TECHNICAL GUIDANCE MATERIAL

for

Aviation Safety Hazard Identification

SOUTH AFRICAN CIVIL AVIATION AUTHORITY

SUBJECT: **TECHNICAL GUIDANCE MATERIAL FOR AVIATION SAFETY HAZARDS IDENTIFICATION.**

EFFECTIVE DATE: **30 MARCH 2023**

APPLICABILITY

To the SACAA and all service providers as according to the Part 140.01.1 applicability and further to Requirements of safety management system Part 140.01.3 (2) (a) – (c).

PURPOSE

This TGM is developed to assist in outlining what a hazard is and what is hazard identification is within a of aviation safety risk management framework, whereby the concepts such as: risk, safety events, undesirable events, outcomes, consequences and risk controls (barriers or mitigations) are referred to and explained.

The basic concepts behind hazard identification methodologies (data-driven and qualitative) are described. It is acknowledged however that it is difficult to declare completeness of a hazard identification process, and hence hazard identification should be periodically reviewed.

Moreover, it is further recognised that the aviation system involves a complex interaction between technical and human-centred sub-systems operated by a wide range of different stakeholders (Airlines, Airports, ANSP and MRO etc.). Each organisation should manage the hazards that fall within their managerial control but should also co-operate with other stakeholders to help manage interactions and interfaces.

REQUIREMENTS

As a recommendation it is encouraged to also read or familiarizes with the **TGM: How to Conduct Aviation Safety Risk Assessment** which is accessible through the SACAA website under **folder "Safety Management System"** located on the **tab "Industry".**

1. REFERENCE:

i. Civil Aviation Regulations Part 140
ii. ICAO Annex 19
iii. ICAO Doc 9859

2. TERMS AND ABBREVIATIONS:

TERM	DEFINITION
Consequence	The degree of injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function arising from an outcome. Consequences have a magnitude.
Hazard	Means a situation or an object with potential to cause death or injury to a person, damage to equipment or a structure, loss of material, or a reduction of ability to

	perform a prescribed function. (Part1 – definition)
Hazard Identification	A process used to determine all possible situations, event and circumstances that may expose people to injury, illness, disease or death or may cause damage or loss of equipment and property, or damage to the environment.
Outcome	A potential end point of an accident scenario which can be assigned a consequence severity.
Risk	The combination of the predicted frequency and severity of the consequences of hazard(s) considering all the potential outcomes.
Risk Controls (Barriers and Mitigation)	A system, activity, action or procedure that is put in place to reduce the risk associated with a hazard. Mitigation may include: a. Elimination of the hazard (preferred); b. Reduction in the frequency of the hazard (barriers); c. Reduction in the likelihood of the outcomes of the hazard (outcome mitigation); d. Reduction of the severity of the outcomes of the hazard (consequence mitigation).
Safety Event	A failure condition, causal factor, threat or precursor event which in isolation or in combination with other safety events could result in an undesirable event.
Safety Risk Management	Is a key component of safety management and includes hazard identification, safety risk assessment, safety risk mitigation and risk acceptance.
Undesirable Event	A stage in the escalation of an accident scenario where the incident, serious incident, or accident will occur, unless an active recovery measure is available and is successfully used.

ABBREVIATION	DESCRIPTION
ANSP	Air Navigation Service Provider
E: ASO	Executive Aviation Safety Operations
FMEA	Failure Modes and Effects Analysis
FTA	Fault Tree Analysis
HAZOP	Hazard and Operability
HAZOPS	Hazard and Operability Study
M: QC & AIIR	Manager: Quality Control and Accident Incident Investigation Review
M: RM	Manager: Records Management
MRO	Maintenance Repair Organisation
SM: CSD	Senior Manager Consistency and Standardisation
SMS	Safety Management System
SMS: TO	Safety Management System: Technical Officer
SRM	Safety Risk Management
SWIFT	Structured What-if Technique
TGM	Technical Guidance Material

3. GENERAL

3.1 Safety risk assessment is one of the functions in a Safety Management System (SMS) and an important element of safety risk assessment is the identification of hazards.

3.2 A hazard can be considered as a dormant potential for harm which is present in one form or another within the aviation system or its environment. This potential for harm may be in the form of a natural hazard such as terrain, or a technical hazard such as wrong runway markings.

4. INTRODUCTION TO HAZARDS IDENTIFICATION

4.1 The ICAO Annex 19 states that, States shall establish and maintain a process to identify hazards from collected safety data. States shall develop and maintain a process that ensures the assessment of safety risks associated with identified hazards.

4.2 Further to that, the ICAO Doc 9859 states that. Hazard identification is the first step in the SRM process. The service providers should develop and maintain a formal process to identify hazards that could impact aviation safety in all areas of operation and activities. This includes equipment, facilities and systems. Any aviation safety-related hazard identified and controlled is beneficial for the safety of the operation. It is important to also consider hazards that may exist as a result of the SMS interfaces with external organisations.

4.3 An SMS is a systematic and organised approach to managing safety, including the necessary organisational structures, accountabilities, policies, and procedures. The component of SMS within which hazards identification takes place is safety risk assessment and this forms part of an overall safety risk management process.

4.4 Safety risk assessment can be performed on steady-state operations to provide assurance that the risks associated with day-to-day operations remain tolerably safe. It can also be performed on proposed changes to a system or operation to ensure that the risks from any additional hazards or any impacts on existing hazards, introduced by the change remain acceptably safe.

4.5 Safety risk assessment features 8 steps:

a. System / operation description
b. <u>Hazards identification processes</u>
c. Consequence analysis
d. Causal analysis
e. Evaluation of risk
f. Mitigation of risk
g. Approval of residual risk
h. Safety assessment documentation

4.6 *<u>Hazards</u>* identification is the act of recognising the failure conditions or threats (*<u>Safety Events</u>*), which could lead to *<u>Undesirable Events</u>* and defining the characteristics of theses undesirable events in terms of their potential *<u>Safety Outcomes</u>* and of the magnitude of these safety outcomes' *<u>Consequences</u>*.

Note: The underlined terms are defined under part 2 terms and abbreviations of this TGM.

Note: This TGM focuses on step b - hazards identification processes, but also touches on the other steps at a high level in so far as they relate to hazards identification in the wider safety risk management process.

5. SAFETY RISK MANAGEMENT

5.1 The identification of hazards associated with the day-to-day operations of an organisation or associated with changes to the operations of an organisation; the assessment of the risks associated with those hazards; and the implementation and management of measures to reduce those risks to an acceptable level (hazard removal; or the application of barriers and/or mitigations – i.e., risk control).

5.2 The definition variables for hazard and hazard itself i.e. (hazard, safety event, undesirable event, outcome, consequence, risk controls, risk, and safety risk management) are diagrammatically illustrated in figure 1 referred to as Bow-Tie diagram methodology. Refer on the table 1 to 3 as provided below the Bow-Tie figure 1 more for light on how data/information from the Bow-Tie methodology can be transferred to an easily readable format, the same also examples on use of the hazard terminology.

5.3 The method for building a Bow-tie involves asking a structured set of questions in a logical sequence. The completed Bow-Tie illustrates the hazard, the undesirable event, the safety events and potential outcomes, and the risk controls put in place to minimise the risk.

5.4 Risk management is about controlling risks. This is done by placing barriers to prevent certain undesirable events from happening. A control can be any measure taken that acts against some undesirable force or intention, in order to maintain a desired state. In the Bow-Tie methodology there are preventive or proactive barriers (on the left side of the Undesirable Event) that prevent the Undesirable Event from happening. There are also corrective or reactive controls (on the right side of the Undesirable Event) that prevent the Undesirable Event from resulting into unwanted Outcomes or reduce the consequence severity of the Outcomes.

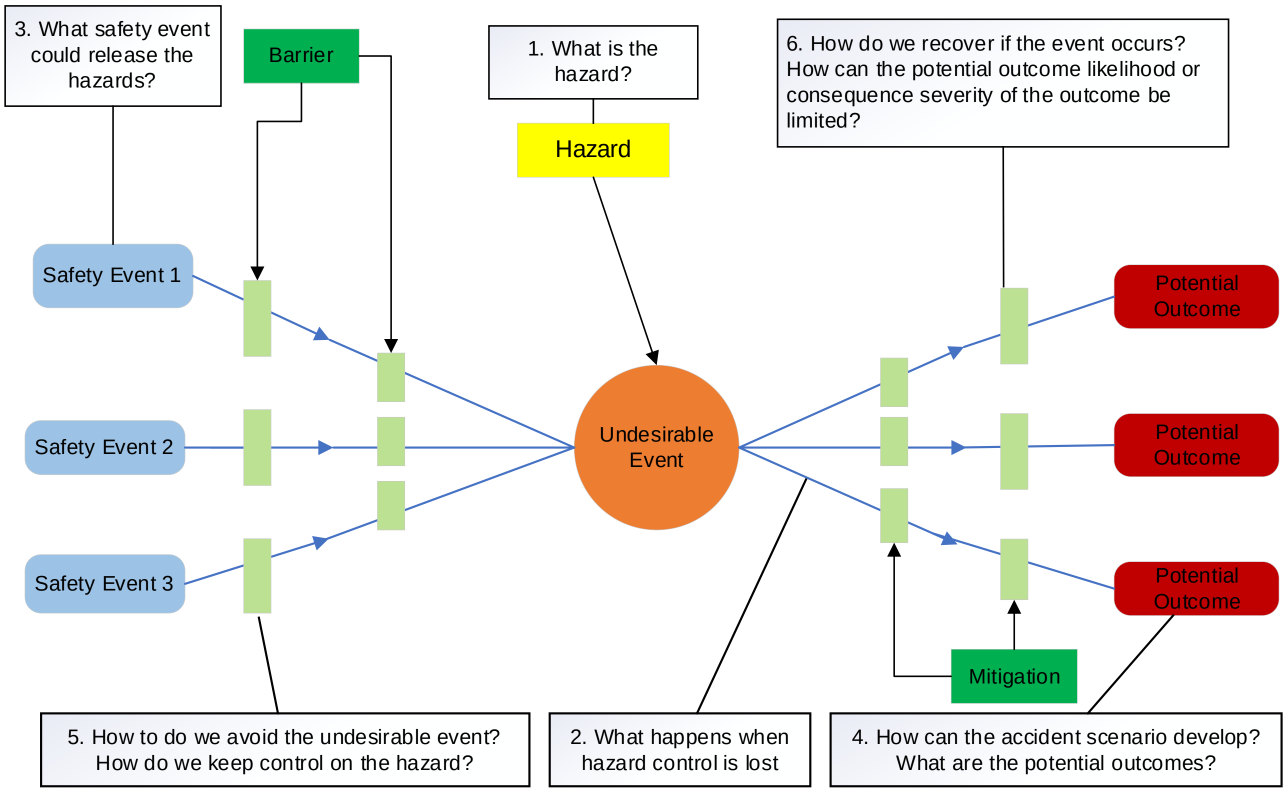

Figure 1: Bow-Tie Diagram illustrating definition of terms.

HAZARD: WRONG TAKE-OFF CONFIGURATION					
Safety Events	**Safety Barriers**	**Undesirable Event**	**Mitigations**	**Potential Outcomes**	***Consequence Severity***
Improper aircraft loading	Ground handling staff training	Pilot attempts to take-off with the aircraft wrongly configured	Stall Warning	Aircraft mush/stall	*Multiple fatalities*
Mis-configured flap setting	Aircraft centre of gravity detection systems (if available)		Aural Misconfiguration Warning	Runway Excursion	*Multiple fatalities*
Improper aircraft trim configuration	Checklist items		Simulator training on aborting a take-off	Aborted Take-off	*Aircraft / ground movement delay*
	Pilot training				
	Cockpit ergonomics				

Table 1: Example of using hazard related terminology for wrong take-off configuration.

HAZARD: WORN RUNWAY MARKINGS					
Safety Events	**Safety Barriers**	**Undesirable Event**	**Mitigations**	**Potential Outcomes**	***Consequence Severity***
Improper snow removal process (Damaging runway)	Runway Inspection	Pilot misinterprets/ cannot see runway markings	Taxiway Markings	Runway Incursion by vehicle	*Aborted landing*
Poor quality of material used for marking	Aerodrome Manual		Taxiway signage	Runway Incursion by aircraft (undetected)	*Multiple fatalities/Aborted landing*
Inadequate runway marking maintenance	Pilot reporting scheme		Taxiway lighting/stop bars	Runway Incursion by aircraft	*Aircraft go ground - delay*
	ATC reporting scheme		Runway lighting	Loss of location awareness by crew	*Aircraft / ground movement delay*
	Scheduled maintenance		Ground surface radar		

Table 2: Example of using hazard related terminology for worn markings on a runway.

HAZARD: FLAMABLE CARGO MATERIAL					
Safety Events	**Safety Barriers**	**Undesirable Event**	**Mitigations**	**Potential Outcomes**	***Consequence Severity***
Improper cargo labelling Ground handling	Ground handling staff training	Ignition of flammable cargo in the cargo hold	Smoke and fire detectors	Fire is uncontrolled	*Aircraft disintegration/ Multiple fatalities*
Improper cargo packaging	Dangerous Goods training		Emergency procedures	Fire is controlled and extinguished after some time	*Significant repair and off line service costs*
Improper cargo combination	Cargo dispatching procedures		Simulator training on aborting a take-off	Fire is extinguished	Aircraft diversion
	Cargo labelling procedures		Pilot training		
	Dangerous goods reference material (incl. software)		Fire extinguishing agents		

Table 3: Example of using hazard related terminology for flammable cargo.

6. HAZARD IDENTIFICATION IN PRACTICE

Hazards may be identified through a data-driven (quantitative) methodology or qualitative process such as discussions, interviews and brainstorming.

7. DATA DRIVEN METHODOLOGY

7.1 In a data-driven approach, hazards are identified and recorded through a systematic process which allows for traceability and further analysis.

7.2 There are various types of recorded observations which may be used to identify hazards.

7.3 Sources for hazards identification can be Flight Data Monitoring (FDM), company audits, staff surveys, hazard reports and others. Investigation and reports of past occurrences may provide rich material as to existing hazards as well as, alternative to these, hazards which may arise. For example, an occurrence report may identify the hazard of standing water affecting the integrity of landing aid equipment at an airport, but through this report other hazards which may affect this equipment may also be identified.

7.4 Furthermore, real-time and non-real-time simulations may be used to identify likely hazards and their interactions. Using simulation modelling it may be easier to identify potential hazards and their potential outcomes.

8. QUALITATIVE METHODOLOGIES

8.1 Hazards may be identified through a qualitative process, either formal (part of safety assessment) or informal based on discussions, interviews, and brainstorming. Informal qualitative methodologies are heuristic processes based on expert judgement. They often allow identifying hazards that other approaches can't detect. Using both approaches in combination will provide better and more comprehensive results.

8.2 it is recognised that hazards identification must be done methodically in order to ensure that all areas of operation where hazards may exist have been identified. It is recommended that among others; design, organisational, work environment factors, as well as procedures and operating practices are taken into account in the identification process (Ref. ICAO SMS Manual, Doc 9859)

8.3 Existing material should be reviewed with the aim of identifying gaps or hazards. Brainstorming exercise may be undertaken as it will allow participants to identify hazards within the organisation. Identification of hazards may be undertaken by an individual or group-based assessors.

Note: The main challenge for individual and group-based brainstorming sessions involves the identification of hazards which exist but are difficult to think of. Some approaches have been developed to cover what might be termed 'unimaginable hazards.

8.3.1 **Individual Approach:** The individual-based approach entails one or two assessors conducting identification of hazards across all aspects of a system. These assessors assume the responsibility for identifying the majority of hazards within the organisation. This particular method may be appropriate for an initial and high-level identification of hazards. An example of question which may assist in identifying hazards are:

a. What would possibly go wrong?
b. What could lead to something possibly going wrong?

8.3.2 **Group-Based Approach:** The group-based approach involves a group of experts conducting the identification exercise. It is suggested that this group consists of selected managers and staff. For small organisations it is suggested that departments participate in this exercise in their entirety. For example, for small operators, all Flight Department staff could participate in the hazard's identification process.

8.3.3 **Unimaginable Hazards:** One of the most common ways of identifying hazards other than from occurrence reports is to conduct functional hazard assessments. In such functional hazard assessments, failures of prescribed or intended system functions or operational procedures, the operational consequences of these failures, and the potential effects on the safety of the operation are identified. It is however a well-established fact that some hazards are hard or even impossible to identify using functional hazard identification sessions. Such hazards are called (functionally) unimaginable hazards.

8.3.4 One reason why not all hazards may be identified through a functional approach is that there may be hazards associated with a system functioning well, for example when operators become overly reliant on a well-functioning alerting system. Another reason is that some hazards may not be associated with functional failures, such as those associated with situational awareness problems.

8.3.5 Also, sometimes functions relevant for the safety of the operations are implicit and go unnoticed, or the available description of the system or operation involved is otherwise not complete. In order to get a complete picture of the relevant hazards, "logical thinking" from the functional failure point of view must be enhanced by creative input of operational experts. Such input is obtained through hazard identification brainstorming sessions that are designed, organised and conducted in a specific manner.

9. HAZARD IDENTIFICATION DOCUMENTATION AND REVIEW

9.1 It should be recognised though that it is very difficult to declare a hazards identification process as complete. For this reason, hazard identification should be periodically reviewed. If there is a significant change in the operations, the organisation or its staff; the process should be repeated. Also, it is recommended that hazards identification be repeated when mitigation measures have been identified in order to detect unforeseen interactions between mitigation measures and other elements of the system or in the light of the outcomes of internal investigations.

9.2 The outcome of the hazard's identification process should be documented in the form of a list of hazards or hazard logs. Hazards logging is useful for subsequent analysis (see section: 18 Hazard Log, and appendix 2: An example Hazard Log Table template)

10. INTERFACE BETWEEN SYSTEMS AND STAKEHOLDERS

10.1 The aviation system involves a complex interaction between different technical and human centred sub-systems operated by a wide range of different stakeholders (Airlines, Airports, ANSP and MRO etc.). Each organisation must manage the hazards that fall within their managerial control but should also co-operate with other stakeholders to help manage interactions and interfaces. In this complex hierarchy of systems, a safety outcome in one system could cause hazards in another system.

10.2 It is therefore important that hazards identification involves representatives from all relevant stakeholder organisations where appropriate.

11. SPECIAL TOOLS AND TECHNIQUES FOR HAZARDS IDENTIFICATION

11.1 This section provides a summary of a number of tools and techniques that can be used for hazards identification. The various techniques are described below together with a brief overview of their advantages and disadvantages.

11.2 It should be remembered that any system or operation comprises:

a. people;
b. procedures;
c. equipment; and
d. an environment of operation

11.3 All **these elements** must be considered during hazards identification.

11.3.1 Hazards identification techniques require a definition of the System / Operation, its environment of operation and its interactions to have been completed prior to undertaking the task (safety risk assessment Step 1: System/Operation description). This System / Operation definition may take different forms depending on the specific technique and type of system. The definition may be:

a. Functional.
b. Operational.
c. Process.
d. Scenario based.

12. BRAINSTORMING

12.1 Brainstorming is an unbounded but facilitated discussion within a group of experts. A facilitator prepares prompts or issues ahead of the group session and then encourages imaginative thinking and discussion between group members during the session. The facilitator initiates a thread of discussion and there are no rules as to what is in or out of scope from the subsequent discussion. All contributions are accepted and recorded, and no view is challenged or criticised. This provides an environment in which the experts feel comfortable in thinking laterally.

12.2 Advantages:

a. Good for identifying new hazards in novel systems.
b. Involves all key stakeholders.
c. Relatively quick and easy to undertake.
d. Can be applied to a wide range of types of systems.

12.3 Disadvantages:

a. Relatively unstructured and therefore not necessarily comprehensive.
b. Depends on the expertise and profile of the participants.
c. May be susceptible to the influence of group dynamics.
d. Can rely heavily on the skills of the facilitator for success.

13. HAZARD AND OPERABILITY (HAZOP) STUDY

13.1 HAZOP is a systematic and structured approach using parameter and deviation guidewords. The technique relies on a very detailed system description being available for study and usually involves breaking down the system into well-defined subsystems and functional or process flows between subsystems. Each element of the system is then subjected to discussion within a multidisciplinary group of experts against the various combinations of the guidewords and deviations.

13.2 The group discussion is facilitated by a chairperson and the results of the discussion recorded by a secretary together including any hazards identified when a particular guideword and deviation combination is discussed. Where a particular guideword and deviation combination does not produce any hazards, or is not thought credible, this should also be recorded to demonstrate completeness.

13.3 The guidewords and deviations must be prepared in advance by the HAZOP Chairperson and may need to be tailored to the system or operation being studied.

13.4 In an aviation context, typical guidewords might include:

a. Detection
b. Co-ordination
c. Notification
d. Transmission
e. Clearance
f. Authorisation
g. Selection
h. Transcription
i. Turn
j. Climb
k. Descend
l. Speed
m. Read-back
n. Monitoring
o. Signage
p. Handover
q. Supervision

13.5 Typical deviations might include:

a. Too soon / early
b. Too late
c. Too much
d. Too little
e. Too high
f. Too low
g. Missing
h. Twice / repeated
i. Out of sequence
j. Ambiguous
k. Reverse / inverted

13.6 <u>Advantages:</u>

a. Systematic and rigorous.
b. Involves interaction of views from multidisciplinary experts.
c. Can be applied to a wide range of types of system.
d. Creates a detailed and auditable record of the hazards identification process.

13.7 <u>Disadvantages:</u>

a. Requires a considerable amount of preparation.
b. Can rely heavily on the skills of the HAZOP Chairperson.
c. Can be time consuming and therefore expensive.
d. Can inhibit imaginative thinking and so certain kinds of hazards.

14. CHECKLIST

14.1 Checklists are lists of known hazards or hazard causes that have been derived from past experience. The past experience could be previous risk assessments of similar systems or operations, or from actual incidents that have occurred in the past.

14.2 This technique involves the systematic use of an appropriate checklist and the consideration of each item on the checklist for possible applicability to a particular system.

14.3 Some example checklists are provided in appendix 1: Examples of Hazards.

14.4 Checklists should always be validated for applicability prior to use.

14.4.1 <u>Advantages:</u>

a. They can be used by non-system experts.
b. They capture a wide range of previous knowledge and experience.
c. They ensure that common and more obvious problems are not overlooked.

14.4.2 <u>Disadvantages:</u>

a. They are of limited use when dealing with novel systems.
b. They can inhibit imagination in the hazards identification process.
c. They would miss hazards that have not been previously seen.

15. FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

15.1 FMEA is a ‘bottom up’ technique that is used to consider **ways in which the basic components of a system can fail to perform their design intent**. This could either be **at an equipment level or at a functional level**. The technique relies on a detailed system description and considers the ways in which each sub-component of the system could fail to meet its design intent and what the consequences would be on the overall system.

15.2 For each sub-component of a system an FMEA considers:

15.2.1 All the potential ways that the component could fail.

15.2.2 The effects that each of these failures would have on the system behaviour.

15.2.3 The possible causes of the various failure modes.

15.2.4 How the failures might be mitigated within the system or its environment.

15.3 Behaviours at the system level arising from the sub-component failures which have a safety consequence are thus identified as hazards. The system level at which the analysis is applied can vary and is determined by the level of detail of the system description used to support the analysis. Depending on the nature and complexity of the system, the analysis could be undertaken by an individual system expert or by a team of system experts acting in group session.

15.4 <u>Advantages:</u>

15.4.1 Systematic and rigorous.

15.4.2 Creates a detailed and auditable record of the hazards identification process.

15.4.3 Can be applied to a wide range of types of system.

15.5 <u>Disadvantages:</u>

15.5.1 Only really considers hazards arising from single point failure modes rather than

15.5.2 combinations of failures.

15.5.3 Relies on people with detailed system knowledge.

15.5.4 Can be time consuming and expensive.

16. STRUCTURED WHAT-IF (SWIFT)

16.1 The SWIFT technique was originally developed as a simpler and more **efficient alternative technique to HAZOP.** Like HAZOP, SWIFT involves a multidisciplinary team of experts under the facilitation of a chairperson. It is a facilitated brainstorming group activity but is typically **carried out on a higher-level system description,** having fewer sub elements, than for HAZOP and with a reduced set of prompts.

16.2 Ahead of the group session the Chairperson prepares a suitable list of prompts such as:

16.2.1 What if…?

16.2.2 Could someone…?

16.2.3 Has anyone ever…?

16.3 The Chairperson uses the prompts to initiate discussion within the group.

16.3.1 <u>Advantages:</u>

a. Creates a detailed and auditable record of the hazards identification process.
b. Is less time consuming than other systematic techniques such as HAZOP.

16.3.2 <u>Disadvantages:</u>

a. Careful thought is required in preparation for the application of the technique.
b. Relies heavily on the expertise and experience of the team members.
c. Relies heavily on the skills of the Chairperson.

17. DYNAMIC METHODS

17.1 A number of techniques widely used across the industry such as the FTA and FMEA described above are static techniques which are not very good at capturing hazards related to the dynamic interaction aspects of complex systems and operations involving multiple actors.

17.2 Some hazards related to timing, sequencing and mutual dependency can be identified using such methods, and also using the various brainstorming approaches described in the previous paragraphs, but other techniques are sometimes needed to ensure an adequate capture of hazards related to the dynamics of complex systems and operations.

17.3 The complexities involved with employing these techniques, most of which involve some form of simulation, are such however, that their use is beyond the scope of most operational organisations and therefore requires expert assistance. Their description is also beyond the scope of this document.

17.4 Nevertheless, experience shows that where these dynamic methods are applied, they often identify relevant hazards that were not –or could not be – identified using static approaches.

17.5 It is therefore wise, when conducting hazard identification for complex and dynamic operations and systems, to give conscious consideration to the possible need to employ dynamic methods in addition to the methods described above.

18. HAZARD LOG

18.1 The last step in the Safety Risk Assessment Process, 4.5 (h), is the Safety Documentation Process. The key element of this process is the documentation of the hazards identified.

18.2 **Organisations should wherever possible maintain a centralised log of all identified hazards**. The nature and format of such a log may vary from a simple list of hazards to a more sophisticated relational database linking hazards to mitigations, responsibilities and actions (as part of an integrated safety risk management process).

18.3 As a minimum, it is recommended that the following information be included in the hazard log:

18.3.1 Unique hazard reference number against each hazard

18.3.2 Hazard description

18.3.3 Indication of the potential causes of the hazard (safety events)

18.3.4 Qualitative assessment of the possible outcomes and severities of consequences arising from the hazard

18.3.5 Qualitative assessment of the risk associated with the possible consequences of the hazard

18.3.6 Description of the risk controls for the hazard

18.3.7 Indication of responsibilities in relation to the management of the risk controls

18.4 In addition, organisations may wish to consider the following information for inclusion in the log.

18.4.1 A quantitative assessment of the risk associated with the possible consequences of the Hazard

18.4.2 Record of actual incidents or events related to the hazard or its' causes

18.4.3 Risk tolerability statement

18.4.4 Statement of formal system monitoring requirements

18.4.5 Indication of how the hazard was identified

18.4.6 Hazard owner

18.4.7 Assumptions

18.4.8 Third party stakeholders

NOTE: An example Hazard Log template is provided for illustration purposes in appendix 2.

DEVELOPED BY:		
	KEBOITIHETSE FREDY TONG	30 MARCH 2023
SIGNATURE OF SMS TO	NAME IN BLOCK LETTERS	DATE
	GCINOKUHLE MKHONZA	11 APRIL 2023
SIGNATURE OF M: QC & AIIR	NAME IN BLOCK LETTERS	DATE
REVIEWED & VALIDATED BY:		
	MARY STEPHENS	11 APRIL 2023
SIGNATURE OF SM: CSD	NAME IN BLOCK LETTERS	DATE
APPROVED BY:		
	ERIC MATABA	11 APRIL 2023
SIGNATURE OF E: ASO (Act.)	NAME IN BLOCK LETTERS	DATE

END

APPENDIX 1

1. Examples of Hazards by Hazard Type:

1.1 Natural

1.1.1 Severe weather or climatic events: Hurricanes, major winter storms, drought, tornadoes, thunderstorms lighting, and wind shear.
1.1.2 Adverse weather conditions: Icing, freezing precipitation, heavy rain, snow, winds, and restrictions to visibility.
1.1.3 Geophysical events: Earthquakes, volcanoes, tsunamis, floods and landslides.
1.1.4 Geographical conditions: E.g.: adverse terrain or large bodies of water.
1.1.5 Environmental events: wildfires, wildlife activity, and insect or pest infestation.
1.1.6 Public health events: epidemics of influenza or other diseases.

1.2 Technical, deficiencies regarding:

1.2.1 Aircraft and aircraft components, systems, sub-systems and equipments. This includes Failures, inadvertent or erroneous functioning of Systems.
1.2.2 An organisation's facilities, tools, and related equipment.
1.2.3 Facilities, systems, sub-systems and related equipment external to the organisation.

1.3 Economic

1.3.1 Major trends related to: Growth, Recession, Cost of material or equipment, Fuel cost, Environmental issues, etc.
1.3.2 Diverging interests: operation vs. shareholder

1.4 Ergonomic

1.4.1 Deficiencies in the environment the front line employees have to operate
1.4.2 24-hour operation with impact on individual's performance (circadian cycle)

1.5 Organisational

1.5.1 Complex organisational structures resulting in unclear responsibilities
1.5.2 Re-organisation.

1.6 Example Hazards by Organisation:

1.6.1 Airport Operator

a. Worn Runway Markings
b. Unclear ramp marking for vehicle holding point
c. Fuel Spillage
d. Not well lit parking position
e. Partial failure of weather monitoring devices (e.g. anemometer)

1.6.2 Ground Handler

a. Jet Blast
b. Noise
c. Understaffing
d. Misinterpretation of Load-sheet
e. Wet surfaces/ equipment
f. Improper application of anti-icing fluid

1.6.3 Aircraft Operator

a. Load-sheet errors
b. Lack of sleep during off duty

c. Partial failure or loss of navigation systems
d. Error in FMS database
e. Loss of radio communication
f. Wrong reed-back of ATC clearance
g. Expired Aeronautical information
h. Loss of transponder transmission

1.6.4 ANSP

a. Loss of communication
b. Loss of aircraft separation
c. Improper flight handover
d. Improper clearance
e. Use of wrong call sign
f. Adverse weather conditions
g. Diversion of multiple aircraft
h. Loss of transponder transmission

1.6.5 Maintenance Organisation

a. Use of outdated procedure
b. Delayed implementation of AD
c. Use of non-OEM certified parts
d. Improper handover of remaining work to next shift
e. Improper application of paint or other chemicals
f. Chemical spillage
g. Repair of wrong system/component

APPENDIX 2

An example Hazard Log Table template is given in Table 4 below.

Operation / System			
Hazard No.			
Hazard Description			
Safety Events (Causes or Threads)			
Potential Outcomes (and Associated Consequence Magnitudes)			
Risk Controls (Barriers and Mitigations)			
No.	Description		Responsible
1			
2			
3			
Risk Assessment (Worst Foreseeable Scenario – i.e., Highest Risk			
Hazard Frequency			
Outcome Likelihood			
Consequence Severity			
Risk			
Management Approval	Name:	Post:	Signature:
Relevant Previously Reported Incident Data			
Safety Performance Monitoring Requirements			
No.	Description		Responsible
1			
2			
3			

Table 4: Example of Hazard Log Template

NOTE: This Hazard Log Table is for illustration purpose, the Hazard Log Table is not exhaustive to this one.

APPENDIX 3

Examples of Sources for Identifying Hazards

1. Flight Operations Data Analysis (FODA) / Flight Data Monitoring (FDM)
2. FODA-Campaigns (subject specific in-depth analysis)
3. Flight Reports
4. Cabin Reports
5. Maintenance Reports
6. Confidential Safety Reports
7. Operations Control Reports
8. Maintenance Reports
9. Reports of the CAA
10. Crew Surveys
11. Crew Observation (LOSA)
12. Investigations & Hearings
13. Partner Airline Assessments
14. Quality Assurance Programme
15. Training records (e.g. crew periodic checks, simulator checks and training, line checks, etc)
16. Manufacturers reports and SIE safety information exchange programs
17. Safety Reporting
18. Observation of Maintenance operations (if applicable)
19. Safety (& Quality) Audits / Assessments
20. Safety Culture monitoring through surveys
21. Internal safety investigations
22. Ad-hoc questionnaires on chosen Safety Issues
23. Internal safety workshops
24. External safety information
25. Training records
26. Company voluntary reporting system
27. Audits and surveys
28. Ground Handling Report
29. Disruptive Passenger Report
30. Captain's Special Report
31. Flight and Duty Time Discretion Report
32. Flight Operations Monitoring
33. Accident reports
34. State mandatory occurrence system
35. Organisation’s partners
36. Assessment of partners
37. IOSA reports