Procedure	Brunei DCA **Aerodromes Standards Section**	
ADR 023	Aeronautical Study	
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Guidance on Methodology for Conducting an Aeronautical Study

RELATED MATERIAL	ASSOCIATED FORMS
Brunei Civil Aviation Order 2006	ADR 012 Aerodrome Certification Manual
BAR 14 Volume 1 Aerodromes	ICAO PANS Doc 9981
	ICAO Doc 9859

1 Introduction and Purpose

1.1 The primary objective of an aeronautical study or safety assessment is to assess the impact of a safety concern such as a design change or deviation in operational procedures at an existing aerodrome. Such a safety concern can often impact multiple stakeholders; therefore, an aeronautical study / safety assessments often need to be carried out in a cross-organizational manner, involving experts from all the involved stakeholders. Prior to the assessment, a preliminary identification of the required tasks and the organizations to be involved in the process is conducted.

1.2 The purpose of this document is to give guidance to the aerodrome operators on conducting an aeronautical study or safety assessment undertaken by aerodrome operators as part of the aerodrome's SMS for a formal approval by Brunei DCA.

1.3 This document outlines the methodologies and procedures to be followed when undertaking an aeronautical study/safety assessment. It includes a brief description of how a safety assessment fulfils an element of the overall aerodrome operator's SMS. An aerodrome operator's SMS should enable the aerodrome operator to manage the safety risks it is exposed to as a consequence of the hazards it must face during the operations of the aerodrome.

By applying the methodology described in this document, the aerodrome operator can demonstrate compliance with the minimum requirements described in the following :-

a) identifies safety hazards;

b) ensures that remedial action necessary to maintain safety is implemented;

c) provides for continuous monitoring and regular assessment of the achieved safety; and

d) aims to make continuous improvement to the overall safety of the aerodrome.

1.4 An aeronautical study / safety assessment is an element of the risk management process of an SMS that is used to assess safety concerns arising from, inter alia, deviations from standards and applicable regulations, identified changes at an aerodrome or when any other safety concerns arise.

Note.— Changes on an aerodrome can include changes to procedures, equipment, infrastructures, safety works, special operations, regulations, staffing, organization, etc.

1.5 Detailed information with regard to the methodology and procedures on the safety assessment undertaken by aerodrome operators can be found in the ICAO PANS Doc 9981 Chapter 3.

1.6 When a safety concern, change or a deviation has an impact on several aerodrome stakeholders, consideration shall be given to the involvement of all stakeholders affected in the safety assessment process. In some cases, the stakeholders impacted by the change will need to conduct a separate safety assessment themselves in order to fulfil the requirements of their SMSs and coordinate with other relevant stakeholders. When a change has an impact on multiple stakeholders, a collaborative safety assessment should be conducted to ensure compatibility of the final solutions.

1.7 A safety assessment considers the impact of the safety concern on all relevant factors determined to be safety-significant. The list below provides a number of items that may need to be considered when conducting a safety assessment. The items in this list are not exhaustive and in no particular order:

a) aerodrome layout, including runway configurations; runway length; taxiway, taxilane and apron configurations; gates; jet bridges; visual aids; and the RFF services infrastructure and capabilities;

b) types of aircraft, and their dimensions and performance characteristics, intended to operate at the aerodrome;

c) traffic density and distribution;

d) aerodrome ground services;

e) air-ground communications and time parameters for voice and data link communications;

f) type and capabilities of surveillance systems and the availability of systems providing controller support and alert functions;

g) flight instrument procedures and related aerodrome equipment;

h) complex operational procedures, such as collaborative decision-making (CDM);

i) aerodrome technical installations, such as advanced surface movement guidance and control systems (A-SMGCS) or other air navigation aids;

j) obstacles or hazardous activities at or in the vicinity of the aerodrome;

k) planned construction or maintenance works at or in the vicinity of the aerodrome;

l) any local or regional hazardous meteorological conditions (such as wind shear); and

m) airspace complexity, ATS route structure and classification of the airspace, which may change the pattern of operations or the capacity of the same airspace.

Note.— Chapter 4 outlines the methodology and procedures to assess the adequacy between aeroplane operations and aerodrome infrastructure and operations.

1.8 Subsequent to the completion of the safety assessment, the aerodrome operator is responsible for implementing and periodically monitoring the effectiveness of the identified mitigation measures.

1.9 The Brunei DCA will reviews the safety assessment provided by the aerodrome operator and its identified mitigation measures, operational procedures and operating restrictions, and is responsible for the subsequent regulatory oversight of their application.

2 Requirements Reference

BAR 14 paragraph 1.4.1, 1.5.4 & 1.6.3 places an obligation on the aerodrome operator for the:

" 1.4.1***Standard***. Any specification for physical characteristics, configuration, material, performance, personnel or procedure, the uniform application of which is recognized as necessary for the safety or regularity of international air navigation and to which aerodrome operators shall conform in accordance with the provisions of the BAR 14 Volume I - Aerodromes. In the event of non-compliance with any standard, an application for exemption and justification (through appropriate risk assessment and/ or aeronautical studies) to the Brunei DCA is compulsory."

"1.5.4 An alternative means of compliance to that specified in paragraph 1.5.1 & 1.3.3 above may be proposed through the submission to the Brunei DCA of an aeronautical study."

"1.6.3 When an aerodrome does not meet the requirement of a standard or practice specified in a requirement, the Brunei DCA may determine, after reviewing the submitted aeronautical study, only if and where permitted by the standards and practices, the alternative conditions and procedures that are necessary to ensure a level of safety equivalent to that established by the relevant standard or practice (see also paragraph 1.5.4)."

3 Safety Assessment Process

3.1 The Methodology

3.1.1 A safety assessment is initially composed of four basic steps:

a) definition of a safety concern and identification of the regulatory compliance;

b) hazard identification and analysis;

c) risk assessment and development of mitigation measures; and

d) development of an implementation plan for the mitigation measures and conclusion of the assessment.

Note 1.— A safety assessment process flow chart applicable for aerodrome operations is provided in Attachment A of ICAO PANS Doc 9981 Chapter 3; a generic safety risk management process can be found in Doc 9859.

Note 2.— Certain safety assessments may involve other stakeholders such as ground handlers, aeroplane operators, air navigation service providers (ANSPs), flight procedure designers and providers of radio navigation signals, including signals from satellites.

3.1.2 Any perceived safety concerns are to be described in detail, including timescales, projected phases, location, stakeholders involved or affected as well as their potential influence on specific processes, procedures, systems and operations.

3.1.3 The perceived safety concern is first analysed to determine whether it is retained or rejected. If rejected, the justification for rejecting the safety concern is to be provided and documented.

3.1.4 An initial evaluation of compliance with the appropriate provisions in the regulations applicable to the aerodrome is conducted and documented.

3.1.5 The corresponding areas of concern are identified before proceeding with the remaining steps of the safety assessment, with all relevant stakeholders.

3.2 Hazard Identification

3.2.1 Hazards related to infrastructure, systems or operational procedures are initially identified using methods such as brain-storming sessions, expert opinions, industry knowledge, experience and operational judgement. The identification of hazards is conducted by considering:

a) accident causal factors and critical events based on a simple causal analysis of available accident and incident databases;

b) events that may have occurred in similar circumstances or that are subsequent to the resolution of a similar safety concern; and

c) potential new hazards that may emerge during or after implementation of the planned changes.

3.2.2 Following the previous steps, all potential outcomes or consequences for each identified hazard are identified.

Note.— Further guidance on the definition of risk can be found in Doc 9859.

3.2.3 The appropriate safety objective for each type of hazard should be defined and detailed. This can be done through:

a) reference to recognized standards and/or codes of practices;

b) reference to the safety performance of the existing system;

c) reference to the acceptance of a similar system elsewhere; and

d) application of explicit safety risk levels.

3.2.4 Safety objectives are specified in either quantitative terms (e.g. identification of a numerical probability) or qualitative terms (e.g. comparison with an existing situation). The selection of the safety objective is made according to the aerodrome operator's policy with respect to safety improvement and is justified for the specific hazard.

3.3 Risk assessment and development of mitigation measures

3.3.1 The level of risk of each identified potential consequence is estimated by conducting a risk assessment. This risk assessment will determine the severity of a consequence (effect on the safety of the considered operations) and the probability of the consequence occurring and will be based on experience as well as on any available data (e.g. accident database, occurrence reports).

3.3.2 Understanding the risks is the basis for the development of mitigation measures, operational procedures and operating restrictions that might be needed to ensure safe aerodrome operations.

3.3.3 The method for risk evaluation is strongly dependent on the nature of the hazards. The risk itself is evaluated by combining the two values for severity of its consequences and probability of occurrence.

Note.— A risk categorization tool in the form of a safety risk (index) assessment matrix is available in Doc 9859.

3.3.4 Once each hazard has been identified and analysed in terms of causes, and assessed for severity and probability of its occurrence, it must be ascertained that all associated risks are appropriately managed. An initial identification of existing mitigation measures must be conducted prior to the development of any additional measures.

3.3.5 All risk mitigation measures, whether currently being applied or still under development, are evaluated for the effectiveness of their risk management capabilities.

Note.— The exposure to a given risk (e.g. duration of a change, time before implementation of corrective actions, traffic density) is taken into account in order to decide on its acceptability.

3.3.6 In some cases, a quantitative approach may be possible, and numerical safety objectives can be used. In other instances such as changes to the operational environment or procedures, a qualitative analysis may be more relevant.

Note 1.— An example of a qualitative approach is the objective of providing at least the same protection as the one offered by the infrastructure corresponding to the appropriate reference code for a specific aeroplane.

Note 2.— Chapter 4 provides a list of typical challenges related to each part of the aerodrome infrastructure and the potential solutions proposed.

3.3.7 Risk assessment models are commonly built on the principle that there should be an inverse relationship between the severity of an incident and its probability.

Note 1. -Methodologies for risk management can be found in Attachment B.

3.3.8 In some cases, the result of the risk assessment may be that the safety objectives will be met without any additional specific mitigation measures.

3.4 Development Of An Implementation Plan And Conclusion Of The Assessment

3.4.1 The last phase of the safety assessment process is the development of a plan for the implementation of the identified mitigation measures.

3.4.2 The implementation plan includes time frames, responsibilities for mitigation measures as well as control measures that may be defined and implemented to monitor the effectiveness of the mitigation measures.

3.5 Approval Or Acceptance Of A Safety Assessment

3.5.1 The safety assessment conducted by the aerodrome operator is a core SMS function. Management approval and implementation of the safety assessment, including future updates and maintenance, are the responsibility of the aerodrome operator. The Brunei DCA may, for specific reasons, require the submission of the specific safety assessment for approval/acceptance.

3.5.2 The Brunei DCA may establishes the type of safety assessments that are subject to approval or acceptance and determines the process used for that approval/acceptance.

3.5.3 Where required in 5.5.1, a safety assessment subject to approval or acceptance by the Brunei DCA shall be submitted by the aerodrome operator prior to implementation.

3.5.4 The Brunei DCA analyses the safety assessment and verifies that:

a) appropriate coordination has been performed between the concerned stakeholders;

b) the risks have been properly identified and assessed, based on documented arguments (e.g. physical or Human Factors studies, analysis of previous accidents and incidents);

c) the proposed mitigation measures adequately address the risk; and

d) the time frames for planned implementation are acceptable.

Note.— It is preferable to work with a team of the State's operational experts in the areas considered in the safety assessment.

3.5.5 On completion of the analysis of the safety assessment, the Brunei DCA :

a) either gives formal approval or acceptance of the safety assessment to the aerodrome operator as required in 5.5.1; or

b) if some risks have been underestimated or have not been identified, coordinates with the aerodrome operator to reach an agreement on safety acceptance; or

c) if no agreement can be reached, rejects the proposal for possible resubmission by the aerodrome operator; or

d) may choose to impose conditional measures to ensure safety.

3.5.6 The Brunei DCA to ensure that the mitigation or conditional measures are properly implemented and that they fulfil their purpose.

3.6 Promulgation Of Safety Information

3.6.1 The aerodrome operator determines the most appropriate method for communicating safety information to the stakeholders and ensures that all safety-relevant conclusions of the safety assessment are adequately communicated.

3.6.2 In order to ensure adequate dissemination of information to interested parties, information that affects the current integrated aeronautical information package (IAIP) or other relevant safety information is:

a) promulgated in the relevant section of the IAIP or automatic terminal information service (ATIS); and

b) published in the relevant aerodrome information communications through appropriate means.

4 **Safety Assessment Flow Chart (See Page 8 of this material)**

(adopted from ICAO PANS Aerodrome 9981 Chapter 3 Attachment A)

5 Safety Assessment Methodologies For Aerodromes (See Page 9 of this material)

(adopted from ICAO PANS Aerodrome 9981 Chapter 3 Attachment B)

6 Documentation and Reference

BAR 14 Volume 1 Aerodromes

ICAO PANS Aerodromes Doc 9981

7 Records

All documentation is on appropriate company data base.

8 Responsibilities

Aerodromes Inspectorate – ensures compliance with the requirements for Approval.

Approvals – Support to the Inspector and ensure all records are complete and correct

Attachment A to Chapter 3

SAFETY ASSESSMENT FLOW CHART

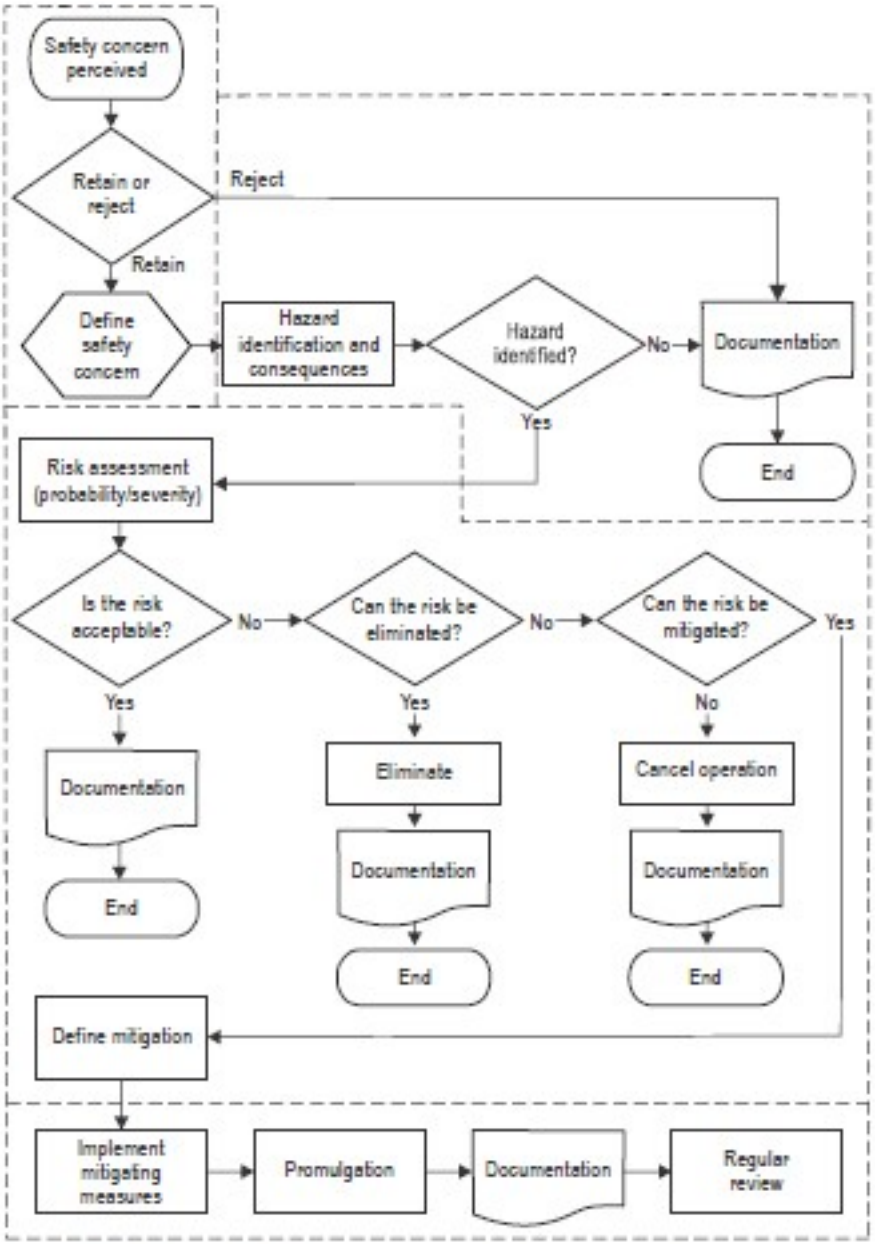

Figure 3-Att A-1. Flow chart to be used for the conduct of a safety assessment

Attachment B to Chapter 3

SAFETY ASSESSMENT METHODOLOGIES FOR AERODROMES

Note.— Further guidance on safety risk probability, severity, tolerability and assessment matrix can be found in Doc 9859 — Safety Management Manual (SMM).

1. *Depending on the nature of the risk, three methodologies can be used to evaluate whether it is being appropriately managed:*

a) *Method type "A"*. For certain hazards, the risk assessment strongly depends on specific aeroplane and/or system performance. The risk level is dependent upon aeroplane/system performance (e.g. more accurate navigation capabilities), handling qualities and infrastructure characteristics. Risk assessment, then, can be based on aeroplane/system design and validation, certification, simulation results and accident/incident analysis;

b) *Method type "B"*. For other hazards, risk assessment is not really linked with specific aeroplane and/or system performance but can be derived from existing performance measurements. Risk assessment, then, can be based on statistics (e.g. deviations) from existing operations or on accident analysis; development of generic quantitative risk models can be well adapted;

c) *Method type "C"*. In this case, a "risk assessment study" is not needed. A simple logical argument may be sufficient to specify the infrastructure, system or procedure requirements, without waiting for additional material, e.g. certification results for newly announced aeroplanes or using statistics from existing aeroplane operations.

Risk assessment method

2. The risk assessment takes into account the probability of occurrence of a hazard and the severity of its consequences; the risk is evaluated by combining the two values for severity and probability of occurrence.

3. Each identified hazard must be classified by probability of occurrence and severity of impact. This process of risk classification will allow the aerodrome to determine the level of risk posed by a particular hazard. The classification of probability and severity refers to potential events.

4. The severity classification includes five classes ranging from "catastrophic" (class A) to "not significant" (class E). The examples in Table 3-Att B-1, adapted from Doc 9859 with aerodrome-specific examples, serve as a guide to better understand the definition.

5. The classification of the severity of an event should be based on a "credible case" but not on a "worst case" scenario. A credible case is expected to be possible under reasonable conditions (probable course of events). A worst case may be expected under extreme conditions and combinations of additional and improbable hazards. If worst cases are to be introduced implicitly, it is necessary to estimate appropriate low frequencies.

Table 3-Att B-1. Severity classification scheme with examples

(adapted from Doc 9859 with aerodrome-specific examples)

Severity	*Meaning*	*Value*	*Example*
Catastrophic	– Equipment destroyed – Multiple deaths	A	– collision between aircraft and/or other object during take-off or landing
Hazardous	– A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely – Serious injury – Major equipment damage	B	– runway incursion, significant potential for an accident, extreme action to avoid collision – attempted take-off or landing on a closed or engaged runway – take-off/landing incidents, such as undershooting or overrunning
Major	– A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency – Serious incident – Injury to persons	C	– runway incursion, ample time and distance (no potential for a collision) – collision with obstacle on apron/ parking position (hard collision) – person falling down from height – missed approach with ground contact of the wing ends during the touchdown – large fuel puddle near the aircraft while passengers are on-board
Minor	– Nuisance – Operating limitations – Use of emergency procedures – Minor incident	D	– hard braking during landing or taxiing – damage due to jet blast (objects) – expendables are laying around the stands – collision between maintenance vehicles on service road – breakage of drawbar during pushback (damage to the aircraft) – slight excess of maximum take-off weight without safety consequences – aircraft rolling into passenger bridge with no damage to the aircraft needing immediate repair

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Severity	*Meaning*	*Value*	*Example*
			– forklift that is tilting – complex taxiing instructions/procedures
Negligible	– Few consequences	E	– slight increase in braking distance – temporary fencing collapsing because of strong winds – cart losing baggage

6. The probability classification includes five classes ranging from "extremely improbable" (class 1) to "frequent" (class 5) as shown in Table 3-Att B-2.

7. The probability classes presented in Table 3-Att B-2 are defined with quantitative limits. It is not the intention to assess frequencies quantitatively; the numerical value serves only to clarify the qualitative description and support a consistent expert judgement.

Table 3-Att B-2. Probability classification scheme

Probability class	*Meaning*
5 Frequent	Likely to occur many times (has occurred frequently)
4 Reasonably probable	Likely to occur sometimes (has occurred infrequently)
3 Remote	Unlikely to occur (has occurred rarely)
2 Extremely remote	Very unlikely to occur (not known to have occurred)
1 Extremely improbable	Almost inconceivable that the event will occur

8. The classification refers to the probability of events per a period of time. This is reasoned through the following:

a) many hazards at aerodromes are not directly related to aircraft movements; and

b) the assessment of hazards occurrence probabilities can be based on expert judgement without any calculations.

9. The aim of the matrix is to provide a means of obtaining a safety risk index. The index can be used to determine tolerability of the risk and to enable the prioritization of relevant actions in order to decide about risk acceptance.

10. Given that the prioritization is dependent on both probability and severity of the events, the prioritization criteria will be two-dimensional. Three main classes of hazard mitigation priority are defined in Table 3-Att B-3:

a) hazards with high priority — intolerable;

b) hazards with mean priority — tolerable; and

c) hazards with low priority — acceptable.

11. The risk assessment matrix has no fixed limits for tolerability but points to a floating assessment where risks are given risk priority for their risk contribution to aircraft operations. For this reason, the priority classes are intentionally not edged along the probability and severity classes in order to take into account the imprecise assessment.

Table 3-Att B-3. Risk assessment matrix with prioritization classes

Risk probability		*Risk severity*				
		Catastrophic **A**	Hazardous **B**	Major **C**	Minor **D**	Negligible **E**
Frequent	**5**	**5A**	**5B**	**5C**	**5D**	**5E**
Occasional	**4**	**4A**	**4B**	**4C**	**4D**	**4E**
Remote	**3**	**3A**	**3B**	**3C**	**3D**	**3E**
Improbable	**2**	**2A**	**2B**	**2C**	**2D**	**2E**
Extremely Improbable	**1**	**1A**	**1B**	**1C**	**1D**	**1E**

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