Regional Safety Oversight Cooperation System

SRVSOP hazards taxonomy and coding examples manual

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Introduction

The purpose of this manual is to present examples of specific hazards of the aviation sector in each of the taxonomy categories. The examples presented are not the only ones, therefore the importance of being used in conjunction with other additional sources.

This manual is based on the knowledge and judgment initially developed by the Safety Management International Collaboration Group (SM ICG).

Four (4) categories of high-level hazard taxonomy have been established:

a) Organizational – Management or documentation, processes and procedures
b) Environmental – Weather or Wildlife
c) Human – Limitation of the human which in the system has the potential for causing harm
d) Technical – Aerodrome, air Navigation, operations, maintenance, and design and manufacturing

This manual contains specific examples of taxonomy that are proposed for each of the following categories applicable to the aviation sectors: Aerodrome, air navigation, operations, maintenance and design and manufacturing.

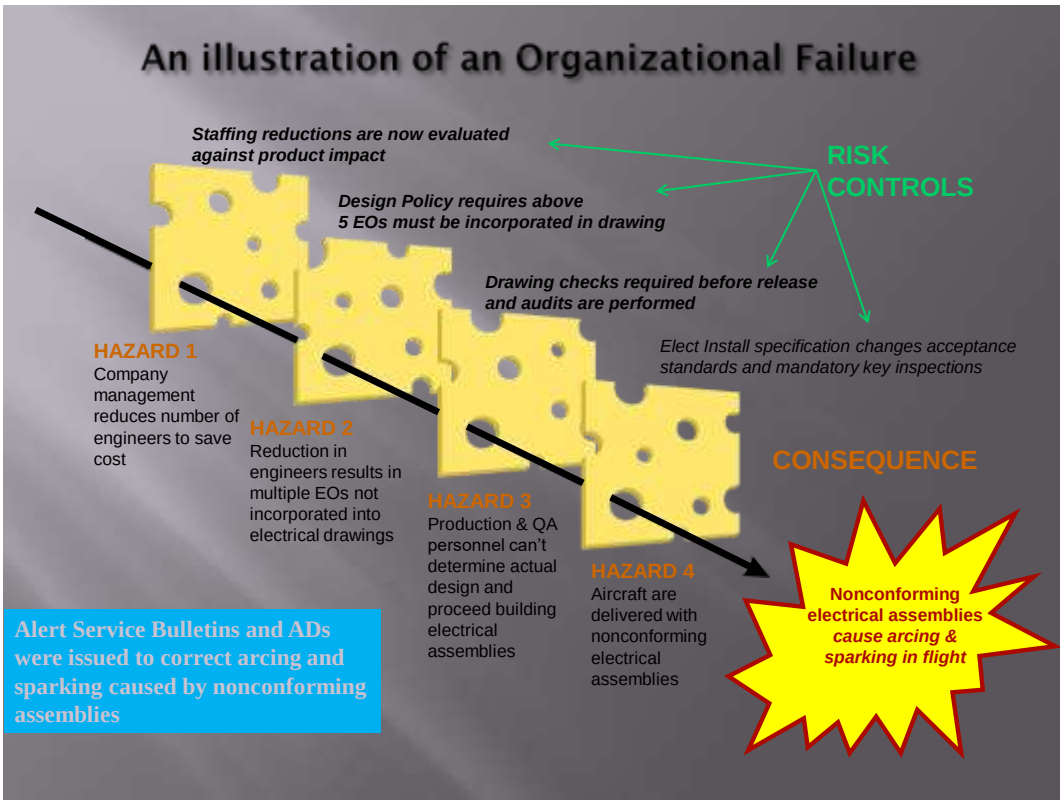
Organizational, environmental and human hazards are mostly generic, and affect all high-level aviation sectors. Human hazards are described as those that have a direct effect on the safety of each aviation sector and as those that have latent effects due to the consideration of human factors in the design aspects of the man-machine interface that could later arise during the design / manufacture, operations and maintenance of aircraft

The specific aviation sector hazards may have descriptions of absence and/or judgmental adjectives since experience through accident/incident investigation and subsequent root cause analysis validates those types of specific hazards.

Due to the nature of the incident/accident causal chain, hazards are often described at various points in the causal chain. Thus, risk mitigation strategies can also be applied at various points in the hazard causal chain. Therefore, it is important to understand this causal chain and contributing factors to identify the opportunities for potential risk mitigation options. For this reason, many of the technical category hazards are not necessarily independent and could stem from certain common organizational hazards. For example, a runway incursion could be described as a hazard itself. However, one could also argue that the runway incursion is not the hazard, but rather the effect (consequence) of lower level hazards, such as lack of proper runway design and/or lack of runway signage. It can further be argued that lack of proper runway design and signage is due to mismanagement stemming from an organizational hazard. Therefore, an organization should strive to develop risk controls to mitigate the runway incursion hazard risk in all hazard categories. However, it is generally impossible to have risk mitigation strategies to address every possible point in the incident/accident causal chain, so an organization should strive to identify all hazards in its organization or activities and develop effective risk mitigation strategies for those hazards determined to have unacceptable risk.

Due to complexity in the aviation system, it would be very difficult to develop comprehensive hazard taxonomies for each aviation sector, unless all of the possible causal chains and contributing factors can be identified, described and documented, and continually updated based on potential future incidents/accidents, which is beyond the scope of this document. In addition, hazards may be different in service provider organizations based on their specific business processes. Therefore, the specific hazard taxonomy elements in this document are only examples of some of the more basic understood hazards in each aviation sector based on expert opinion. It is anticipated that with more mature safety management processes in place, these example hazards will be developed further based on aggregate data from multiple service providers and analysis of systems under consideration to understand causal and contributing factors for interdependencies.

It is expected in the future that the global aviation community will share and add information related to hazards, which will be used for the review and increase of the taxonomy presented in this manual.


An illustration of an Organizational Failure
Staffing reductions are now evaluated against product impact
RISK CONTROLS
Design Policy requires above 5 EOs must be incorporated in drawing
Drawing checks required before release and audits are performed
Elect Install specification changes acceptance standards and mandatory key inspections
HAZARD 1
Company management reduces number of engineers to save cost
HAZARD 2
Reduction in engineers results in multiple EOs not incorporated into electrical drawings
HAZARD 3
Production & QA personnel can't determine actual design and proceed building electrical assemblies
HAZARD 4
Aircraft are delivered with nonconforming electrical assemblies
CONSEQUENCE
Nonconforming electrical assemblies cause arcing & sparking in flight
Alert Service Bulletins and ADs were issued to correct arcing and sparking caused by nonconforming assemblies

ORGANIZATIONAL (ORG)

Existing hazards as a result of the organization of the aeronautical entity.

- The category of organizational hazards includes the following sub-categories:
- **(REG - Regulator):** factors related to the elements that allow the Civil Aviation Authority (CAA) and the Accident Investigation Authority (AIA) to establish regulations and supervise safety
- **(OMN - Organizational management):** factors related to the control of the organization, support, and supervision of the company's programs, policy and personnel.
- **(ODP – Organizational documentation, process and procedures):** factors related to the action of development, maintenance and implementation of procedures, tasks, or performance of operational tasks.
- **(OTR – Organizational training):** factors related to experience, qualifications and training, and knowledge.
- **(QAS – Quality assurance system):** factors related to quality assurance.
- **(KOS – Key organization staff):** factors related to the procedures and work to be accomplished by the key personnel of the organization.

Usage Notes:

- *This category is used to describe factors that will affect the organization of the operations of the aeronautical entity due to economic changes. These economic changes can be global, state or limited to the organization. These changes need to be described within an aeronautical context.*

- *Regulatory factors include dangers caused by poor or absence of laws and regulations. Likewise, the lack of capacity to carry out an independent aviation accident and incident investigation and the inadequate capacity to carry out supervision by the inspectors of the Civil Aviation Authority.*

- *The management factors are caused by the lack of or limited commitment of those responsible for the service providers, which means that clear roles and responsibilities are not established, lack of commitment to have financial resources, that there is no policy clear and effective, bad relationship between key staff and employees, poor organizational structure, poor safety culture, poor transfer of knowledge and communication, increased strikes, permanent changes and rotation of staff, bad or inappropriate decisions, poor recruitment of personal.*

- *Factors related to documents, procedures and processes can cause problems with internal and external communication, outdated or incomplete documentation, missing or incomplete reports and/or records, lack of documentation control, incorrect application or lack of compliance with procedures, absence of contracts between suppliers that define the scope of what must be executed, use of documents not approved/accepted by the CAA, absence of personnel appointment documents.*

ORGANIZATIONAL (ORG)

Existing hazards as a result of the organization of the aeronautical entity.

- *Hazards developed due to instruction. For example, poor instruction delivery, ineffective instruction program, absence or ineffective procedures for qualifying staff (including initial instruction and training, on-the-job training (OJT), periodic training and current qualifications and certifications of an individual, breach of the procedure that guarantees the initial and periodic qualification.*

- *The sub-category related to the dangers caused by the quality system (quality assurance) could lead to breach of the quality system and SMS audit program, timely solution of problems detected during the audits, incomplete audit records, incorrect or incomplete communication of the findings to the key personnel of the organization, absence of a quality policy (when applicable).*

- *The factors generated by the key personnel can be derived as a result of absence, incorrect or lack of appointment documents where the functions and responsibilities of the position are established; Ignorance of the requirements established in the regulations by key personnel.*

Taxonomy applicable to the category of organizational hazards.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
Aerodrome Air operation Air navigation service provider Maintenance organization Design & manufacturing organization Training organization	Regulator	REG-01	Lack of, poor or ineffective legislation and/or regulations.
		REG-02	Lack of or ineffective accident-investigation capacity.
		REG-03	Inadequate oversight capability.
	Management	OMN-01	Lack of designation of the responsible executive. Limited or lack of management commitment – Management do not demonstrate support for the activity.
		OMN-02	Lack of or incomplete description of roles, qualifications, accountabilities and responsibilities.
		OMN-03	Limited or lack of resource availability or planning, including staffing.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
		OMN-04	Lack of or ineffective policies.
		OMN-05	Incorrect or incomplete procedures including instructions.
		OMN-06	Lack of or poor management and labor relationships.
		OMN-07	Lack of or ineffective organizational structure.
		OMN-08	Poor organizational safety culture.
		OMN-09	Lack of or ineffective safety management processes (including risk management, safety assurance, auditing, training and resource allocation).
		OMN-10	Lack or ineffective audit procedures.
		OMN-11	Lack of or limited resource allocation.
		OMN-12	Incorrect or incomplete or lack of training, knowledge transfer and formal means of safety communication (promotion). Note: Training should reflect the needs of the organization. Accidents have shown that inadequate training is a hazard and may lead to accidents.
		OMN-13	Unofficial organizational structures. Note: These structures may be of a benefit but also may lead to a hazard.
		OMN-14	Growth, strikes, recession or organizational financial distress.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
		OMN-15	Mergers or acquisition.
		OMN-16	Changes, upgrades or new tools, equipment, processes or facilities.
		OMN-17	Incorrect or ineffective shift/crew member change over procedures.
		OMN-18	Changes or turnover in management or employees.
		OMN-19	Informal processes (Standard Operating Procedures).
		OMN-20	Lack of or poor or inappropriate materials/equipment acquisition decisions.
		OMN-21	Lack of, poor staffing recruitment/assignment. Note: Staff should be hired or assigned according to organizational needs but also according to their skills, qualifications and abilities. An employee with the wrong skill set can be a hazard. This includes management.
		OMN-22	Lack of, or does not comply with or has not been developed an adequate emergency response plan.
	Documentation, processes and procedures	ODP-01	Incorrect, poor or lack of internal and external communication including language barriers.
		ODP-02	Lack of, outdated, incorrect or incomplete manuals, or operating procedures (including maintenance).

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
		ODP-03	Lack of, incorrect or incomplete employee duty descriptions.
		ODP-04	Lack of, incorrect, incomplete or complicated document update processes.
		ODP-05	Lack of, incorrect or incomplete reports and records.
		ODP-06	Lack of, incorrect or incomplete control of necessary documents for personnel (licenses, ratings, and certificates).
		ODP-07	Absence of, or incomplete application of the procedures and good practices of the organization's manuals
		ODP-08	Lack of, or uncompliance with, procedures that demonstrate compliance with standards under which the organization works.
		ODP-09	Partial, or total uncompliance of requirements applicable to own or subcontracted works.
		ODP-10	Lack of, or lack of maintenance of, staff competence.
		ODP-11	Lack of a contract or work order between the maintenance organization and operator, that defines the scope of the work to will be performed and the jobs requested and accepted by the operator.
		ODP-12	Lack of approval / acceptance of documents by the CAA.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
		ODP-13	Lack of, or absence of, staff appointment documents, according to the functions performed (scope and limitations), within the organization, signed by the responsible executive or delegated person.
		ODP-14	Lack of, or non-compliance with, the corresponding procedure regarding major repairs or major modifications.
	Training	OTR-01	Lack of, incorrect or incomplete, in delivering of training, for example, its frequency, completeness, or the training system's measures of training effectiveness, Including human factors.
		OTR-02	Lack or ineffective, training program, including overall program management, course curriculums, instruction, instructors, course evaluations, adequate recurrent training program, adequate recurrent training program, adequate remedial training program, and examinations.
		OTR-03	Lack of or ineffective, procedures for qualifying/training including initial, on-the-job training (OJT), recurrent instruction/training, type of instruction/training received, ratings, and current certifications of an individual. Example: Recent simulation experience, ground school instruction, classroom instruction/ practice; qualification of maintenance staff carrying out scheduled and unscheduled inspections.
		OTR-04	Lack of, or ineffective, compliance with the training program in reference to its preparation and control.
		OTR-05	The procedure that guarantees the qualification and competence initial and recurrent of personnel in technical and regulatory matters is not complied with.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
		OTR-06	Lack of, or inadequate or inappropriate equipment (aircraft, flight simulation training device), material and training aids.
	Quality assurance system	QAS - 01	Lack of, non-compliance of, independent audit program and SMS.
		QAS - 02	Lack of, absence of, root cause analysis and timely solution to the findings detected in the independent audits and SMS.
		QAS - 03	Lack of, incomplete, records of independent audits and SMS that contain at least: audit reports, corrective actions, effectiveness evaluation of the actions carried out, compliance analysis, feedback reports.
		QAS - 04	Lack of evidence of monitoring procedures that ensure good practices of the maintenance organization.
		QAS - 05	Lack of, incorrect or incomplete, communication of findings to the key personnel of the organization.
		QAS - 06	Lack of, not adequate, quality policy.
		QAS - 07	Lack of quality policy in the organization's manual, signed by the responsible executive.
		QAS - 08	Third party audits: Lack of, or lack of knowledge of, aeronautical technical knowledge, operational safety, audit techniques.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
	Key staff	KOS-01	Lack of, incorrect, not adequate, document of appointment of the responsible executive where the functions and responsibilities of the position are established (focal point with the CAA, ensure that personnel complies with the regulations and safety; safety policy be understood, implemented and maintained at all levels of the organization).
		KOS-02	Lack of knowledge of the applicable regulations by the responsible executive and key staff.
		KOS-03	Lack of, incorrect not adequate document of the key personnel where the functions, responsibilities and competence of the position are established.

ENVIRONMENTAL(ENV)

Existing hazards as a result of the habitat or environment in which operations related to the provision of the service take place.

The category of environmental hazards includes the following sub-categories:

- **(END – Environment natural disasters):** factors related to forest fires, hurricanes, winter storms, droughts, tornadoes, thunderstorms, lightning and wind shear/icing, freezing precipitation, heavy rain, snow, wind, extreme temperatures and visibility restrictions.
- **(EGE – Environment geography):** factors related to mountainous terrain, aerodrome altitude, aerodrome terrain and large areas of water such as the oceans.
- **(EWL – Environment wildlife):** factors related to wildlife and insect or infectious pests.

Usage Notes:

- *The environmental factors that will have an effect on aeronautical operations. They need to be described in an aeronautical context. For example, snow may not be a danger in itself, but it may become so and have potential consequences in an operational aerodrome context.*
- *This category is used to describe natural and meteorological disasters such as: winter storms, droughts, tornadoes, thunderstorms, lightning, windbreaks, floods, ashes, earthquakes, etc.*
- *Quantity is an important consideration in environmental events or conditions to consider a hazard. A light wind can be advantageous for the operation, however, a strong cross wind is a danger to a landing aircraft.*
- *In order to add details to the description of a hazard, when it is included in a subcategory it can also be described in a third level code as a specific component of the hazard.*

Taxonomy applicable to the category of environmental hazards:

Type of operation	Type of activity/ infrastructure/system	Code	Examples of Hazards
Aerodrome Air navigation service provider Air operation	Weather/Natural disasters	END-01	Thunderstorms and lightning.
		END-02	Hail.
		END-03	Heavy rain Fog.
		END-04	Fog (reduced visibility).

Type of operation	Type of activity/ infrastructure/system	Code	Examples of Hazards
Maintenance organization (Effects may not be all encompassing)		END-05	Wind shear.
		END-06	Sand storm.
		END-07	Snow or ice storms.
		END-08	Excessive or cross winds.
		END-09	Hurricane, Tsunami, or tornado.
		END-10	Floods.
		END-11	Ash (including volcanic or forest fire).
		END-12	Earthquake.
		END-13	Extreme temperatures.
		END-14	Icing conditions (Impact on aircraft surfaces).
	Geography	EGE-01	Mountains or bodies of water.
		EGE-02	Altitude at the aerodrome.
	Wildlife	EWL-01	Wildlife on airfield.
		EWL-02	Flying wildlife.

HUMAN(HUM)

Dangers due to limitations or human deficiencies in the aeronautical context.

The category of human hazards includes the following sub-categories:

- **(HSI - Human-sudden incapacitation)**: related factors for serious medical conditions that permanently incapacitate humans.
- **(HDI – Human-incapacitation/impairment)**: related factors for medical conditions that affect human performance if not treated.
- **(HIL – Human illness)**: related factors for medical conditions that may affect for a short period of time when treated.
- **(HSL – Human static limitations)**: related factors for medical conditions that affect a person's normal performance.
- **(HSS – Human self-improved stresses)**: factors related to anxiety or the use of substances that affect human behavior.
- **(HPS – Human psycho social stress)**: personal factors that affect human behavior in some way.
- **(HTR – Human trauma)**: injuries to people that affect human performance.
- **(HEO – Human environmental/occupational)**: external factors that influence human beings and their performance in the processes they perform.
- **(HMM – Human latent related to man/machine/process interface)**: human factors related to design, manufacturing, maintenance and operations.
- **(HCC – Human cognitive capacity)**: factors related to mental processes such as perception, memory, reasoning and motor response, since they affect the interactions between humans and other elements of the system.

Usage Notes:

- *This category is used to describe factors that will affect aeronautical operations due to medical or psychological conditions, or physical limitations that may exist in the organization's personnel. These dangers may exist due to the working conditions of the affected personnel, in some cases without being aware of it. These factors need to be described in an aeronautical context.*
- *Factors that affect human ability include conditions of any severity, such as disease or heart attack, that may create a hazard.*
- *Psychological factors include those that would negatively influence the operation if they exist in the organization's staff. The dangers in this subcategory are closely related to human factors, such as states of depression or fatigue.*
- *Cognitive factors include the psychological/cognitive functioning of human beings during their interactions with other humans and with the machines in their organization.*

Taxonomy applicable to the category of human hazards:

Type of operation	Type of activity / infrastructure/ system	Code	Examples of Hazards
Aerodrome Air operation Air navigation service provider Maintenance organization Design & manufacturing organization Training organization	Sudden incapacitation	HSI-01	Heart attack, stroke, kidney stone, seizure, epilepsy.
	Subtle incapacitation / Impairment	HDI-01	Nausea, diarrhea, carbon monoxide, medication, fatigue.
	Illness	HIL-01	Influenza, upper respiratory tract infection, urinary
	Static limitations	HSL-01	Color vision, visual field limitations, mobility limitations, colostomy bag, hearing loss.
	Self-Imposed stress	HSS-01	Fatigue (lack of sleep), alcohol and substance abuse, medications, complacency.
	Psycho-Social stress	HPS-01	Financial, birth of child, divorce, bereavement, challenging timelines, inadequate resources.
	Trauma	HTR-01	Inflight turbulence cabin crew injury, injury caused to personnel during ground aircraft operations or luggage handlings.
	Environmental / Occupational	HEO-01	Jet lag, paint shop, solvents, chemical/biological exposures, noise, vibrations, distractions.
	Latent failures related to man / machine/ process interface	HMM-01	Human factors related to design, manufacturing, maintenance and operations.

Type of operation	Type of activity / infrastructure/ system	Code	Examples of Hazards
	Cognitive capacity	HCC-01	Excessive number of aircraft in a controller's area; varying multi-tasking actions; over saturation of digital information.

TECHNICAL (TECH) – AIR OPERATION AND MAINTENANCE

Existing hazards as a result of technical deficiencies in aircraft or other mechanisms.

The category of technical hazards includes the following sub-categories:

- **(TOF – Technical air operations facilities)**: factors related to the facilities applicable to the operations carried out by air operators in relation to objects and conditions such as offices, lighting, conditioning systems, flight and taxiways, equipment, etc.
- **(TPP – Technical pre-flight preparation)**: factors related to pre-flight preparation.
- **(TAL – Technical aircraft loading)**: factors related to cargo and its distribution, dangerous goods, weight calculation and balance.
- **(TFO – Technical flight operations)**: factors related to all processes that could affect the flight operations of an air operator, such as: out-of-date information, absence of manuals or letters on board, poor management of resources, absence of flight tracking, equipment and instrument failures or navigation systems, linguistic problems.
- **(TMF – Technical maintenance facilities):** factors related to the maintenance organization's facilities in relation to objects and conditions such as tools, equipment, workshops, hangars and warehouses.
- **(TMA – Technical maintenance activity)**: factors related to processes, documents, staff competence, controls, among others that affect maintenance activities.
- **(TMT – Technical maintenance tooling)**: factors related to the use, control, approval of the tools to be used in maintenance.
- **(TMM – Technical maintenance maintainability)**: factors related to the design, accessibility, configuration of aircraft.
- **(TMD – Technical maintenance data)**: factors related to updating, availability, data integrity and maintenance procedures.
- **(TMC - Maintenance Conformity Certification):** factors related to final compliance by authorized personnel.

Usage Notes:

- *This category is used to describe technical factors of the areas of operations and maintenance that will have an effect on the aeronautical operations of operators and maintenance organizations. It needs to be described in an aeronautical context as aircraft maintenance that involves facilities, tools, maintainability, data and compliance certifications.*

- *Technical hazards may exist in facilities of contractors, service providers or other organizations that will have an effect on the operation. If there are hazards in the facilities of contractors that repair parts of the aircraft based on a contract, this danger could cause the failure of that repaired part of the aircraft.*

Taxonomy applicable to the category of technical hazards - air operation and maintenance:

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
Air operation	Facilities	TOF-01	Faulty electrical power supply systems on airport or navigational aids (radars, satellites, VOR, ADS-B, etc.)
		TOF-02	Faulty, incorrect or incomplete airfield markings and lighting
		TOF-03	Faulty, incorrect, or incomplete approach lighting.
		TOF-04	Taxiway and runway system complexity.
		TOF-05	Inadequate airfield drainage.
		TOF-06	Insufficient equipment, radios, infrastructure, or personnel.
		TOF-07	Lack of, limited or incorrect type of aircraft parking.
		TOF-08	Poor HVAC (heating, ventilation, and air conditioning).
		TOF-09	Noisy environment.
		TOF-10	Lack of or poor *lighting.*
		TOF-11	Poor facilities (inadequate space, environmental protection, segregated areas)).
		TOF-12	Facilities intended to be restricted without protection, identification or security measures
		TOF-13	Special equipment installations do not comply with the equipment manufacturer's recommendations (dust, humidity, temperature).
	Preflight preparation	TPP-01	Lack of or poor airworthiness verification.
		TPP-02	Lack of or poor verification of equipment and instruments necessary to a particular flight or operation.
		TPP-03	Lack of, incorrect or incomplete aircraft performance limitations verification.
		TPP-04	Lack of, incorrect or incomplete flight planning.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
		TPP-05	Poor fueling processes.
		TPP-06	Lack of or poor aircraft dispatch or release.
		TPP-07	Lack of or poor maintenance release.
	Aircraft loading	TAL-01	Incorrect cargo loading and distribution.
		TAL-02	/mproper or unauthorized hazardous materials carriage.
		TAL-03	Poor cargo and baggage stowage.
		TAL-04	Incorrect information on cargo or baggage loaded.
		TAL-05	Improper stowage of carry-on baggage.
		TAL-06	Improper mass and balance calculations.
	Flight opertations	TFO-01	Use of obsolete documents
		TFO-02	Absence of or incorrect flight and cabin crew manuals or charts on board.
		TFO-03	Improper response to flight route changes.
		TFO-04	Lack of, or poor crew resource management.
		TFO-05	Lack of or poor flight following.
		TFO-06	Improper execution of procedures in all flight phases (including taxiing and parking).
		TFO-07	Inadequate or complicated procedures.
		TFO-08	Equipment and instruments necessary for a particular flight or operation not available or malfunctioning.
		TFO-09	Lack of, or poor communication (ATC, ramp, maintenance, flight Ops, cabin, dispatch, etc).
		TFO-10	Language barriers (Multiple languages).

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
Maintenance	Facilities	TMF-01	Poor HVAC (heating, ventilation, and air conditioning).
		TMF-02	Noisy work environment.
		TMF-03	Lack of, or poor Lighting.
		TMF-04	Poor facilities (inadequate space, equipment or infrastructure).
		TMF-05	Poor facilities (inadequate space, environmental protection, segregated areas).
		TMF-06	Restricted facilities without protection, identification or security measures.
		TMF-07	Special equipment installations do not comply with the equipment manufacturer's recommendations (dust, humidity, temperature).
		TMF-08	Poor facilities of additional stations.
	Maintenance activity	TMA-01	Lack of, or poor maintenance release.
		TMA-02	Lack of, or poor maintenance programs (Including imprecise maintenance data or transcription errors when creating job-cards).
		TMA-03	SUPS (Suspected Unapproved Parts).
		TMA-04	Maintenance movement of aircraft/run-ups.
		TMA-05	Lack of or poor communication (ATC, ramp, flight Ops, cabin, dispatch, etc.)
		TMA-06	Language barriers in maintenance teams (Multiple languages)
		TMA-07	Poor control of outsourced maintenance (any maintenance completed outside the maintenance facility or organization including third party maintenance)

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
		TMA-08	Lack of or, inappropriate specialized processes (including NDT, plating, welding, composite repairs etc…)
		TMA-09	Lack of or, improper Airworthiness Directive Control.
		TMA-10	Ineffective or lack of procedures to ensure materials, parts, or assemblies are worked or manufactured through a series of precisely controlled steps, and that undergo physical, chemical, or metallurgical transformation (some examples are heat-treating, brazing, welding, and processing of composite materials).
		TMA-11	Lack of or, inadequate reliability program.
		TMA-12	Lack of, or incorrect use of, maintenance data for the execution of modifications and / or major repairs.
		TMA-13	Lack of, or poor, compliance with maintenance work (inspection, inspection in process, certification of conformity).
		TMA-14	Inadequate, or lack of, execution and records of inspections (materials and components reception, preliminary, hidden damages, in process, final or maintenance compliance)
		TMA-15	Not met, or there is a poor control, distribution, preservation of maintenance of maintenance records.
	Tooling	TMT-01	Lack of, or poor tool accountability (Including traceability or registration), or lack or noncompliance of calibration program accepted by CAA.
		TMT-02	Lack of or unsafe or unreliable equipment, tools, and safety equipment.
		TMT-03	Inappropriate layout of controls or displays.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
		TMT-04	Lack of, poor control of, or absence of, calibrated tools and equipment's.
		TMT-05	Inappropriate or incorrect use of tools for the task.
		TMT-06	Lack of, or inadequate instructions for equipment, tools, and safety equipment.
		TMT-07	Tool or equipment is not approved by the State of design, or the tool or equipment manufactured by the AMO does not meet the standards of the State of design.
		TMT-08	Lack to accept the CAA that issued the certification to an AMO, to a tool or equipment manufactured by that organization
	Maintainability	TMM-01	Complex design (Difficult fault isolation, multiple similar connections, etc)
		TMM-02	Inaccessible component/area.
		TMM-03	Aircraft configuration variability (Similar parts on different models).
	Maintenance data	TMD-01	Lack of, or outdated, or not applicable, maintenance data.
		TMD-02	Lack of, or inappropriate, procedure for the management of maintenance data that includes the functions and responsibilities of the person responsible for maintaining the maintenance data.
		TMD-03	Lack of, or inappropriate, procedure to modify the maintenance data issued by the Design State.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of hazards
		TMD-04	Error in the transcription, or lack of control, or lack of protection that prevents alteration, of the maintenance data to the system of forms used by the AMO for the work to be done.
		TMD-05	Lack of availability, or integrity, or readability, or update of maintenance data.
	Release to service	CCM-01	Lack of certification document by authorized personnel by the AMO.
		CCM-02	Lack of data in the maintenance release document.

TECHNICAL (TECH) - AERODROMES

Existing hazards as a result of technical deficiencies in aerodromes.

The category of technical hazards of aerodromes includes the following sub-categories:

- **(TRO – Technical runways operations)**: factors related to the operations carried out in an aerodrome applicable to the areas of movement, design of the aerodrome, interaction with air traffic control (ATC), NOTAMs.
- **(TRC – Technical runway conditions)**: factors related to the situation in which the airfield runway is located.
- **(TAO – Technical airfield apron operations)**: factors related to the different situations that occur on the aerodrome platform, produced by air operators, platform service providers (fuel services, ground assistance)
- **(TAV – Technical Airside vehicle)**: factors related to the operation of vehicles that support aircraft operations.
- **personas (TAI – Technical action individuals)**: factors related to the personnel that performs some process at the aerodrome.
- **(TAF – Technical aerodrome facilities)**: factors related to the facilities applicable to the operations carried out by the aerodrome in relation to objects and conditions such as: power supply systems, flight field signaling, flight field lighting, runway pavement deficiencies, complexity of taxiways, inadequate drainage systems, wildlife, firefighting systems, protective equipment, etc.

Usage Notes:

- *This category is used to describe technical factors of the areas of operations and maintenance that will have an effect on the aeronautical operations of operators and maintenance organizations. It needs to be described in an aeronautical context as aircraft maintenance that involves facilities, tools, maintainability, data and compliance certifications.*

- *Technical hazards may exist in facilities of contractors, service providers or other organizations that will have an effect on the operation. If there are hazards in the facilities of contractors that repair parts of the aircraft based on a contract, this danger could cause the failure of that repaired part of the aircraft.*

Taxonomy applicable to the category of technical hazards - air operation and maintenance:

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of Hazards
Aerodrome	Runway operations	TRO-01	Construction, vehicles and people on movement area.
		TRO-02	Poor aerodrome design (Intersecting runways; Obstacle clearance; Taxiway crossing runways).
		TRO-03	Distracting lights.
		TRO-04	Lack of coordination with Air Traffic Control (ATC).
		TRO-05	Improper, inadequate, or lack of Notices to Airmen (NOTAMs) issuance.
		TRO-06	Laser beams.
	Runway condition	TRC-01	Poor condition or improper runway surface.
		TRC-02	inadequate runway length
		TRC-03	Lack of, or inadequate runway protected areas
	Airfield apron operation	TAO-01	Jet blast.
		TAO-02	Lack of, limited or incorrect type of aircraft parking.
		TAO-03	Improper marshaling.
		TAO-04	Lack of, or insufficient protective pylons around aircraft.
		TAO-05	Lack of, or inadequate chalks when aircraft parks.
		TAO-06	Lack of, or improper foreign object debris (FOD) control
		TAO-07	Lack of, or improper ramp control tie down procedures.
		TAO-08	Improper fuel or hazardous material spill containment and cleanup.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of Hazards
		TAO-09	Poor refueling procedures.
	Airside vehicle operations	TAV-01	Vehicle failure during aerodrome services.
		TAV-02	Poor mechanical condition.
		TAV-03	Poor radio or communication equipment condition.
		TAV-04	Oil spills on apron and/or in passenger areas.
		TAV-05	Lack of vehicle maintenance.
		TVA-06	Poor emergency reponse plan.
		TAV-07	Erratic driving or not complying with flight line driving regulations.
		TAV-08	Driving too fast.
		TAV-09	Improper parking.
		TAV-10	Failure to chalk vehicles.
		TAV-11	Leaving engine running while vehicle is unattended.
		TAV-12	Lack of coordination between vehicles during aircraft servicing.
	Action of individuals	TAI-01	Pedestrians on apron areas.
		TAI-02	Ignoring aircraft hazard beacons.
		TAI-03	Improper checking around aircraft during departure marshaling.
		TAI-04	Misinterpreting apron markings.
		TAI-05	Smoking on the apron.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of Hazards
		TAI-06	Passenger failure to follow guidance.
		TAI-07	Use of cell phone within 15 meters of a refueling operation.
		TAI-08	Littering on ramp Running on apron.
		TAI-09	Running on apron.
	Facilities	TAF-01	Faulty electrical power supply systems on airport or navigational aids (radars, satellites, very high frequency (VHF) omnidirectional radio range (VOR), Automatic Dependent Surveillance - Broadcast (ADS-B), etc.)
		TAF-02	Faulty, incorrect or incomplete airfield markings (especially in movement areas).
		TAF-03	Faulty, incorrect, or incomplete airfield lighting (especially in movement areas).
		TAF-04	Faulty, incorrect, or incomplete approach lighting.
		TAF-05	Poor condition or inappropriate runway surface.
		TAF-06	Poor condition or inappropriate apron surface.
		TAF-07	Taxiway and runway system complexity.
		TAF-08	Inadequate airfield or terrain drainage.
		TAF-09	Insufficient equipment, radios, infrastructure, or personnel.
		TAF-10	Issues that attract wildlife (high grass, proximity of landfills, nearby water bodies).
		TAF-11	Inadequate or inappropriate firefighting equipment.
		TAF-12	Lack of or limited parking areas.

Type of operation	Type of activity/ infrastructure/ system	Code	Examples of Hazards
		TAF-13	Lack of safety protective equipment.

TECHNICAL (TECH) - AIR NAVIGATION SERVICES

Existing hazards as a result of technical deficiencies of air navigation service providers (ANSP).

The category of technical hazards of air navigation services includes the following sub-categories:

- **(TIP – Technical traffic pattern)**: factors related to complexity, design and traffic flow.
- **(TAS – Technical airspace)**: factors related to airspace where the service provider may encounter problems that lead to errors.
- **(TCA – Technical Controller actions)**: factors related to the mistakes that can be made by the people in charge of providing the air navigation service.
- **(TCO – Technical communications)**: factors related to team communication issues, phraseology, language barriers.
- **(TNF – Technical air navigation facilities)**: factors related to the facilities applicable to the services performed by the air service provider in relation to objects and conditions such as: deficiency of the electric power supply systems, signaling or lighting of the flight field or faulty approach, complexity of the tracks, insufficient support teams etc.

Usage Notes:

- *This category is used to describe technical factors of the air navigation areas (ANS) that will have an effect on the aeronautical operations of the air operators and the aerodrome. It must be described in an aeronautical context as air traffic, airspace, air traffic control, communications and facilities.*

- *The technical hazards related to the air traffic circuit are generally a consequence of traffic complexity, excessive aircraft in a given circuit, traffic design and flow, runway incursions (aircraft and vehicles), unauthorized aircraft in the traffic model, unauthorized procedures, confusing signals, absence of procedures, among others.*

- *Technical hazards related to airspace are generally related to insufficient or poorly distributed airspace, inadequate instrumental procedures, incorrect procedures of frustrated approaches, mixed procedures, etc.*

- *In reference to the actions of the controller, they are problems that are related to incomplete authorizations, aircraft identification errors, inadequate authorization instructions, loss of aircraft separation, obstacles in the field, misinterpretations, incorrect judgment, etc.*

- *The technical hazards related to communications are related to incorrect communication, radio and/or frequency failures, navigation aids, differences in ICAO and controller phraseologies, language barriers, lack of aeronautical information, etc.*

Taxonomy applicable to the category of technical hazards - Air navigation service providers (ANSP):

Type of operation	Type of activity /infrastructure/system	Code	Examples of Hazards
ANSP	Traffic pattern	TTP-01	Traffic complexity (mixture of aircraft type).
		TTP-02	Excessive aircraft in pattern or given airspace.
		TTP-03	Ineffective design and flow of traffic pattern.
		TTP-04	Runway incursions by aircraft or vehicles.
		TTP-05	Unauthorized flights entering into traffic pattern.
		TTP-06	Unauthorized procedures by aircraft.
		TTP-07	Similar sounding or confusing call signs.
		TTP-08	Lack of or poor procedures for aircraft in distress.
	Airspace	TAS-01	Insufficient airspace for typical traffic.
		TAS-02	Improperly distributed airspace.
		TAS-03	Airspace combined during excessive traffic.
		TAS-04	Confusing labeling of fixes or way points.
		TAS-05	Improperly developed instrument procedures.
		TAS-06	Aircraft incorrectly performing missed approach procedures.
		TAS-07	Intermingling of ICAO and national instrument procedure criteria.
	Controller actions	TCA-01	Incomplete clearances.
		TCA-02	Misidentification of aircraft or targets (radar).
		TCA-03	Improper reading of clearance instructions.

Type of operation	Type of activity /infrastructure/system	Code	Examples of Hazards
		TCA-04	Loss of separation between aircraft.
		TCA-05	Loss of separation between aircraft and terrain or obstacles and terrain or obstacles
		TCA-06	Misinterpretation of pilot desires.
		TCA-07	Incorrect judgment of aircraft characteristics.
	Communications	TCO-01	Incorrect, confusing, or incomplete communications between ATC and aerodrome personnel.
		TCO-02	Incorrect, confusing, or incomplete communications between ATC and aircraft.
		TCO-03	Incorrect, confusing, or incomplete coordination between or within ATC facilities.
		TCO-02	Radio/Frequency failures or anomalies.
		TCO-04	Navigational aid (radars, satellites, VOR, ADS-B, etc) failures or anomalies.
		TCO-05	Differences in ICAO and national Air Traffic Control phraseology.
		TCO-06	Not using the standard international aviation language.
		TCO-07	Language barriers (Multiple languages).
		TCO-08	Lack of, or wrong aeronautical information.
	Facilities	TNF-01	Faulty electrical power supply systems on airport or navigational aids (radars, satellites, VOR, ADS-B, etc.).
		TNF-02	Faulty, incorrect or incomplete airfield markings or lighting.
		TNF-03	Faulty, incorrect, or incomplete approach lighting.

Type of operation	Type of activity /infrastructure/system	Code	Examples of Hazards
		TNF-04	Taxiway and runway system complexity.
		TNF-05	Inadequate airfield or terrain drainage.
		TNF-06	Insufficient equipment, radios, infrastructure, or personnel.

TECHNICAL (TECH) – DESIGN AND MANUFACTURING

Existing hazards as a result of technical deficiencies of aircraft design and manufacturing service providers.

The design and manufacturing technical hazards category includes the following sub-categories:

- **(TRC – Technical capture requirements)**: factors related to the evaluation, identification and analysis of problems related to regulatory requirements, functional hazards of aircraft design related to safety.
- **(TRV – Technical requirements validation)**: factors related to the review of the designs and tests of aircraft that affect safety.
- **(TVE – Technical verification)**: factors related to aircraft systems including software and hardware.
- **(TAI – Technical aircraft integration)**: factors related to traceability issues and control of design requirements.
- **(TCS – Technical continued safety)**: factors related to the actions carried out based on the lessons learned.
- **(TDC – Technical design control)**: factors related to design changes.
- **(TME – Technical manufacturing process)**: factors related to the existence of procedures and the implementation of processes related to the manufacture of aircraft.
- **(TMC – Technical manufacturing controls)**: factors related to aircraft production.
- **(TSC – Technical supplier control)**: factors related to the suppliers of the material that will be used for the manufacture of aircraft.

Usage Notes:

- *This category is used to describe technical factors of aircraft design and manufacturing, within this factor are designers, material suppliers, manufacturers, development and maintenance of procedures, etc.*
- *Technical hazards related to the design and manufacturing pattern are generally a consequence of not following the airworthiness standards established in the requirements of the applicable regulations and the poor process of hazard assessment.*

Taxonomy applicable to the category of technical hazards - Design and manufacturing:

Type of operation	Type of activity / infrastructure / system	Code	Examples of Hazards
Aircraft design	Safety requirements capture	TRC-01	Noncompliance with applicable regulations (For example FAA 14 CFR part 23, 25, 27, 29, 33).
		TRC-02	Inadequate functional hazard assessment.
		TRC-03	Inadequate structural static and dynamic loads analysis.
		TRC-04	Inadequate Preliminary System Safety Assessment.
		TRC-05	Inadequate common cause analysis.
	Safety requirements validation	TRV-01	Incomplete or ineffective design reviews, analysis, simulator, wind tunnel, and flight testing.
		TRV-02	Ineffective or incomplete structural external, internal, and elemental loads analysis.
	Safety requirement verification	TVE-01	Incomplete structures loads verification, such as static load tests, ground vibration tests, and flight tests.
		TVE-02	Inadequate System Safety Assessments (SSA) process including lack of, or improper verifying of, failure effects using failure performance testing.
		TVE-03	Inadequate verification of software and complex hardware.
	Aircraft integration	TAI-01	Inadequate requirements traceability.
		TAI-02	Inadequate design requirements control.

Type of operation	Type of activity / infrastructure / system	Code	Examples of Hazards
		TAI-03	Inadequate verification of system/system and system/structure unintended functions and physical interference, such as lack of Bench/Sim/Airplane Testing and inadequate zonal inspections.
	Continued operational safety	TCS-01	Ineffective in-service monitoring methods such as lack of failure reporting and tracking.
		TCS-02	Inadequate or no root cause analysis, risk analysis, corrective action development, corrective action validation, and incorporation of corrective action and lessons learned into Design Process.
	Design control	TDC-01	Lack of methods for approving, controlling, and documenting initial designs and design changes.
		TDC-02	Inadequate planning and integration of the facility's procedures for continuously maintaining the integrity of design data, drawings, part lists, and specifications necessary to define the configuration and the design features of the product.
Aircraft manufacturing	Manufacturing processes	TMP-01	. Lack of processes for the control of materials, parts, or assemblies, how they are accepted, worked or fabricated, tested, inspected, stored, and prepared for shipment.
		TMP-02	Problems with special manufacturing processes and specific functions and operations necessary for the fabrication and inspection of parts and assemblies (some examples are machining, riveting, and assembling).

Type of operation	Type of activity / infrastructure / system	Code	Examples of Hazards
		TMP-03	Ineffective or lack of procedures to ensure materials, parts, or assemblies are worked or fabricated through a series of precisely controlled steps, and that undergo physical, chemical, or metallurgical transformation (some examples are heat-treating, brazing, welding, and processing of composite materials).
		TMP-04	Inadequate methods used to accept and protect raw materials, parts, subassemblies, assemblies, and completed products during receipt, manufacture, inspection, test, storage, and preparation for shipment.
		TMP-05	Inadequate Airworthiness Determination, which is the function that provides for evaluation of completed products/parts thereof, and related documentation, to determine conformity to approved design data and their condition for safe operation.
	Manufacturing controls	TMC-01	Ineffective methods that are used by the Production Approval Holder to control product quality by statistical methods, and that may be used for continuous improvement and/or product acceptance. Statistical Quality Control includes techniques such as statistical sampling, PRE-control, and statistical process control.
		TMC-02	Ineffective control of precision measuring devices (for example, tools, scales, gauges, fixtures, instruments, and automated measuring machines) used in fabrication, special processing, inspection, test of detail

Type of operation	Type of activity / infrastructure / system	Code	Examples of Hazards
			parts, assemblies, and completed products to determine conformity to approved design.
		TMC-03	Lack of functions that provide for static, destructive, and functional tests of production products/parts thereof to ensure conformity to approved design.
		TMC-04	Ineffective methods of controlling, evaluating, and dispositioning of any product/part thereof that does not conform to approved design.
	Supplier control	TSC-01	Ineffective methods by which the production facility ensures supplier materials, parts, and services conform to approved design. The term “supplier” includes distributors.