and so it is not dealt with here. A specification that is sufficient implies that the service meets the provider's intent, i.e. it is valid. Two necessary conditions for a sufficient specification are provided here:

(1) Assessment of failure conditions

i) Failures or failure conditions are malfunctions of behaviour. This means either the loss or corruption of some intended behaviour, e.g. behaviour that is considered to be:
(A) more than (quantity, information);
(B) less than (quantity, information);
(C) additional to;
(D) faster than;
(E) slower than;
(F) part of;
(G) reverse of;
(H) other than;
(I) not;
(J) earlier than;
(K) later than;
(L) before; or
(M) after
that which was intended. If the behaviour of the service is altered in any way during malfunctions, the altered behaviour needs to be included in the specification. Further details could be found under GM1 ATM/ANS.OR.C.005(b)(1) and GM1 ATM/ANS.OR.C.005(b)(2).

ii) Some failures may not result in a degraded service.

iii) Some failures may not be relevant in the context of use.

iv) Strictly speaking, the failure and failure conditions described here are malfunctions of the services delivered by a component and may be caused by failures of components, errors in design, failures of services used by the component, or failures of the activities associated with installing the component, i.e. failure to install the component in the intended manner.

v) When a redundancy within a component is no longer available, the behaviour of the component is considered to have changed, e.g. the reliability of the component will have changed and an indication of the loss of redundancy will have been provided.

(2) Evaluation of the behaviour

It is necessary to argue that the behaviour of the implementation, i.e. the system as built, matches the specification and there is no additional (unspecified) behaviour. This implies verification of service behaviour, which is required by ATM/ANS.OR.C.005(b)(2) of BCAR ATM/ANS and stated here in a more specific way.

It is also necessary to argue that the behaviour of the change during transition into service matches the specification and there is no additional (unspecified) behaviour. If transition into service causes disruption to the service being changed or other services provided by the service provider, then it may be necessary to include, within the specification, a specification of the intended installation activities. This implies an assessment of failure conditions associated with the installation activities and the specification of any necessary mitigations, should the failures materialise and the installation not be performed as intended.

(b) Safety support requirements

(1) The safety support requirements are characteristics/items of the functional system to ensure that the system operates as specified. Based on the verification/demonstration of these characteristics/items, it could be concluded that the specifications are met.

(2) The highest-layer of safety support requirements represents the desired behaviour of the change at its interface with the operational context. These, ultimately become the specification, once the implementation is verified.

(3) In almost all cases, verification that a system behaves as specified cannot be accomplished to an acceptable level of confidence at the level of its interface with its operational environment. To this end, the system verification should be decomposed into verifiable parts, taking into account the following principles:

i) Verification relies on requirements placed on these parts via a hierarchical decomposition of the top-level requirements, in accordance with the constraints imposed by the chosen architecture.

ii) At the lowest level, this decomposition places requirements on elements, where verification that the implementation satisfies its requirements can be achieved by testing.

iii) At higher levels in the architecture, during integration, verified elements of different types are combined into subsystems/components, in order to verify more complete parts of the system.

iv) While they cannot be fully tested, other verification techniques may be used to provide sufficient levels of confidence that these subsystems/components do what they are supposed to do.

v) Consequently, since decomposing the system into verifiable parts relies on establishing requirements for those parts, then safety support requirements are necessary.

(4) The way safety support requirements are achieved, is not of particular interest in a safety assessment, because a safety support argument demonstrates the trustworthiness of the specification.

(5) The architecture may not have requirements. During development, the need to argue satisfaction of system level requirements, which cannot be performed at the system level for any practical system, drives the architecture because verifiability depends on the decomposition of the system into verifiable parts.

(6) Demonstration that safety support requirements at system level are met allows them to be transformed into the safety support specification.

(c) Satisfaction of safety support requirements

(1) The concept laid down in AMC2 ATM/ANS.OR.C.005(a)(2) is that, provided the system and each subsystem/component/element meet its requirements, the system will behave as specified. This will be true provided (2), (3) and (4) below are met.

(2) The activity needed to meet objective (c) of AMC2 ATM/ANS.OR.C.005(a)(2) consists of obtaining sufficient confidence that the set of requirements is complete and correct, i.e. that:

i. the architectural decomposition leads to a complete and correct set of requirements being allocated to each subsystem/component/element;
ii. each requirement is a correct, complete and unambiguous statement of the desired behaviour, and does not contradict another requirement or any other subset of requirements; and
iii. the requirements allocated to a subsystem/component/element necessitate the complete required behaviour of the subsystem/component/element in the target environment.

(3) This should take into account specific aspects such as:

i. the possible presence of functions within the subsystem/component/element that produce unnecessary behaviour. For instance, in the case where a previously developed part is used, activities should be undertaken to identify all the possible behaviours of the part. If any of these behaviours is not needed for the foreseen use, then additional requirements may be needed to make sure that these functions are not solicited or inadvertently activated in operation or that the effects of any resulting behaviour are mitigated;
ii. subsystem/component/element requirements that are not directly related to the desired behaviour of the functional system. This kind of requirement can, for instance, ask that the subsystem/component/element be developed in a given syntax or be designed in a certain way. These requirements often relate to technical aspects of the subsystem/component/element. Activities should be undertaken to ensure that each of these requirements is a correct, complete and unambiguous statement of the desired effect, and does not contradict another requirement or any other subset of requirements.

(4) The system behaviour should be considered complete in the sense that the specification is only true for the defined context. This restriction to the context of the use of the service makes safety support assessment and assurance of changes to the functional system a practical proposition.

(d) Traceability of requirements

The traceability requirement can be met by tracing to the highest-level element in the architectural hierarchy that has been shown to satisfy its requirements, by verifying it in isolation. It is likely and completely acceptable that this point will be reached at a different architectural level for each element.

(e) Satisfaction of safety support requirements

(1) The component view taken must be able to support verification, i.e. the component must be verifiable — see guidance in (b).

(2) Care should be taken in selecting subsystems that are to be treated as components for verification to ensure that they are small and simple enough to be verifiable.

(3) The context argument needs to demonstrate that the context in which a component is verified does not compromise the claim that the specification is true over a specified context, i.e. the component verification context is correctly related to the context claimed for the operation of the functional system.

(f) Configuration identification

1) This is only about configuration of the evidence and should not be interpreted as configuration management of the functional system. However, since the safety support assessment is based on a set of elements and the way they are interlinked, the safety support assessment should only be valid if the configuration remains as described in the safety support argument.

2) Evidence for the use of a component should rely on testing activities considering the actual usage of domains and contexts. When the same component is used in different parts of the system or in different systems, it may not be possible to rely on testing in a single context since it is unlikely that the contexts for each use will be the same or can be covered by a single set of test conditions. This applies equally to the reuse of evidence gathered from testing subsystems.

GM1 ATM/ANS.OR.C.005(a)(2) Safety support assessment and assurance of changes to the functional system

SPECIFICATION

'Continue to behave only as specified in the specified context' means that assurance needs to be provided that the monitoring requirements are suitable for demonstrating that the service behaves only as specified in the specified context during operation.

GM2 ATM/ANS.OR.C.005(a)(2) Safety support assessment and assurance of changes to the functional system

ASSURANCE LEVELS

The use of assurance level concepts, e.g. design assurance levels (DAL), software assurance levels (SWAL), hardware assurance levels (HWAL), can be helpful in generating an appropriate and sufficient body of evidence to help establish the required confidence in the argument.

GM3 ATM/ANS.OR.C.005(a)(2) Safety support assessment and assurance of changes to the functional system

SAFETY SUPPORT REQUIREMENTS

The complete behaviour is limited to the scope of the change. Safety support requirements only apply to the parts of a system affected by the change. In other words, if parts of a system can be isolated from each other and only some parts are affected by the change, then these are the only parts that are of concern and so will have safety support requirements attached to them.

The following list contains examples, not exhaustive, of safety support requirements that specify:

a) for equipment, the complete behaviour, in terms of functions, accuracy, timing, order, format, capacity, resource usage, robustness to abnormal conditions, overload tolerance, availability, reliability, confidence and integrity;

b) for people, their performance in terms of tasks (e.g. accuracy, response times, acceptable workload, resilience to distraction, self-awareness, 'team-playerness', adaptability, reliability, confidence, skills, and knowledge in relation to their tasks);

c) for procedures, the circumstances for their enactment, the resources needed to perform the procedure (i.e. people and equipment), the sequence of actions to be performed and the timing and accuracy of the actions; and

d) interactions between all parts of the system.

GM1 ATM/ANS.OR.C.005(b)(1) Safety support assessment and assurance of changes to the functional system

DESCRIPTION OF THE SCOPE — 'MULTI-ACTOR CHANGE'

In the case where the change is a 'multi-actor change' in reference to ATM/ANS.OR.A.045(e), the interfaces and interactions include the interfaces with the other service providers and/or aviation undertakings that are also affected by the change.

GM2 ATM/ANS.OR.C.005(b)(1) Safety support assessment and assurance of changes to the functional system

VERIFICATION

This requirement is seeking verification because it is a simple cross-check of available material, i.e. that the specification reflects the requirements of other parts of BCAR ATM/ANS.

a) Behaviour

ATM/ANS.OR.C.005(b)(1)(ii) of BCAR ATM/ANS requires that the service meets its specification. Consequently, the specification must be complete and valid, i.e. it includes the behaviour addressed in ATM/ANS.OR.C.005(b)(1)(iii) and any additional behaviour in the specified context.

b) Compliance with other requirements

(1) ATM/ANS.OR.C.005(b)(1)(iii) requires the service providers to identify all parts of the BCAR ATM/ANS that impose behaviour on the changed service and also includes any conditions attached to the certificate. They have to identify only those parts of BCAR ATM/ANS that describe required behaviour relevant to the changed service. The identified behaviour shall be included in the specification of the changed service.

Note that the Regulation or conditions attached to the certificate may render compliance with technical standards and ICAO SARPs mandatory.

(2) Compliance with other non-mandatory standards may also be a necessary condition for other reasons.

(3) ATM/ANS.OR.C.005(b)(1)(iii) does not state that the service only meets the requirements of the other parts of BCAR ATM/ANS. It may do other things as well, as described in (5) below.

(4) In ATM/ANS.OR.C.005(b)(1)(iii), 'does not contradict' is used to express the concern that behaviour beyond that required by a standard might cause the behaviour required by the standard to be undermined.

(5) The behaviour of a service is likely to include behaviour unspecified in standards; such behaviour may come from:
   i. the behaviour of degraded modes of operation;
   ii. additional behaviour not required by the standard, but put there for commercial purposes, e.g. competitive edge; or
   iii. other behaviour identified by the customer, e.g. an air traffic services provider.

(6) Consequently, the total behaviour should be specified.

GM1 ATM/ANS.OR.C.005(b)(2) Safety support assessment and assurance of changes to the functional system

MONITORING OF INTRODUCED CHANGES

a) Monitoring is intended to maintain confidence in the safety support argument during operation of the changed functional system. Monitoring is, therefore, only applicable following the entry into service of the change.

b) Monitoring is likely to be of internal parameters of the functional system that provide a good indication of the performance of the service. These parameters may not be directly observable at the service level, i.e. at the interface of the service with the operational environment. For example, where a function is provided by multiple redundant resources, the availability of the function will be so high that monitoring it may not be useful. However, monitoring the availability of individual resources, which fail much more often, may be a useful indicator of the performance of the overall function.

CHAPTER IV — PART-ATS
SPECIFIC REQUIREMENTS FOR PROVIDERS OF AIR TRAFFIC SERVICES

SUBPART A — ADDITIONAL ORGANISATION REQUIREMENTS FOR PROVIDERS OF AIR TRAFFIC SERVICES (ATS.OR)

SECTION 2 – SAFETY OF SERVICES

GM1 ATS.OR.200(1)(i) Safety management system

SAFETY POLICY — COMPLEX ATS PROVIDERS

Operational behaviour, when disciplinary action would not apply, could be where someone is not blamed for reporting something which would not have been otherwise detected.

GM2 ATS.OR.200(1)(i) Safety management system

SAFETY POLICY — COMPLEX ATS PROVIDERS

(a) The safety policy should state that the purpose of safety reporting and internal investigations is to improve safety, not to apportion blame to individuals.

(b) An air traffic services provider may combine the safety policy with the policy required by ATM/ANS.OR.B.005(a)(2) of BCAR ATM/ANS.

GM3 ATS.OR.200(1)(i) Safety management system

SAFETY POLICY — NON-COMPLEX ATS PROVIDERS

(a) The safety policy should state that the purpose of safety reporting is to improve safety, not to apportion blame to individuals.

(b) An air traffic services provider may combine the safety policy with the policy required by ATM/ANS.OR.B.005(a)(2) of BCAR ATM/ANS.

GM1 ATS.OR.200(1)(ii) Safety management system

SAFETY ACTION GROUP — COMPLEX ATS PROVIDERS

(a) A safety action group may be established as a standing group or as an ad hoc group to assist or act on behalf of the safety review board as defined in point (b) of AMC2 ATS.OR.200(1)(ii);(iii) of BCAR ATM/ANS.

(b) More than one safety action group may be established depending on the scope of the task and the specific expertise required.

(c) The safety action group should report to and take strategic direction from the safety review board and should comprise managers, supervisors and personnel from operational areas.

(d) The safety action group should:
  (1) monitor operational safety;
  (2) resolve identified risks;
  (3) assess the impact on safety of operational changes; and
  (4) ensure that safety actions are implemented within agreed timescales.

(e) The safety action group should review the effectiveness of previous safety recommendations and safety promotion.

(f) Members of the safety action group should participate in the local runway safety team.

GM1 ATS.OR.200(1)(iii) Safety management system

SAFETY MANAGER — COMPLEX ATS PROVIDERS

(a) Depending on the size of the air traffic services provider and the nature and complexity of their activities, the safety manager may be assisted by additional safety personnel in the performance of all the safety-management-related tasks.

(b) Regardless of the organisational set-up, it is important that the safety manager remains the unique focal point as regards the development, administration and maintenance of the air traffic services provider's SMS.

GM2 ATS.OR.200(1)(iii) Safety management system

SAFETY MANAGER — NON-COMPLEX AIR TRAFFIC SERVICES PROVIDERS

In the case of a non-complex air traffic services provider, the function of the safety manager could be combined with another function within the organisation provided that sufficient independence is guaranteed.

GM1 ATS.OR.200(1)(iv) Safety management system

TYPES OF EMERGENCIES

At least the following types of emergencies may be considered:
(a) aircraft emergencies;
(b) natural phenomena (e.g. extreme weather conditions);
(c) acts of terrorism;
(d) loss of the ability to communicate with the aircraft; and
(e) loss of the air traffic services unit.

GM1 ATS.OR.200(1)(v) Safety management system

SAFETY MANAGEMENT MANUAL (SMM) — COMPLEX ATS PROVIDERS

The SMM may be contained in (one of) the manual(s) of the air traffic services provider.

GM1 ATS.OR.200(3)(i) Safety management system

SAFETY ASSURANCE — COMPLEX ATS PROVIDERS

(a) Leading indicators

(1) Metrics that measure inputs to the safety system (either within an organisation, a sector or across the total aviation system) to manage and improve safety performance.

(2) Leading indicators measure the specific features of the aviation safety system designed to support continuous improvement and to give an indication of likely future safety performance. They are designed to help identify whether the providers and regulators are taking actions and/or have processes in place that are effective in lowering the risk.

(b) Lagging indicators

Metrics that measure the outcome of the service delivery by measuring events that have already occurred and that impact safety performance. There are two subsets of lagging indicators:

(1) Outcome indicators: These include only the occurrences that one aims to prevent, for example fatal or catastrophic accidents. Depending on the system, the severity of the occurrences that are included as outcome indicators can be adjusted to include all accidents and serious incidents.

(2) Precursor indicators: These indicators do not manifest themselves in accidents or serious incidents. They indicate less severe system failures or ‘near misses’, and are used to assess how frequently the system comes close to severe failure. Because they are typically more numerous than outcome indicators, they can be used for trend monitoring.

(c) Safety management system

In the case of a complex air traffic services provider, the SMS should include all of these measures. Risk management efforts, however, should be targeted at leading indicators and precursor events. The reason for doing this is to reduce the number of accidents and serious incidents.

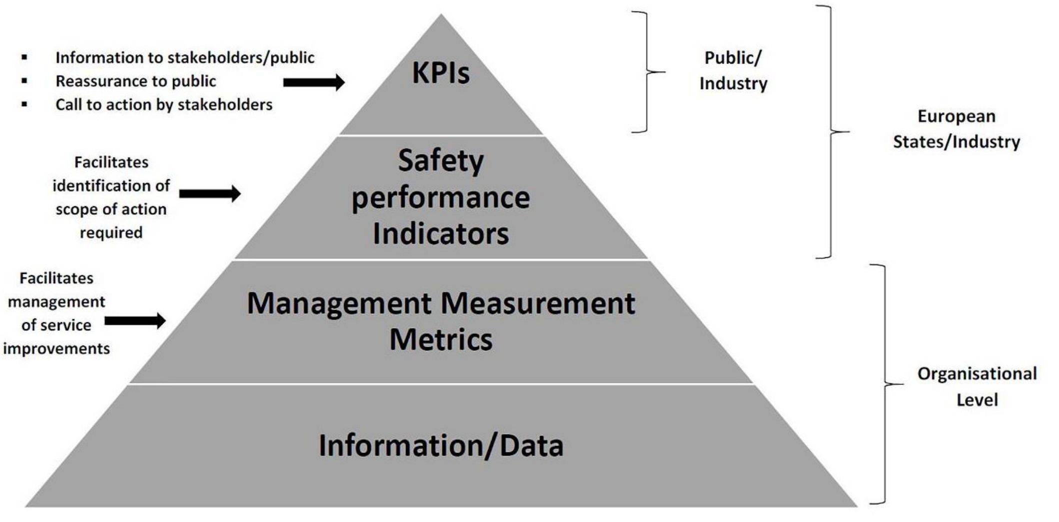
(d) Differing levels of safety performance monitoring

(1) Measurements of safety in terms of undesirable events, such as accidents and incidents, are examples of ‘lagging indicators’, which can capture safety performance a posteriori. Such indicators give valuable signals to all involved in air traffic services — providers, regulators, and recipients — of the levels of safety being experienced and of the ability of the organisations concerned to take appropriate mitigation action.

(2) However, other types of measurement — ‘leading indicators’ — can give a wider perspective of the safety ‘health’ of the functional system, and focus on systemic issues, such as safety maturity and SMS performance.

(3) A holistic approach to performance monitoring is an essential input to decision-making with regard to safety. It is important to ensure that good safety performance is attributable to good performance of the SMS, not simply to lack of incidents or accidents. It is also essential that the metrics chosen match the requirements of the stakeholders and decision-makers involved in safety improvement.

(4) As shown in the diagram, stakeholders in the wider aviation industry and the general public require relatively small numbers of safety indicators (safety performance indicators or key performance indicators) which can give an instant ‘feel’ for the overall position regarding safety performance. Conversely, those involved in the management of services concerned need a more detailed set of metrics on which to base decisions regarding the management of the services and facilities being reviewed.



Monitoring metrics

GM1 ATS.OR.200(3)(iii) Safety management system

CONTINUOUS IMPROVEMENT OF THE SMS — COMPLEX ATS PROVIDERS

(a) Substandard performance of the SMS can manifest itself in two ways. Firstly, where the SMS processes themselves do not fit their purpose (e.g. not adequately enabling the air traffic services provider to identify, manage and mitigate hazards and their associated risks) resulting in the safety performance of the service being impacted in a negative way. Secondly, where the SMS processes fit their purpose, but are not applied correctly or adequately by the personnel whose safety accountabilities and responsibilities are discharged through the application of the SMS. Personnel who have safety accountabilities and responsibilities are considered an essential part of the effectiveness of the SMS and viewed as part of the SMS.

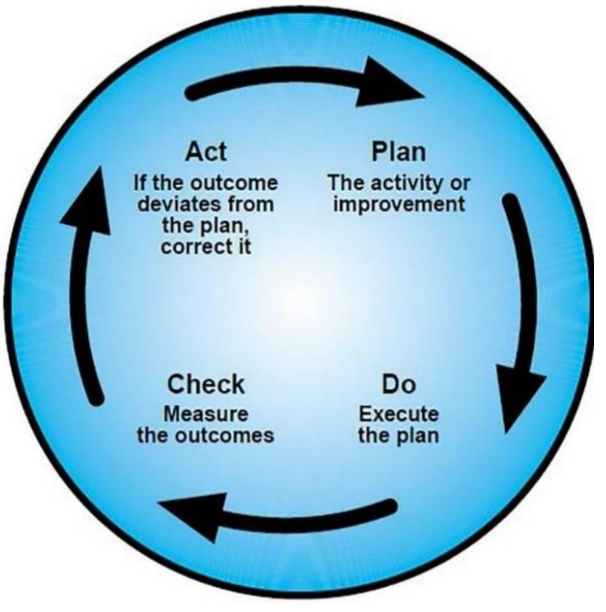
(b) Therefore, by detecting substandard performance of the SMS, the air traffic services provider can take action to improve the SMS processes themselves or to improve the application of the SMS processes by those with safety accountabilities and responsibilities resulting in an improvement to the safety performance.

(c) Continuous improvement of the effectiveness of the safety management processes can be achieved through:
   (1) proactive and reactive evaluations of facilities, equipment, documentation, processes and procedures through safety audits and surveys; and
   (2) reactive evaluations in order to verify the effectiveness of the system for control and mitigation of risks.

(d) In the same way that continuous improvement is sought through safety performance monitoring and measurement (see GM1 ATM/ANS.OR.B.005(a)(3) and GM1 ATS.OR.200(3)(i)) by the use of leading and lagging indicators, continuous improvement of the SMS provides the air traffic services provider with safety assurance for the service.

(e) As with safety performance monitoring, the continuous improvement of the SMS lends itself to a process that can be summarised as:
   (1) Identify where there are potential weaknesses or opportunities for improvement;
   (2) Identify what goes right and disseminate as best practice;
   (3) Identify what can be done to tackle weaknesses or lead to improvement;

(4) Set performance standards for the actions identified;
(5) Monitor performance against the standards;
(6) Take corrective actions to improve performance; and
(7) Repeat the process by using the continuous improvement model below:



(8) Taking into account that the SMS is being required to manage safety, it can be assumed that by continuously improving the effectiveness of the SMS, ATS providers should be able to better manage and mitigate, and ultimately control the safety risks associated with the provisions of their services.

GM1 ATS.OR.200(4)(i) Safety management system

TRAINING — COMPLEX ATS PROVIDERS

The safety training programme may consist of self-instruction (e.g. newsletters, flight safety magazines), classroom training, e-learning or similar training provided by training organisations.

GM1 ATS.OR.205(a)(1) Safety assessment and assurance of changes to the functional system

GENERAL

(a) The safety assessment should be conducted by the air traffic services provider itself. It may also be carried out by another organisation, on its behalf, provided that the responsibility for the safety assessment remains with the air traffic services provider.

(b) A safety assessment needs to be performed when a change affects a part of the functional system managed by the provider of air traffic services and that is being used in the provision of its (air traffic) services. The safety assessment or the way it is conducted does not depend on whether the change is a result of a business decision or a decision to improve safety.

GM2 ATS.OR.205(a)(1) Safety assessment and assurance of changes to the functional system

SCOPE OF THE CHANGE

(a) The description of the elements being changed includes the nature, functionality, location, performance, maintenance tasks, training and responsibilities of these elements, where applicable. The description of interfaces and interactions, between machines and between humans and machines, should include communication means, e.g. language, phraseology, protocol, format, order and timing and transmission means, where applicable. In addition, it includes the description of the context in which they operate.

(b) There are two main aspects to consider in evaluating the scope of a change:
   (1) The interactions within the changed functional system;
   (2) The interactions within the changing functional system, i.e. those that occur during transitions from the current functional system to the changed functional system. During such transitions, components are replaced/installed in the functional system. These installation activities are interactions within the changing functional system and are to be included within the scope of the change.

   As each transition can be treated as a change to the functional system, the identification of both the above has a common approach described below.

(c) The scope of the change is defined as the set of the changed components and affected components. In order to identify the affected components and the changed components, it is necessary to:
   (1) know which components will be changed;
   (2) know which component's (components') behaviour might be directly affected by the changed components, although it is (they are) not changed itself (themselves);
   (3) detect indirectly affected components by identifying:
      i) new interactions introduced by the changed or directly affected components; and/or
      ii) interactions with changed or directly affected components via the environment.
   (4) Furthermore, directly and indirectly affected components will be identified as a result of applying the above iteratively to any directly and indirectly affected components that have been identified previously.

   The scope of the change is the set of changed, directly impacted and indirectly impacted components identified when the iteration identifies no new components.

(d) The context in which the changed service is intended to operate (see ATS.OR.205(a)(1)(iii) of BCAR ATM/ANS) includes the interface through which the service will be delivered to its users.

GM3 ATS.OR.205(a)(1) Safety assessment and assurance of changes to the functional system

TRAINING

If the change modifies the way people interact with the rest of the functional system, then a training might be required before the change becomes operational. Care should be taken when training operational staff before the change is operational, as the training may change the behaviour of the operational staff when they interact with the existing functional system before any other part of the change is made, and so may have to be treated as a transitional stage of the change.
For example, as a result of training, air traffic controllers (ATCOs) may come to expect information or alerts to be presented differently. People may also need refreshment training periodically in order to ensure that their performance does not degrade over time. The training needed before operation forms part of the design of the change, while the refreshment training is part of the maintenance of the functional system after the change is in operation.

GM4 ATS.OR.205(a)(1) Safety assessment and assurance of changes to the functional system

DESCRIPTION OF THE SCOPE — 'MULTI-ACTOR CHANGE'

In reference to 'multi-actor change', please refer to GM1 ATM/ANS.OR.C.005(b)(1) Safety support assessment and assurance of changes to the functional system.

GM1 ATS.OR.205(a)(1)(iii) Safety assessment and assurance of changes to the functional system

INTERACTIONS

The identification of changed interactions is necessary in order to identify the scope of the change because any changed behaviour in the system comes about via a changed interaction. Changed interaction happens via an interaction at an interface of the functional system and the context in which it operates. Consequently, identification of both interfaces and interactions is needed to be sure that all interactions have identified interfaces and all interfaces have identified interactions. From this, all interactions and interfaces that will be changed can be identified.

GM1 to AMC2 ATS.OR.205(a)(2) Safety assessment and assurance of changes to the functional system

COMPLETENESS OF THE ARGUMENT

(a) Sufficiency of safety criteria

(1) A sufficient set of safety criteria is one where the safety goal of the change is validly represented by the set of individual safety criteria, each criterion of which must be valid in its own right and not contradict another criterion or any other subset of criteria. A valid criterion is a correct, complete and unambiguous statement of the desired property. An individual valid criterion does not necessarily represent a complete safety criterion. An example of an invalid criterion is that the maximum take-off weight must not exceed 225 Tonnes because weight is measured in Newtons and not in Tonnes. An example of an incomplete criterion is that the accuracy must be 5 m because no reliability attribute is present. This implies it must always be within 5 m, which is impossible in practice.

(2) Optimally, a sufficient set of criteria would consist of the minimum set of non-overlapping valid criteria and it is preferable to a set containing overlapping criteria.

(3) Criteria that are not relevant, i.e. ones that do not address the safety goal of the change at all, should be removed from the set as they contribute nothing, may contradict other valid criteria and may serve to confuse.

(4) There are two forms of overlap: complete overlap and partial overlap.

i) In the first case (complete overlap), one or more criteria can be removed and the set would remain sufficient, i.e. there are unnecessary criteria.

ii) In the second case, (partially overlapping criteria) if any criterion were to be removed, the set would not be sufficient. Consequently, all criteria are necessary; however, validating the set would be much more difficult. Showing that a set of criteria with significant overlap do not contradict each other is extremely difficult and consequently prone to error.

(5) It may, in fact, be simpler to develop an architecture that supports non-overlapping criteria than to attempt to validate a partially overlapping set of criteria.

(b) Safety requirements

(1) The safety requirements are design characteristics/items of the functional system to ensure that the system operates as specified. Based on the verification/demonstration of these characteristics/items, it could be concluded that the safety criteria are met.

(2) The highest layer of safety requirements represents the desired safety behaviour of the change at its interface with the operational context.

(3) In almost all cases, verification that a system behaves as specified cannot be accomplished, to an acceptable level of confidence, at the level of its interface with its operational environment. To this end, the system verification should be decomposed into verifiable parts, taking into account the following principles:

i) Verification relies on requirements placed on these parts via a hierarchical decomposition of the top level requirements, in accordance with the constraints imposed by the chosen architecture.

ii) At the lowest level, this decomposition places requirements on elements, where verification that the implementation satisfies its requirements can be achieved by testing.

iii) At higher levels in the architecture, during integration, verified elements of different types are combined into subsystems/components, in order to verify more complete parts of the system.

iv) While they cannot be fully tested, other verification techniques may be used to provide sufficient levels of confidence that these subsystems/components do what they are supposed to do.

v) Consequently, since decomposing the system into verifiable parts relies on establishing requirements for those parts, then safety requirements are necessary.

(4) The architecture may not have requirements. During development, the need to argue satisfaction of safety criteria, which cannot be performed at the system level for any practical system, drives the architecture because verifiability depends on the decomposition of the system into verifiable parts.

(c) Satisfaction of safety criteria

(1) The concept laid down in AMC2 ATS.OR.205(a)(2) of BCAR ATM/ANS is that, provided each element meets its safety requirements, the system will meet its safety criteria. This will be true provided (2) and (3) below are met.

(2) The activity needed to meet this objective consists of obtaining sufficient confidence that the set of safety requirements is complete and correct, i.e. that:

i) the architectural decomposition of the elements leads to a complete and correct set of safety requirements being allocated to each sub-element;

ii) each safety requirement is a correct, complete and unambiguous statement of the desired behaviour and does not contradict another requirement or any other subset of requirements; and

iii) the safety requirements allocated to an element necessitate the complete required safety behaviour of the element in the target environment.

(3) This should take into account specific aspects such as:

i) the possible presence of functions within the element that produce unnecessary behaviour. For instance, in the case where a previously developed element is used, activities should be undertaken to identify all the possible behaviours of the element. If any of these behaviours is not needed for the foreseen use, then additional requirements may be needed to make sure that these functions will not be solicited or inadvertently activated in operation or that the effects of any resulting behaviour are mitigated;

(d) other requirements that are not directly related to the desired behaviour of the functional system. These requirements often relate to technical aspects of the system or its components. Activities should ensure that each of these requirements does not compromise the safety of the system, i.e. does not contradict the safety requirements or criteria.

(e) Traceability of requirements

The traceability requirement can be met by tracing to the highest-level element in the architectural hierarchy that has been shown to satisfy its requirements, by verifying it in isolation.

(f) Satisfaction of safety requirements

(1) The component view taken must be able to support verification, i.e. the component must be verifiable.

(2) Care should be taken in selecting subsystems that are to be treated as components for verification to ensure that they are small and simple enough to be verifiable.

(g) Adverse effects on safety

(1) Interactions of all changed components or components affected by the change, operating in their defined context, have to be identified and assessed for safety in order to be able to show that they do not adversely affect safety. This assessment must include the failure conditions for all components and the behaviour of the services delivered to the component including failures in those services.

(2) Interactions between changing components, as they are installed during transitions into operation, and the context in which they operate have to be identified and assessed for safety in order to be able to show that they do not adversely affect safety. This assessment must include the failure conditions for all installation activities.

In some cases, installing components during transition into operation may cause disruption to services other than the one being changed. These services fall within the scope of the change (see GM1 ATM/ANS.OR.A.045(c); (d)), and consequently the safety effects failures of these services, due to failures of the installation activities, have to be assessed as well and, if necessary, their impacts mitigated.

(3) Interactions in complex systems are dealt with in ATM/ANS.OR.A.045(e)(1) of BCAR ATM/ANS.

(h) Configuration identification

(1) AMC2 ATS.OR.205(a)(2), point (f) is only about configuration of the evidence and should not be interpreted as configuration management of the changed functional system. However, since the safety case is based on a set of elements and the way they are joined together, the safety case will only be valid if the configuration remains as described in the safety case.

(2) Evidence for the use of a component should rely on testing activities considering the actual usage domains and contexts. When the same component is used in different parts of the system or in different systems, it may not be possible to rely on testing in a single context since it is unlikely that the contexts for each use will be the same or can be covered by a single set of test conditions. This applies equally to the reuse of evidence gathered from testing subsystems.

GM1 ATS.OR.205(a)(2) Safety assessment and assurance of changes to the functional system

SAFETY CRITERIA

'Safety criteria will remain satisfied' means that the safety criteria continue to be satisfied after the change is implemented and put into operation. The safety case needs to provide assurance that the monitoring requirements of ATS.OR.205(b)(6) are suitable for demonstrating, during operation, that the safety criteria remain satisfied and, therefore, the argument remains valid.

GM2 ATS.OR.205(a)(2) Safety assessment and assurance of changes to the functional system

ASSURANCE LEVELS

The use of assurance level concepts, e.g. design assurance levels (DAL), software assurance levels (SWAL), hardware assurance levels (HWAL), can be helpful in generating an appropriate and sufficient body of evidence to help establish the required confidence in the argument.

GM1 ATS.OR.205(b)(1) Safety assessment and assurance of changes to the functional system

HAZARD IDENTIFICATION

(a) Completeness of hazard identification

In order to achieve completeness in the identification of hazards, it might be beneficial to aggregate hazards and to formulate them in a more abstract way, e.g. at the service level. This might in turn have drawbacks when analysing and evaluating the risk of the hazards. The appropriate level of detail in the set of hazards and their formulation, therefore, depends on the change and the way the safety assessment is executed.

Only credible hazards need to be identified. A credible hazard is one that has a material effect on the risk assessment. A hazard will not be considered credible when it is either highly improbable that the hazard will occur or that the accident trajectories it initiates will materialise. In other words, a hazard need not be considered if it can be shown that it induces an insignificant risk.

(b) Sources of hazards

(1) Hazards introduced by failures or nominal operations of the ATM/ANS functional systems may include the following factors and processes:
  i) design factors, including equipment, procedural and task design;
  ii) operating practices, including the application of procedures under actual operating conditions and the unwritten ways of operating;
  iii) communications, including means, terminology, order, timing and language and including human–human, human–machine and machine–machine communications;
  iv) installation issues;
  v) equipment and infrastructure, including failures, outages, error tolerances, nuisance alerts, defect defence systems and delays; and
  vi) human performance, including restrictions due to fatigue and medical conditions, and physical limitations, when considered relevant to the change assessment.

(2) Hazards introduced in the context in which the ATM/ANS functional system operates may include the following factors and processes:
  i) wrong, insufficient or delayed information and inadequate services delivered by third parties;

ii) personnel factors, including working conditions, company policies for and actual practice of recruitment, training and allocation of resources, when considered relevant to the change;
iii) organisational factors, including the incompatibility of production and safety goals, the allocation of resources, operating pressures and the safety culture;
iv) work environment factors such as ambient noise, temperature, lighting, annoyance, ergonomics and the quality of man–machine interfaces; and
v) external threats such as fire, electromagnetic interference and sources of distraction, when considered relevant to the change.

(3) The hazards introduced in the context in which the ATM/ANS services are delivered may include the following factors and processes:
i) errors, failures, non-compliance and misunderstandings between the airborne and ground domains;
ii) traffic complexity, including traffic growth, fleet mix and different types of traffic, when considered relevant to the change;
iii) wrong, insufficient or delayed information delivered by third parties;
iv) inadequate service provisioning by third parties; and
v) external physical factors, including terrain, weather phenomena, volcanoes and animal behaviour, when considered relevant to the change.

(c) Methods to identify hazards

(1) The air traffic services provider may use a combination of tools and techniques, including functional analysis, what if techniques, brainstorming sessions, expert judgement, literature search (including accident and incident reports), queries of accident and incident databases in order to identify hazards.

(2) The air traffic services provider needs to make sure that the method is appropriate for the change and produces (either individually or in combination) a valid (necessary and sufficient) set of hazards. This may be aided by drawing up a list of the functions associated with part of the functional system being changed. The air traffic services provider needs to make sure their personnel that use these techniques are appropriately trained to apply these methods and techniques.

GM1 to AMC1 ATS.OR.205(b)(4) Safety assessment and assurance of changes to the functional system

RISK ANALYSIS IN TERMS OF PROXIES — EXAMPLES

Point (c) of AMC1 ATS.OR.205(b)(2) in BCAR ATM/ANS allows safety assessment to be performed in terms of risk, proxies or a combination of risk and proxies. This GM provides two examples to illustrate the use of proxies in safety analysis.

(a) Use of proxies when assessing the safety of a wind farm installation

(1) A wind farm is to be introduced on or near an aerodrome. It is assumed that before the introduction of the wind farm, the safety risk of the air traffic services being provided at the aerodrome was acceptable. To return to this level after the introduction of the farm, the change would also be acceptable.

A diagram showing the effects this has on the risk at the aerodrome is shown below:

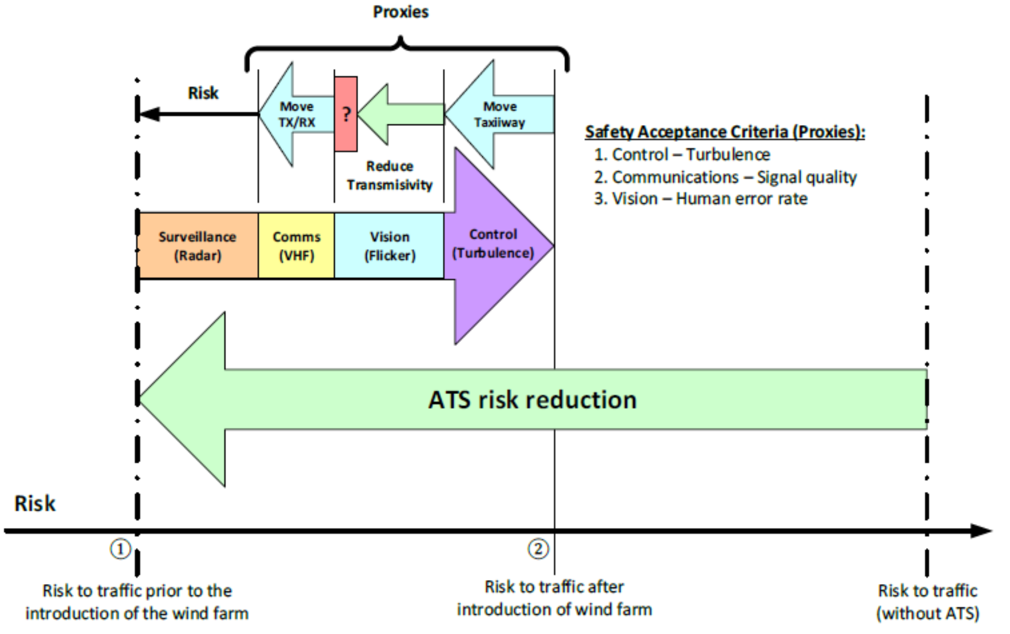


Figure 1: Evaluation of risks after the introduction of wind farm

(2) The risk due to the introduction of the wind farm will rise from ① to ②, if not mitigated, because:

i) turbulence will increase and so may destabilise manoeuvring of aircraft;

ii) the movement of the blades will cause radio interference (communications radio and surveillance radar) and so communications may be lost or aircraft may be hidden from view on the radar screen; and

iii) the flicker in the peripheral vision of ATCOs, caused by the rotation of the blades, may capture attention and increase their perception error rate.

(3) The problem of analysing the safety impact can be split into these areas of concern since they do not interact or overlap and so satisfy the independence criterion (b) of AMC2 ATS.OR.210(a). However, whilst it can be argued that each is a circumstantial hazard and that in each case a justifiable qualitative relationship can be established linking the hazard with the resulting accident (so satisfying the causality criterion (a) of AMC2 ATS.OR.210(a)), the actual or quantitative logical relationship is, in each case, extremely difficult to determine. Conditions for seeking proxies have, therefore, been established:

— Performing a risk evaluation using actual risk may not be worthwhile due to the considerable cost and effort involved; and

— The first two criteria for proxies have been satisfied.

Consequently, it may be possible to find proxies that can be used more simply and effectively than performing an analysis based on risk.

(4) The solutions proposed below are for illustrative purposes only. There are many other solutions and, for each change, several should be investigated. In this example, the following proxies, which satisfy the measurability criterion (c) of AMC2 ATS.OR.210(a) of BCAR ATM/ANS, are used to set safety criteria:

i) Turbulence can be measured and predicted by models so the level of turbulence can be a proxy.

In this example, let's assume the only significant effect of turbulence is to light aircraft using a particular taxiway. It is possible to predict the level of turbulence at different sites on the aerodrome and an alternative taxiway is found where the level of turbulence after the introduction of the wind farm will be less than that currently encountered on the present taxiway. This can be confirmed during operation after the change by monitoring.

ii) Signal quality can be also be predicted by models and measured so it can be used as a proxy.

In this example, it is possible to move the communications transmitter and receiver aerials so that communications are not affected by interference. Sites can be found using modelling and the signal quality confirmed prior to moving the aerials by trial installations during periods when the aerodrome is not operating.

iii) Human error rate in detecting events on the manoeuvring area can be measured in simulations and can be used as a proxy.

It is suggested that increasing the opaqueness of the glass in the control tower will reduce the effects of flicker on the ATCOs, but there is no direct relationship between the transmissivity and the effects of flicker. It is, therefore, decided to make a simulation of the control tower and measure the effects of flicker on human error rate using glass of different levels of transmissivity.

However, there is a conflict between increasing the opaqueness of the glass to reduce the effects of flicker and decreasing it to improve direct vision, which is needed so that manoeuvring aircraft can be seen clearly. In other words, the simulation predicts a minimum for the human error rate that relates to a decrease, as the effects of flicker decrease, followed by an increase, as the effects of a lack of direct vision increase. This minimum is greater than the human error rate achieved by the current system and so the risk of the wind farm, in respect of flicker, cannot be completely mitigated. This is shown by the red box with a question mark in it on the diagram.

(5) Finally, the argument for the performance of surveillance radars is commonly performed using risk. This can be repeated in this case since the idea is to filter the effects of the interference without increasing the risk. Moreover, if necessary, a system may be added (or a current one improved) to reduce the risk simply and economically and the effects of the additional system may be argued using risk.

(6) Since risks can be combined, the safety impacts of the changes to the surveillance radar by filtering the effects of the interference together with the addition of another system or the improvement of the current system can be established by summing the risks associated with these two kinds of change.

(7) In these circumstances, it is not possible to argue objectively that the risk of introducing the wind farm has been mitigated, as risks cannot be summed with proxies. This demonstrates the difficulties of using proxies. However, it may be possible to argue convincingly, albeit subjectively, that installing another system or improving the current system improves the current level of risk by a margin large enough to provide adequate compensation for the unmitigated effects of flicker.

(8) In summary, this example shows how proxies and risks can be combined in a single assurance case to argue that a change to a functional system can be introduced safely. It also demonstrates that the strategies available to demonstrate safety are not generic, but are dependent on

identifying analysable qualities or quantities related to specific properties of the system or service that are impacted by the change.

(b) Use of proxies when changing to electronic flight strips

(1) An air traffic services provider considers the introduction of a digital strip system in one of its air traffic control towers to replace the paper flight progress strips currently in use. This change is expected to have an impact on several aspects of the air traffic control service that is provided such as the controller's recollection of the progress of the flight, the mental modelling of the traffic situation and the communication and task allocation between controllers. A change of the medium, from paper to digital, might, therefore, have implications on the tower operations, and, hence, on the safety of the air traffic. The actual relation between the change of the strip medium and the risk for the traffic is, however, difficult to establish.

(2) The influence of the quantity on the risk is globally known, but cannot easily be quantified. One difficulty is that strip management is at the heart of the air traffic control operations: the set of potential sequences of events from a strip management error to an accident or incident is enormous. This set includes, for example, the loss of the call sign at the moment a ground controller needs to intervene in a taxiway conflict, and whether this results in an incident depends, for example, on the visibility. This set also includes the allocation of a wrong standard instrument departure (SID) to an aircraft, and whether this results in an accident depends, for example, on the runway configuration.

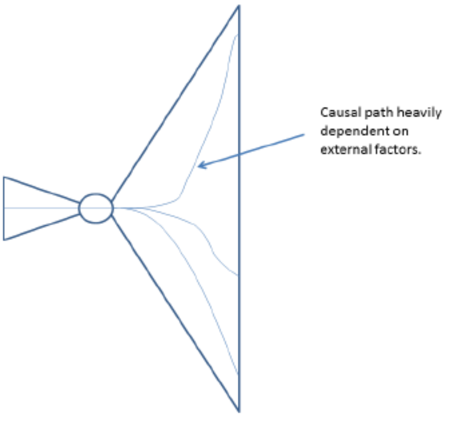


Figure 2: Notional Bow Tie Model of a strip management error

(3) The Bow Tie Model of a strip management error has, figuratively speaking, a vertically stretched right part. This expresses that a hazard — such as the loss of a single strip — may have many different outcomes which heavily depend on factors that have nothing to do with the cause of the hazard — factors such as the status of the aircraft corresponding to the absent strip, that aircraft's position on the aerodrome, the traffic situation and the visibility.

(4) Another difficulty with the relationship between the change of the medium and the risk to the air traffic is that several human and cultural aspects are involved. The difficulty lies in the largely unknown causal relationship between these human and cultural aspects and the occurrences of accidents and incidents. As an example of this, it is noted that strip manipulation — like moving a strip into another bay, or making a mark to indicate that a landing clearance is given — assists a controller in distinguishing the potential from the actual developments. The way of working with paper strips generates impressions in a wider variety than digital strips by their physical nature: handling paper strips has tactile, auditory and social aspects. This difference in these aspects may lead to a difference in the quality of the controller's situation awareness which may lead to a difference in the efficacy of the controller's instructions and advisories, which may lead to a difference in the occurrence of accidents and incidents. However, the

relation between the change of the medium and the risk for the air traffic is difficult to assess and would require a great deal of effort, time and experimentation to quantify.

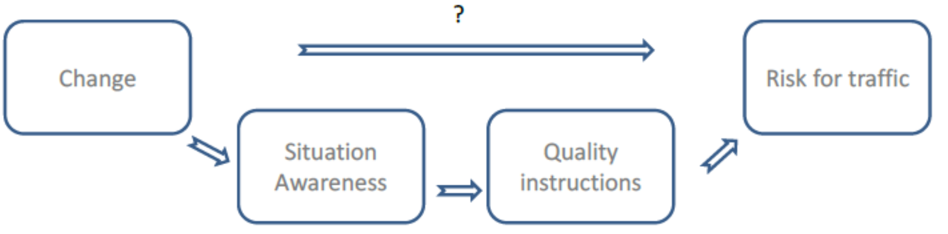


Figure 3: Relation between the change of flight strip and the risk

(5) There is probably a relation between the change of the flight progress strip medium and the risk for air traffic: a new human–machine interface may have an effect on the situation awareness of some individual controllers in some circumstances, which might have an effect on whether, when and what instructions are given, and this in turn influences the aircraft movements, and, hence, the risks. The question by what amount risks increase or decrease is very hard to answer.

(6) Performing a risk evaluation using actual risk may not be worthwhile due to the difficulties and considerable cost and effort involved in assessing the risk of the change directly. Therefore, the use of proxies might be preferred. A quantity is only considered an appropriate proxy if it satisfies the criteria in point AMC2 ATS.OR.210(a):

i) Causality: The quantity used as proxy can be expected to be influenced by the change, and the risk can be expected to be influenced by the quantity. In addition to this causal relationship, a criterion can be formulated and agreed upon that expresses by which amount the value of the quantity may shift due to the change. Note that the influence of the proxy on the risk cannot easily be quantified, otherwise it might be more beneficial to use risk as a measure and the quantity as an auxiliary function.

ii) Measurability: The influence of the change on the quantity can be assessed before as well as after the change.

iii) Independence: When the proxy selected does not cover all hazards, a set of proxies should be used. Any proxy of that set should be sufficiently isolated from other proxies to be treated independently.

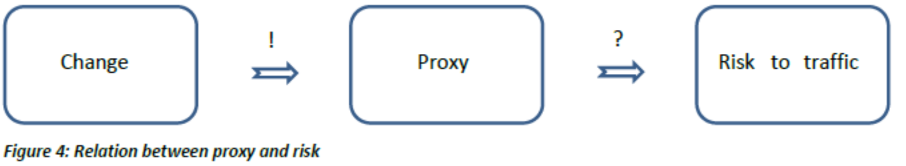


Figure 4: Relation between proxy and risk

(7) There is a relationship between the change and the proxy, and there is a relationship between the proxy and the risk to traffic. The first relationship can be assessed (indicated by the '!'), while the second cannot (indicated by the '?'). An acceptance criterion is typically formulated for the amount the proxy value might increase or decrease.

(8) Proxy 1: Head-down time. The head-down time is a good proxy as it satisfies the conditions of:

i) Causality: It is known that more head-down time leads to a higher risk but there is no well-established or generally accepted statement in literature in terms of: 'x % more head-down time implies y% more accidents', not to mention for the specific circumstances of the specific air traffic control tower. The causal relationship indicated in Figure 4 can be established because:

(A) the head-down time can be expected to change as the manipulation, writing and reading of digital strips might cost more, or perhaps less, attention and effort than the handling of paper strips;

(B) the loss of head-up time of ground and runway controllers implies less surveillance, at least less time for the out-of-the-window-view in good visibility, and this implies a later or less probable detection of conflicts; and

(C) an example of an acceptance criterion reads: 'The introduction of the digital strip system does not lead to a significant increase in the head down time'.

ii) Measurability: The influence of the change on the head-down time can be assessed before the change by means of real-time human-in-the-loop experiments in which controllers are tasked to handle equal amounts of traffic in equal circumstances, one time using paper strips and another time using digital strips. The percentage of head-down time can then be determined by observing the controllers by cameras and eye-trackers.

(9) Proxy 2: Fraction of erroneous SID allocations. The fraction of erroneous SID allocations is a good proxy as it satisfies the conditions of:

i) Causality: It can be imagined that an erroneous SID selected in the flight management system (FMS) might lead to accidents, but the precise conditional probability is small and difficult to estimate as it depends on several external factors such as the flight paths of the correct and incorrect SIDs, the presence of other traffic, the timing and geometry of the trajectories, the cloud base or the vigilance of the controller. The causal relationship indicated in Figure 4 can be established because:

(A) the number of incorrect SIDs indicated on electronic strips can be expected to be less than on paper strips, because of the possibilities of systematic checks with respect to runway allocation, runway configuration, SID allocation of the predecessor and destination in the flight plan;

(B) the allocation of an incorrect SID to an aircrew might lead to a situation in which the aircraft manoeuvres in an unanticipated way, possibly leading to a conflict with another aircraft, for example departing from a parallel runway; and

(C) an example of an acceptance criterion reads: 'The introduction of the digital strip system should lead to a decrease of the fraction of erroneous SID allocations of more than 20 %'.

ii) Measurability: The influence of the change on the fraction of erroneous SID allocations can be assessed before the change by means of an analysis of the causes and occurrences of such errors and the estimated efficacy of the systematic checks. The fractions can be assessed after the change by the statistics of the event reports.

(10) Finally, the last condition of independence of proxies is also satisfied. For the purpose of this example, the proxies in (5) and (6) form a set of independent proxies that are complete, i.e. they cover all identified hazards introduced by the replacement of paper strips by a digital strip system.

GM1 ATS.OR.205(b)(4) Safety assessment and assurance of changes to the functional system

RISK ANALYSIS IN TERMS OF SAFETY RISK

(a) Risk analysis

When a risk assessment of a set of hazards is executed, in terms of risk:

(1) the frequency or probability of the occurrence of the hazard should be determined;

(2) the possible sequences of events from the occurrence of a hazardous event to the occurrence of an accident, which may be referred to as accident trajectories, should be identified. The contributing factors and circumstances that distinguish the different trajectories from one another should also be identified, as should any mitigations between a hazardous event and the associated accident;

(3) the potential harmful effects of the accident, including those resulting from a simultaneous occurrence of a combination of hazards, should be identified;

(4) the severity of these harmful effects should be assessed, using a defined severity scheme according to point (f) of AMC2 ATS.OR.205(b)(3) in BCAR ATM/ANS; and

(5) the risk of the potential harmful effects of all the accidents, given the occurrence of the hazard, should be determined, taking into account the probabilities that the mitigations may fail as well as succeed, and that particular accident trajectories will be followed when particular contributing factors and circumstances occur.

(b) Severity schemes

The severity determination should take place according to a severity classification scheme. The purpose of a severity classification scheme is to facilitate the management and control of risk. A severity class is, in effect, a container within which accidents can be placed if their severities are considered similar. Each container can be given a value which represents the consequences, i.e. small for accidents causing little harm and big for accidents causing a lot of harm. The sum of the probabilities of all the accidents assigned to a severity class multiplied by the value that is related to the severity class, is the risk associated with that class. If the value that represents severity for all classes is scalar, then the total risk is the sum of the risks in each severity class.

(a) Single-risk value severity schemes

Such schemes use a single severity category to represent harm to humans. Other categories representing other kinds of harm e.g. damage to aircraft and loss of separation, may be present but do not represent harm to humans. In these circumstances, risk analysis would actually be reduced to frequency/probability analysis.

(b) Multiple-risk value severity schemes

Multiple-risk value severity schemes, which use a number of severity categories to classify different levels of harm, facilitate the management and control of risk in a number of ways. At the simplest level, the distribution of accidents across the severity classes gives a picture of whether the risk profile of a system is well balanced. For example, many accidents in the top and bottom severity classes with few in between suggests an imbalance in risk, perhaps due to an undue amount of attention having been paid to some types of accident at the expense of others. More detailed management and control of risk includes:

(i) Severity classes may be used as the basis for reporting accident statistics.
(ii) Severity classes combined with frequency (or probability) classes can be used to define criteria for decision-making regarding risk acceptance.
(iii) The total risk associated with one or more severity classes can be managed and controlled. For example, the sum of the risk from all severity classes represents the total risk and may be used as a basis for making decisions about changes.
(iv) Similarly, the risk associated with accident types of different levels of severity can be compared. For example, comparing runway infringement accidents with low speed taxiway accidents would allow an organisation to focus their efforts on mitigating the accident type with greatest risk.

(c) The air traffic services provider should coordinate its severity scheme(s) when performing multi-actor changes to ensure adequate assessment. This includes coordination with air traffic services providers outside Bhutan.

GM1 ATS.OR.205(b)(5) Safety assessment and assurance of changes to the functional system

OUTCOME OF RISK EVALUATION

The purpose of risk evaluation is to evaluate the risk of the change and to compare that against the safety criteria with the following outcomes in mind:

(a) A possible (desired) outcome is that the assessed risk satisfies the safety criteria. This implies that the change is assessed as sufficiently safe to implement.

(b) Another possible outcome is that the assessed risk does not satisfy the safety criteria. This might lead to the decision to refine the risk analysis, to the decision to add mitigating means, or to the decision to abandon the change.

GM2 ATS.OR.205(b)(5) Safety assessment and assurance of changes to the functional system

RISK EVALUATION — UNCERTAINTY

(a) The outcome of a risk analysis is uncertain due to modelling, estimates, exclusion of rare circumstances or contributing factors, incident and safety event underreporting, false or unclear evidence, different expert opinions, etc. The uncertainty may be indicated explicitly, e.g. by means of an uncertainty interval, or implicitly, e.g. by means of a reference to the sources the estimates are based upon.

(b) Where possible sequences of events, contributing factors and circumstances are excluded in order to simplify the risk estimate, which may be necessary to make the estimate of risks feasible, arguments and evidence justifying this should be provided in the safety case. This may result in increasing the uncertainty of the risk estimations.

GM3 ATS.OR.205(b)(5) Safety assessment and assurance of changes to the functional system

RISK EVALUATION — FORMS OF RISK EVALUATION

The risk evaluation can take several forms, even within the safety assessment of a single change, depending on the nature of the risk analysis and the safety criteria:

(a) If a set of safety requirements has been created and can be unambiguously and directly related to the safety criteria, then the risk evaluation takes the form of justifying that these requirements satisfy the safety criteria;

(b) If the safety criteria have been established in terms of the likelihood of the hazards and the severity of their effects, then the risk evaluation takes the form of verifying that the assessed risks satisfy the safety criteria in terms of risks; and

(c) If the values of all relevant proxies have been determined, then the risk evaluation takes the form of verifying that these values satisfy the safety criteria in terms of proxies.

GM4 ATS.OR.205(b)(5) Safety assessment and assurance of changes to the functional system

TYPE OF RISK MITIGATION

Risk mitigation may be achieved in the following ways:
(a) an improvement of the performance of a functional subsystem;
(b) an additional change of the ATM/ANS functional system;
(c) an improvement of the services delivered by third parties;
(d) a change in the physical environment; or
(e) any combination of the above-mentioned methods.

GM1 ATS.OR.205(b)(5)(ii) Safety assessment and assurance of changes to the functional system

VERIFICATION OF SAFETY CRITERIA

As the complete behaviour of the change is reflected in satisfying the safety criteria for the change, no safety requirements are set at system or change level. Nevertheless, safety requirements can be placed on the architecture and the components affected by the change.

GM1 ATS.OR.205(b)(6) Safety assessment and assurance of changes to the functional system

MONITORING OF INTRODUCED CHANGE

(a) Monitoring is intended to maintain confidence in the safety case during operation of the changed functional system. At entry into service, the safety criteria become performance criteria rather than design criteria. Monitoring is, therefore, only applicable following entry into service of the change.

(b) Monitoring is likely to be of internal parameters of the functional system that provide a good indication of the performance of the service. These parameters may not be directly observable at the service level, i.e. at the interface of the service with the operational context. For example, where a function is provided by multiple redundant resources, the availability of the function will be so high that monitoring it may not be useful. However, monitoring the availability of individual resources, which fail much more often, may be a useful indicator of the performance of the overall function.

GM1 ATS.OR.210(a) Safety criteria

SAFETY CRITERIA IN TERMS OF PROXIES FOR SAFETY RISKS

(a) In the safety assessment of functional systems, it may not always be possible or desirable to specify safety criteria in terms of quantitative values of risk. Instead, safety criteria may be defined in terms of other measures that are related to risk. These measures are called proxies and they need to meet the requirements for a proxy as stated in AMC2 ATS.OR.210(a) of BCAR ATM/ANS. For examples of their use, see GM1 to AMC1 ATS.OR.205(b)(4).

(b) A proxy is some measurable property that can be used to represent the value of something else. In the safety assessment of functional systems, the value of a proxy may be used as a substitute for a value of risk, providing it meets the requirements for a proxy as stated in AMC2 ATS.OR.210(a). Examples of proxies are the frequency of airspace infringements, runway incursions, false alert rate, head-down time, limited sight, level of situation awareness, fraction of read back errors, reduced vigilance, amount of turbulence, distraction of controller’s attention, inappropriate pilot behaviour, system availability, information integrity and service continuity.

An example of the concept of using a different but specific quantity to assess an actually relevant quantity is the transposition/measure of an aircraft's altitude which is in terms of barometric pressure or the transposition/measure of an aircraft's airspeed which is in terms of dynamic pressure.

(c) A proxy is a measure of a certain property along the causal trajectory between the hazard/event and the harmful effects of the hazard/event in question (see Figure 5). The causal relationship between the proxy and the accident must be justified in the safety case, i.e. it must satisfy AMC2 ATS.OR.210(a). This means that the accident trajectory must be modelled and analysed such that the causal relationship can be assured but without the need to evaluate the quantitative nature of this relationship. It is assumed that since the proxy lies between the hazard/event and the accident, then there is a quantitative causal relationship between the rate of the hazard/event's occurrence and the rate of the proxy's occurrence. As a consequence, the variation of values of the proxy correlates with values of the hazards/events rate of occurrence and the value of the rate at which the harmful effects occur, i.e. the accident rate, and this relationship is a monotonically increasing one. This means that when the proxy value, e.g. Proxy1, increases/decreases, the associated risk value of the related accident, e.g. Accident1, increases/decreases accordingly.

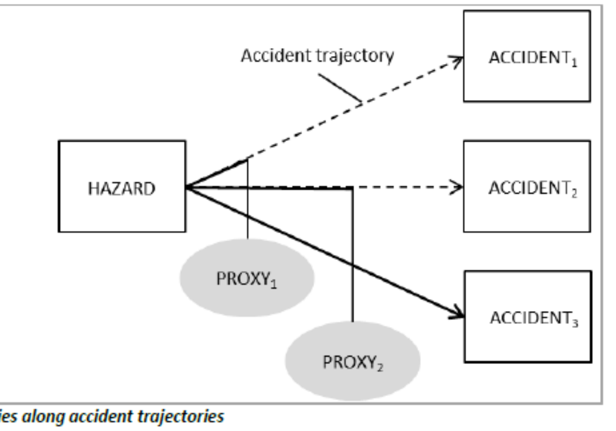


Figure 5: Use of proxies along accident trajectories

(d) Proxies might be preferred where the extra effort needed to identify, describe and analyse a complete set of sequences of events from the occurrence of a hazard to the occurrence of an accident or incident has no added value in the safety assessment. The intrinsic reasons for the amount of the extra effort are the number of significantly different event sequences, the complexity of some accident scenarios, the existence of many barriers preventing the occurrence of a hazard developing into an accident and the lack of evidence on the probability of some events or the frequency of occurrence of some external circumstances and factors. The usage of proxies might then make the safety assessment more tractable and comprehensible and increase the quality of the risk analysis.

(e) The main advantages of proxies are the easy recognition of safety issues by operational staff involved in the safety assessment, and the direct focus on the analysis and mitigation of the identified hazards and safety issues introduced or affected by the change.

(f) The main disadvantage of using proxies is that it is not possible to express risk by a uniform measure. However, the value of the proxy should be measurable.

(g) For further details on the use of proxies, please refer to GM1 to AMC1 ATS.OR.205(b)(4), which contains two examples to assist in the selection and use of proxies in safety analysis.

GM1 ATS.OR.305(a) Responsibilities of air traffic control service providers with regard to the problematic use of psychoactive substances by air traffic controllers

POLICY

(a) Guidance for the development and implementation of the policy is contained in ICAO Doc 9654 'Manual on Prevention of Problematic Use of Substances in the Aviation Workplace', First Edition - 1995, and in particular:
  (1) Attachment A (pp. 27–34) as regards elements for the definition and the implementation of policy and programme;
  (2) Chapter 3 (pp. 9–12) as regards the identification, treatment, and rehabilitation of staff, with related supporting material, available in Attachment C (pp. 61–68); and
  (3) Attachment D (pp. 69–75) as regards the employment consequences of problematic use of substances.

TRAINING AND EDUCATION PROGRAMMES

(b) Guidance for the development and implementation of training and education programmes is contained in ICAO Doc 9654 'Manual on Prevention of Problematic Use of Substances in the Aviation Workplace', First Edition - 1995, in particular:
  (1) Chapter 2 (pp. 6–7) as regards the education of the workforce and educational material, with related supporting material available in Attachment A (pp. 35–48); and
  (2) Attachment B (pp. 49–59) and Attachment F (pp. 87–94), where extracts from the ICAO Manual of Civil Aviation Medicine are provided

GM2 ATS.OR.305(a) Responsibilities of air traffic control service providers with regard to the problematic use of psychoactive substances by air traffic controllers

THIRD PARTY ASSISTANCE TO AIR TRAFFIC CONTROLLERS

The air traffic control service provider may employ third-party assistance. Such assistance should be made freely available to air traffic controllers who are dependent on psychoactive substances.

GM1 ATS.OR.305(b) Responsibilities of air traffic control service providers with regard to the problematic use of psychoactive substances by air traffic controllers

PROCEDURE FOR THE DETECTION OF CASES OF PROBLEMATIC USE OF PSYCHOACTIVE SUBSTANCES

Guidance for the development and implementation of the procedure for detection of cases of psychoactive substances is contained in ICAO Doc 9654 'Manual on Prevention of problematic use of Substances in the Aviation Workplace', First Edition - 1995, particularly in Chapter 5 (pp. 15–23) and Attachment E (pp. 77–85) as regards biochemical testing programmes, with related supporting material.

GM1 ATS.OR.310 Stress

EXPLANATION OF THE FUNDAMENTALS OF STRESS

(a) Introduction

  (1) The job of an air traffic controller is considered to be responsible and demanding, and at times can lead to the experience of high levels of stress. The combination of skills and knowledge required to complete air traffic control tasks is wide. Visual spatial skills, perception, information processing, image and pattern recognition, prioritising, logical problem-solving, application of rules and

procedures and decision-making form core skills to which we can add interpersonal communication, teamwork and technical vocabulary usage.

(2) Air traffic control also requires to constantly adapt to an ever-changing traffic picture and work environment within restricted time constraints. This has the potential to lead to considerable work pressure. In contrast, there may be times when traffic flows are low and controllers experience relatively low levels of activity. For some controllers, this may bring its own kind of stress due to the increased efforts required to maintain vigilance under light traffic load.

(3) Thus, the work of an air traffic controller has the potential to induce high levels of stress; however, the stress experienced by controllers is always unique to the individual and their interaction with their environment.

(4) 'Stress' is a term that is in common use within everyday language and can mean different things to different people depending on the context in which it is used. In lay terms, stress is often used to describe an external pressure experienced by an individual whilst at the same time encompassing the subjective experience of this pressure. Usually, the term is used in a negative way. In this sense, the lay use of the term 'stress' encompasses both the cause and the effect, and this can lead to confusion as to its meaning.

(b) Technical definitions of stress

(1) Even in its technical use, the word 'stress' is sometimes used when the term 'stressor' (or pressure) would be more appropriate, referring to the cause of a stress experience. Stressors can be internal (cognitive or physical) or external (environmental) to the individual and may be defined as any activity, event or other stimulus that causes the individual to experience stress.

(2) It is helpful to clarify the way the term 'stress' and other technical terms are used. For the purposes of this guidance material, stress is defined following the Transactional Model of Stress. This views stress as the outcomes experienced by an individual when faced with a potentially stressful event. The experience of the event as negatively stressful (distress), neutral or positive (eustress) is based on the individual's perception of their ability to manage the event. Under this definition, stress is a manifestation in the individual of usually negative effects, which can lead to a decrease in performance and negative health effects.

(3) A stressor can also act to improve performance when it is a stimulus to increase arousal and improves the outputs of an individual in the short to medium term. Too much arousal paradoxically leads to an inverse effect and subsequent detriment in performance.

(4) Acute stress is, as its name suggests, episodic and occurring for short periods of time. In most cases, the cause of the stress is eliminated by the air traffic controller taking action to manage the situation leading to stress. High levels of acute stress may lead to hyper-arousal and may leave an air traffic controller feeling exhausted. It is important to identify work situations that lead to this acute stress and manage this within the work schedule.

(5) Chronic stress differs from acute stress only in that it is ongoing and even low levels of continuous chronic stress can lead to performance degradation and serious health implications, if it is not addressed. Chronic stress is insidious in its nature and a sufferer may become so accustomed to the sensations that they are unaware of the long-term negative effects. Chronic stress commonly leads to a sense of inability to cope.

(6) Both acute and chronic stresses have the potential to lead individuals into hyper-aroused states which may result in panic where task and skill performance, planning, reasoning and judgement are

significantly impaired. In such instances, a well-practised but incorrect action, for that particular circumstance, may be performed when an alternative and more appropriate response is required.

(7) Chronic stress may result in a condition known as burnout. Burnout is generally identified by the following characteristics: disaffection with the job leading to a decrease in motivation with an associated decrease, perceived or otherwise, in performance.

(c) Sources of stress

Broadly speaking, the stress experienced by an air traffic controller at work is a function of their underlying background levels of stress, related to lifestyle, health and well-being, personality, organisational/work environment, levels of satisfaction with life generally, and the acute stress imposed by and operational conditions at any given time. There are three major sources of stress: environmental, work-related, and personal.

(1) Environmental/physical stressors

(i) Physical stressors are underlying conditions that can either be internal to the body (e.g. pain, hunger, lack of sleep, exhaustion), or external environmental factors (e.g. noise pollution, overcrowding, excess heat). The common factor among all of these stressors is that they all create a physically uncomfortable environment that can cause stress. Stress is not solely dependent on the intensity of a stimulus, but also on the duration of exposure. For example, a low-pitched but persistent noise can cause as much stress as a sudden loud noise.

(ii) In the air traffic control room, some common environmental/physical stressors could be:
(A) uncomfortable temperature;
(B) cramped workspace;
(C) air quality;
(D) lighting conditions; and
(E) intrusive noise or vibration.

(2) Work-related stressors

(i) Stress in the workplace can come from a variety of sources besides physical stimuli. Some of these include:
(A) continuing high levels of workload near or above the maximum traffic handling capacity of an air traffic controller;
(B) a heterogeneous traffic mix where aircraft have varying levels of equipment and considerable variability in pilot skills;
(C) unsuitable or unreliable equipment;
(D) inappropriate, vague procedures;
(E) complex equipment which is insufficiently understood or mistrusted;
(F) supervision of trainees or less experienced colleagues;
(G) workload and task breakdown not being matched to the level of technical skill of the controller, lack of support or too much support (interference);
(H) role ambiguity, where it is unclear where the responsibilities lie;
(I) interpersonal conflict with colleagues, other professionals;
(J) poor management relations (social dialogue), working conditions, e.g. rostering; and
(K) unusual or emergency situations.

(ii) Incidents, including emergencies and accidents, that lead controllers to feel that they are not coping may lead to the experience of critical incident stress; this, in turn, may impair performance in varying degrees.

(3) Personal stressors

(i) Personal stressors include the range of events that occur throughout people's lives but external to the workplace. The belief that such stressors can be left at home, however, is a myth, and these personal stressors accompany air traffic controllers to work every day.

(ii) Personal issues such as health, personal life, living situation and major life events (deaths, births, marriages, and moving house) add to the background level of stress that individuals have to cope with. Where these are excessive, they can interfere with work due to the distraction they cause and the mental effort they require to resolve them.

(iii) Stress is also considered to have a contagious quality, which happens when a stressed person or stressed persons create stressful situations for those around them.

(d) Signs of stress in the individual

Signs of stress are many and varied. Some of the most commonly observed are shown below:

(1) Physiological
- (i) Cardiovascular: increased pulse rate, elevated blood pressure, chest pains;
- (ii) Respiratory: shortness of breath, tightness of chest, hyperventilation, dizziness;
- (iii) Gastrointestinal: loss of appetite, gas pain, abdominal cramps, indigestion, diarrhoea, nausea;
- (iv) Sweaty palms;
- (v) Aching neck, jaw and back muscles;
- (vi) Trembling;
- (vii) Sleep disturbance, tiredness;
- (viii) Itching;
- (ix) Getting easily startled;
- (x) Susceptibility to minor illnesses; and
- (xi) Other: headaches, muscular tension, general weakness, psychosomatic symptoms.
- (xii) Psychological
- (xiii) Emotional: anger, guilt, mood swings, low self-esteem, depression and anxiety;
- (xiv) Concentration problems, forgetfulness;
- (xv) Pessimism;
- (xvi) Difficulty in making decisions;
- (xvii) Irritability;
- (xviii) Loss of interest;
- (xix) Loss of self-control; and
- (xx) Loss of confidence.

(2) Behavioural
- (i) Self-medication, drugs or alcohol;
- (ii) Excess fatigue;
- (iii) Sleep disruption;
- (iv) Social withdrawal;
- (v) Absenteeism;
- (vi) Staff turnover rates; and
- (vii) Job performance decrements.

(e) Impact of stress on air traffic controllers' performance of air traffic control tasks

Any source of stress has the potential to create unique subjective experiences in different individuals, and these may be positive or negative experiences or something in between.

(f) Negative experiences of stress

There is a number of ways in which stress experienced by air traffic controllers can be manifested in the performance of air traffic control tasks. Some of these are listed in Table 1, but, in general terms, performance of tasks decreases due to the detrimental effects that high levels of stress can have on perception, awareness, decision-making and judgement. In the longer term, health and well-being may also be compromised, leading to decreased performance of air traffic controllers.

Table 1 below shows the effects on air traffic controller performance which can be linked to stress and which can potentially have very significant implications for the safety performance of an operation. Difficulty in concentrating and reduced vigilance — easily distracted.

Errors, omissions, mistakes, incorrect actions, poor judgment and memory.
Tendency to cut corners, skip items and look for the easiest way out.
Either slowness (due to lack of interest) or hyperactivity (due to adrenaline).
Focusing on easily manageable details while ignoring serious threats.
Tendency to pass responsibility on to others.
Fixation on single issues or even a mental block.
Unwillingness to make decisions — decisions are postponed or take longer to be made.
Fewer plans and backup plans are made.
Increase in risk-taking, leading to an increase in the number of violations, especially when frustrated with failures.
Excessively hurried actions — due to adrenaline and alertness level, there is a tendency to act very quickly even when there is no time pressure. Hurried actions increase the chance of errors.
In cases of significantly high stress, a controller will often: (1) return to old procedures that may no longer be applicable, appropriate or safe; (2) use non-standard phraseology when communicating; (3) return to the use of one's native language; and/or (4) look for items in a place where they used to be, but are no longer located.

Table 1: Effects of stress on physical and mental performance of air traffic control tasks

(g) Mitigation of stress in the individual and the organisation

Air traffic control service providers have a duty to take care of their employees and the customers of their services. They should aim at mitigating the negative effects of stress. This is best achieved by ensuring that a range of preventative measures as well as countermeasures are in place. These include:

(1) adoption of a stress policy and/or a critical incident stress management policy within the organisation;

(2) completion of regular risk assessment of sources of occupational stress and its effects on individuals and operations;

(3) employee stress level monitoring;

(4) adoption of stress intervention/mitigation/prevention practices and, where the organisation identifies a source of stress, use of a stress team/committee;

(5) stress management training for all levels of employees;

(6) education and prevention programmes on stress; and

(7) staff support mechanisms (e.g. peer counselling, professional support from health practitioners, critical incident stress management (CISM) programmes);

(8) adequate rostering allowing time to evacuate stress; and

(9) promotion of sports or relaxation activities.

GM1 ATS.OR.310(a) Stress

CRITICAL INCIDENT STRESS MANAGEMENT

The purpose of critical incident stress management (CISM) programmes is to prepare an organisation for the potential aftermath of an incident. These programmes come in a number of different forms, but have the added benefit of providing education on the effects of stress, how stress affects performance and stress management, even when the incident is relatively minor and perhaps personal to the individual.

GM1 ATS.OR.315 Fatigue

EFFECTS OF FATIGUE

Guidance material on fatigue and its effects on safety-relevant aviation professionals may be found in Chapter 2 'Scientific principles for fatigue management' of ICAO Doc 9966 'Manual for the Oversight of Fatigue Management Approaches', second edition 2016.

GM1 to AMC1 ATS.OR.315(a) Fatigue

FATIGUE TAXONOMY

When establishing procedures to enable air traffic controllers to report when fatigued, an associated taxonomy for fatigue should be established.

GM2 to AMC1 ATS.OR.315(a) Fatigue

FATIGUE IN OCCURRENCE INVESTIGATION AND ANALYSIS

Fatigue may have a significant impact on the performance of air traffic controllers and consequently on the safety of air operations. Therefore, when investigating occurrences, the air traffic control service providers should analyse the occurrence for fatigue as a contributing factor.

The analysis of available occurrence reports where fatigue was identified as contributing factor, generated by the air traffic control service providers or by other sources, could support the implementation and the improvement of fatigue management.

GM3 to AMC1 ATS.OR.315(a) Fatigue

IDENTIFICATION AND MANAGEMENT OF THE EFFECT OF FATIGUE ON THE SAFETY OF OPERATIONS

(a) The following non exhaustive list contains some of the initiatives that the air traffic control service provider may undertake in order to identify air traffic controllers' fatigue:

(1) establishment of a procedure allowing air traffic controllers to report when fatigued, and promotion of its use. Templates for such reporting procedure could be established;

(2) utilisation of system support to manage rostering principles and thresholds established in accordance with ATS.OR.320 of BCAR ATM/ANS, also highlighting criticalities in advance;

(3) undertaking fatigue surveys;

(4) application of scientific principles on fatigue and fatigue management and their effect on the operational and organisational context.

(b) The knowledge and understanding of the underlying scientific principles of fatigue, as well of its potential impact on the safety of operations, may represent a considerable added value for the effectiveness of fatigue management arrangements established within the organisation. For this purpose, the air traffic control service provider might consider making available education and information programmes for staff involved in fatigue management, such as operational and safety managers, staff in charge of managing the rostering system, staff in charge of occurrence investigation.

(c) Activities air traffic control service providers could undertake to monitor the effectiveness of the established fatigue management arrangements may be but are not limited to the following:

(1) verification of the allocation and implementation of duty and rest periods in accordance with the rostering principles established in ATS.OR.320;

(2) collection and analysis of data related to planned versus achieved rosters, and in particular:
(i) exceedances of planned working hours and reasons generating exceedances;
(ii) variation of the nature of the duty (office work, operational air traffic control service provision, training, etc.);
(iii) operational circumstances which required a modification of established duty and rest periods; and
(iv) swapped shifts between air traffic controllers and impact on the established fatigue management principles;

(3) verification of the use and of the effectiveness of the procedure allowing air traffic controllers to self-declare fatigue, when such procedure is established; and

(4) analysis if specific roster patterns generate fatigue and, as a consequence, sickness or cases of provisional inability.

GM1 ATS.OR.315(b) Fatigue

INFORMATION PROGRAMMES

Information programmes may consist of lectures, leaflets, posters, CDs, and any other informative material to raise the awareness of the effects of fatigue on the individuals and on air traffic control service provision, and to advise on the need and the means to manage it. When choosing the most appropriate information programme and the medium, the air traffic control service provider should evaluate the level of awareness of its staff of fatigue management, the type of operations (e.g. single-person operations, nightshifts), and the periodicity of human factors training in the scope of refresher training.

GM1 ATS.OR.320(a) Air traffic controllers' rostering system(s)

STRUCTURE AND VALUES OF THE ROSTERING SYSTEM

The selection and the regular revision of an appropriate structure and of appropriate values of the rostering system, in accordance with ATS.OR.320(a) of BCAR ATM/ANS and which fit the intended operations, should be based upon:

(1) scientific principles;
(2) data gathered by the air traffic control service provider; and
(3) best practices.

SUBPART B — TECHNICAL REQUIREMENTS FOR PROVIDERS OF AIR TRAFFIC SERVICES (ATS.TR)

SECTION 1 — GENERAL REQUIREMENTS

GM1 ATS.TR.100(b) Working methods and operating procedures for providers of air traffic services

SPECIAL AND ALTERNATIVE CONDITIONS AND OPERATING PROCEDURES FOR ATS PROVIDERS PROVIDING SERVICES TO FLIGHT TESTS

(a) While flight tests are regularly conducted in compliance with the standards and the provision specified in ATS.TR.100(a) of BCAR ATM/ANS, some of them need to follow specific additional or alternative conditions and procedures approved by the competent authority to meet the needs of flight tests carried out during the flight. This is also the case for flight tests involving more than one aircraft in the same flight test. These special provisions will not jeopardise the safety of the other airspace users and the population in the area overflown.

(b) In order to ensure safe operations within the provision of air traffic service for flight tests control, the air traffic controllers providing these services may need to have specific knowledge of flight tests and/or be briefed, depending on the specificities of the flight profiles.

(c) Air traffic controllers that provide air traffic services to flight tests (flight test ATCOs) may need to obtain their specific competence through a dedicated training.

(d) Air traffic services for flight test should be provided through dedicated and specific procedures. These procedures should address:

(1) Compatibility with other airspace users
   (i) In order to ensure the compatibility of the flight test with other airspace users and to ensure safe operations and an acceptable rate of success of flight test, the air traffic services provider should ensure proper coordination at all levels, including strategic, pre-tactical and real-time coordination.
   (ii) An air traffic services unit providing services to flight test is responsible for ensuring compatibility of their activities with other airspace users.

(2) Flight plan
The air traffic services unit should obtain all the necessary details related to flight tests (e.g. from the design organisation or the entity wishing to carry out the flight test).

(3) Flight tests with limited manoeuvrability
During certain phases of the flight test, the capability to normally perform manoeuvres may only be possible after a necessary period of time (e.g. for the flight crew to get into a configuration that allows the execution of these manoeuvres).

The air traffic services provider should obtain the necessary information about the phases of flight and the duration if known.

For the conduct of these flights, the use of a temporarily reserved area is preferred. If unable, after prior coordination with the relevant air traffic services units neighbouring the flight tests, the use of a transponder should be mandated.

This real-time information does not relieve the air traffic services unit responsible for providing services to the flight tests from the obligation to ensure traffic separation and assure compatibility with all airspace users.

(e) The above-mentioned procedures are not exhaustive and additional provisions may be necessary to meet the needs of flight tests. The paramount principle is anyhow to make provisions without contradicting the standards and the provision specified in ATS.TR.100(a).

CHAPTER V — PART-MET
SPECIFIC REQUIREMENTS FOR PROVIDERS OF METEOROLOGICAL SERVICES

SUBPART A — ADDITIONAL ORGANISATION REQUIREMENTS FOR PROVIDERS OF METEOROLOGICAL SERVICES (MET.OR)

SECTION 1 — GENERAL REQUIREMENTS

GM1 MET.OR.100 Meteorological data and information

DATA AND INFORMATION RELIABILITY

Owing to the variability of meteorological elements in space and time, to limitations of observing techniques and to limitations caused by the definitions of some of the elements, the specific value of any of the elements given in a forecast is understood to be the most probable value which the element is likely to assume during the period of the forecast. Similarly, when the time of occurrence or change of an element is given in a forecast, this time is understood to be the most probable time.

GM1 MET.OR.100(a) Meteorological data and information

OTHER AVIATION ENTITIES

The competent authority determines who may be the 'other service providers and aviation entities' that could be provided with the necessary meteorological information.

GM1 MET.OR.110 Meteorological information exchange requirements

GENERAL

Operational meteorological information is disseminated to international OPMET databanks and the centres for the operation of aeronautical fixed service satellite distribution systems.

GM2 MET.OR.110 Meteorological information exchange requirements

OPMET DATABANK

The list of relevant meteorological exchange requirements for OPMET can be found in the FASID tables in ICAO Doc 7754 (EUR ANP).

GM1 MET.OR.110(a) Meteorological information exchange requirements

AREA FORECASTS — LOW-LEVEL FLIGHTS

Area forecasts for low-level flights prepared in support of the issuance of AIRMET information are exchanged between aerodrome meteorological offices and/or meteorological watch offices responsible for the issuance of flight documentation for low-level flights in the flight information regions concerned.

GM1 MET.OR.120 Notification of discrepancies to the world area forecast centres (WAFCs)

REPORTING — SIGNIFICANT DISCREPANCIES

Guidance on reporting significant discrepancies is provided in the Manual of Aeronautical Meteorological Practice (ICAO Doc 8896).

SECTION 2 — SPECIFIC REQUIREMENTS

[Reserved]

SUBPART B — TECHNICAL REQUIREMENTS FOR PROVIDERS OF METEOROLOGICAL SERVICES (MET.TR)

SECTION 1 — GENERAL REQUIREMENTS

GM1 MET.TR.115(a) Meteorological bulletins

ALPHANUMERICAL FORMAT

The format of the meteorological bulletins is understood to be that in alphanumerical format.

GM2 MET.TR.115(a) Meteorological bulletins

COMPOSITION AND FILING TIMES OF BULLETINS

(a) Whenever possible, exchanges of operational meteorological information should be made in consolidated bulletins of the same types of meteorological information.

(b) Meteorological bulletins required for scheduled transmissions should be filed regularly and at the prescribed scheduled times.

GM3 MET.TR.115(a) Meteorological bulletins

HEADING

Detailed specifications on format and contents of the heading are given in the WMO Publication No 386, Manual on the Global Telecommunication System, Volume I, and in the ICAO Manual of Aeronautical Meteorological Practice (ICAO Doc 8896).

GM1 MET.TR.115(a)(2) Meteorological bulletins

LOCATION INDICATOR

ICAO location indicators are listed in ICAO Doc 7910 - Location Indicators.

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