

Development of a proposed update to the Safety Performance Framework in the GANP

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Chapter 1

GENERAL

1.1 BACKGROUND INFORMATION

1.1.1 The sixth edition of the Global Air Navigation Plan (GANP) contains, the GANP performance framework, composed of a series of performance ambitions, focus areas, performance objectives and key performance indicators (KPIs) within the eleven key performance areas (KPAs)¹ matching the global performance expectations outlined in the *Global Air Traffic Management Operational Concept* (Doc 9854).

1.1.2 The Performance Ambitions, contained in the global strategic level of the GANP, are qualitative statements, defined in the eleven ICAO KPAs, whose goal is to provide global priorities on the performance evolution of the global air navigation system (see Figure 1). The performance ambitions should not be regarded as targets to continuously monitor and report performance against, but rather as a catalyst for change.

Note – More information on the GANP Performance Ambitions is available at https://www4.icao.int/ganpportal/GanpDocument#/lessons/mjR-NvTw42AWIArgUwLYarQFkoUGNX_h?_k=h8tv8t

1.1.3 The Performance Objectives and KPIs are included in the global technical level of the GANP. The Performance Objectives, detailed in the areas of capacity, efficiency and predictability, are qualitative and focused statements that defined a desired trend from today's performance (e.g. improvement). To support some of these performance objectives, 19 KPIs are defined for capacity, efficiency and predictability.

Note – The list of performance objectives is available at <https://www4.icao.int/ganpportal/ASBU/PerformanceObjective>.

Note – The list and details of the KPIs are available at <https://www4.icao.int/ganpportal/ASBU/KPI>.

1.1.4 In order to expedite the work on performance, the Thirteenth Air Navigation Conference recommended ICAO to consider establishing a group of performance experts under the GANP Study Group (GSG) (Recommendation 4.3/1 refers). ICAO, therefore, formed the Global ICAO Performance Expert Group (GIPEG) to maintain, evolve and develop the global performance management framework of the GANP, focusing on its effective application at regional and national levels by all members of the aviation community.

¹ The eleven ICAO KPAs: safety, security, environmental impact, cost effectiveness, capacity, flight efficiency, flexibility, predictability, access and equity, participation by the ATM community and global interoperability.

SUMMARY OF THE GANP PERFORMANCE AMBITIONS “A high performing system by 2040 and beyond”	
KPA	Ambition
ACCESS AND EQUITY	No aviation community member excluded or treated unfairly.
CAPACITY	Nominal capacity easily scalable with demand.
	Disruptive events do not interrupt service provision and do not significantly affect the performance of the system.
COST-EFFECTIVENESS	No increase of total direct ANS cost while maintaining the safety and quality of service.
	Significant increase of ANS productivity, irrespective of demand.
EFFICIENCY	Reduction of the gap between the flight efficiency achieved and the desired optimum trajectory of airspace users.
ENVIRONMENT	ANS-induced inefficiencies to be progressively removed to contribute to the global ICAO aspirational goals for CO ₂ emissions.
	To benefit from achieved flight efficiency gains.
FLEXIBILITY	To absorb required changes to individual business and operational trajectories.
INTEROPERABILITY	Essential at an operational and technical level.
PARTICIPATION BY THE ATM COMMUNITY	Pre-agreed level of participation to make the maximum shared use of the air navigation resources.
PREDICTABILITY	No increase in ANS delivery variability including asset availability.
SAFETY	Zero ANS-related accidents and a significant (50%) reduction of ANS-related serious incidents.
SECURITY	Zero significant disruptions due to cyber incidents

Figure 1 Summary of the GANP Performance ambitions

1.1.5 One of the tasks of the GIPEG is to expand the Performance Framework of the GANP to cover its eleven KPAs, and in particular to contribute to the coherency and consistency related to the performance of the *Global Aviation Safety Plan (GASP)* (Doc 10004) and *Global Aviation Security Plan (GASeP)* (Doc 10118). ICAO aimed to schedule its work programme around the main ICAO global events in order to maximize the input from the aviation community. Hence, the GIPEG was requested to develop a safety performance framework proposal to be discussed during the High-Level Safety Conference (HLSC), scheduled for May 2021, and to be considered for inclusion in the seventh edition of the GANP.

Note – See GIPEG Terms of Reference, Tasks and Work programme in [Appendix B](#).

1.1.6 Recognising that the GASP is the strategic document for improving global safety as well as the request from the Thirteenth Air Navigation Conference to further support the development of appropriate harmonized safety performance indicators (SPIs) and to explore the development of means to monitor the effectiveness of State Safety Programme (SSP) and Safety Management System (SMS) on a more real time basis (Recommendation 6.2/1 refers), it was agreed to call for safety and performance management experts to ensure an integrated approach to the development of the safety performance framework in the GANP.

1.1.7 Although the proposed safety performance framework was to be included in the GANP, its scope was not expected to be limited to the GANP. On the contrary, the proposed framework was expected to be an encompassing framework to be further developed in the future, by the GIPEG as well as by the Safety Management Panel and the GASP Study Group, within their different areas of expertise, so that a common safety performance framework could be shared by the whole aviation community.

1.1.8 The safety performance framework presented in this document represents the joint efforts of the GIPEG and safety experts. It makes explicit the links between the GANP, which covers eleven KPAs,

one of which is safety, and the GASP, which has a dedicated safety focus. The proposed safety performance framework identifies common high-level safety focus areas that cover all aspects of the aviation system, allowing the GANP to consider safety in an integrated way within its other ten KPAs. At the same time, it provides a shared safety language for the GANP and the GASP, allowing users to track safety elements across the two Global Plans, sourcing more detailed safety information from the GASP and tracing its consequences for overall aviation system performance in the GANP.

Note 1 – See Glossary in [Appendix A](#).

Note 2 – See approach followed in the development of the safety performance framework proposal in [Appendix C](#).

1.2 INTRODUCTION

1.2.1 The *Manual on Global Performance of the Air Navigation System* (Doc 9883) provides decision-makers with a consistent method to apply a performance-based approach when implementing changes to the air navigation system. This method consists of six steps (see Fig. 3).

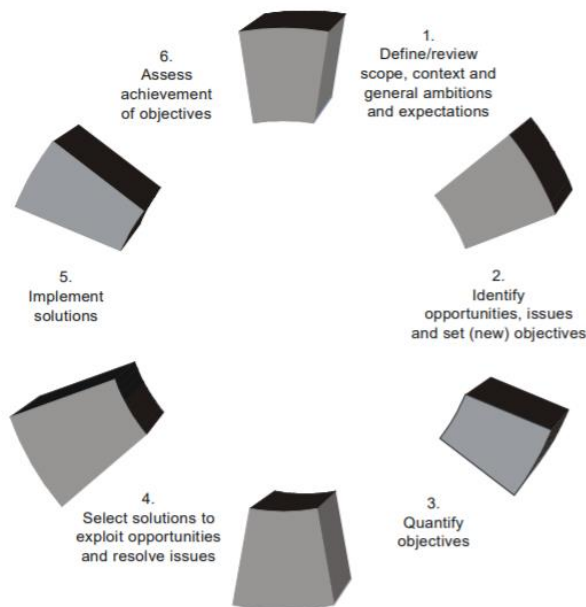


Figure 2 General Performance Management Process

1.2.2 The Manual also highlights additional elements of a performance-based approach for which consistency brings advantages in terms of end-to-end performance, benchmarking, best practices, accountability, consistency in requirements, and service delivery reporting. These additional elements are:

- a performance hierarchy that helps to describe how performance changes at one level can influence high-level objectives;
- a measurement taxonomy that describes how metrics are defined within each KPA;

- a structured view of the air navigation system required for explicit and consistent definitions of metrics; and
- a description of the performance process maturity level.

1.2.3 Together, these elements are called a performance framework. In essence, a performance framework is the set of definitions and terminology describing the building blocks used by a group of aviation community members to collaborate on performance management activities.

Performance Hierarchy

1.2.4 A performance hierarchy represents different views of the air navigation system performance (e.g. external, functional, system, technological) from the high-level political and socio-economic views to the low-level technological views. This hierarchy is useful for illustrating that the performance-based approach can be applied at different levels, ranging from high-level socio-political issues to lower-level technology issues as well as that the different levels have a performance impact on each other, which should be carefully managed.

1.2.5 In the GANP performance framework, this hierarchical structure is realized through performance ambitions, regional and national performance targets, and the performance requirements of the operational improvements and supporting systems and technology in the Aviation System Block Upgrade (ASBU) framework. The end-goal being, as highlighted in the last evolutionary step of the conceptual roadmap in the Global Strategic Level of the GANP², to achieve a Total Performance Management System supported by this performance hierarchy.

Measurement Taxonomy

1.2.6 A measurement taxonomy provides a structured method for the breakdown of KPAs into performance indicators and targets. At the same time, key performance area (KPA), focus area, performance objective, performance indicator, supporting metrics, etc. play a key role in the various steps of the performance management process.

1.2.7 The KPAs within the GANP performance framework follow the structured method described in Doc 9883 and depicted in Figure 4.

1.2.8 The breakdown starts with eleven KPAs matching the global performance expectations outlined in the Global Air Traffic Management Operational Concept (Doc 9854).

1.2.9 Focus areas are defined within each KPA to identify and delineate the broad areas in which there are intentions to establish a performance policy via the definition of generic objectives. Focus areas may be defined as a result of a high-level analysis indicating areas where performance must be addressed in any given KPA. For example, in the safety KPA, focus may be in such areas as CFIT accidents, runway incursions, or mid-air collisions for general aviation aircraft.

² <https://www4.icao.int/ganportal/GanpDocument#/lessons/-gbUn70LSAM5CNEGkjrFLcGjwTnB9aaM? k=us66zd>

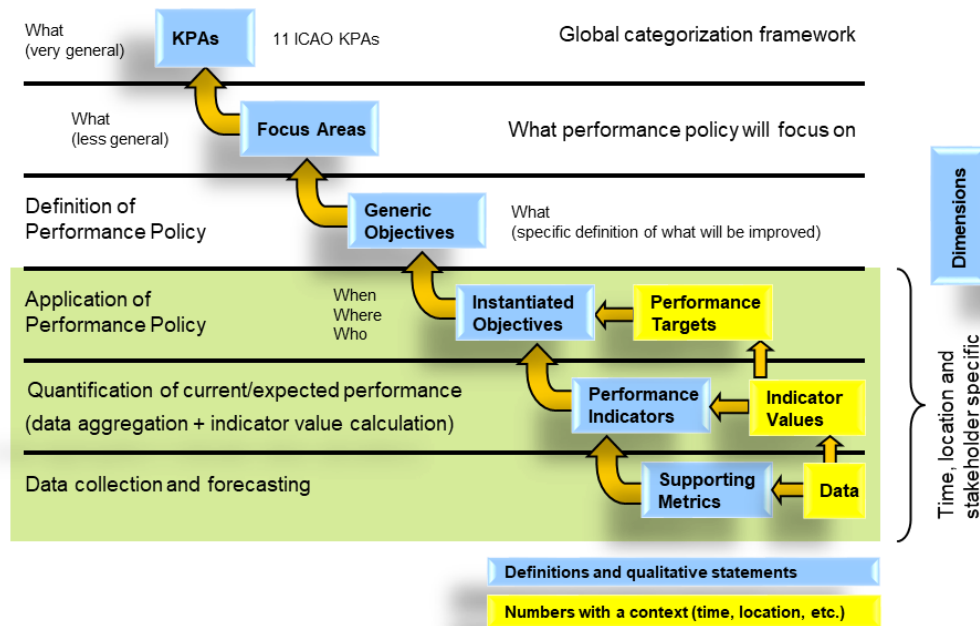


Figure 3 Illustration of measurement taxonomy (Doc 9883 Figure I-A-2)

1.2.10 Performance policy should be defined through a set of specific, measurable, achievable, relevant and timely (SMART) objectives. A distinction is made between generic objectives and instantiated objectives. Generic objectives are an expression of performance policy by defining — in a qualitative but focused way — a desired trend from today’s performance (e.g. improvement). They specifically focus on what has to be achieved, but do not make statements about the when, where, or who. Because at this level, no mention is made about the when, where and who, it does not make sense to try to associate numbers (indicator values or targets) at this level.

1.2.11 Once generic objectives have been described, these must be precisely defined and numerical targets must be set. These precisely defined objectives are labelled “instantiated objectives”. The instantiated objectives add the when, where, who and how much to the generic objectives. Starting with the generic objectives previously defined, the instantiated objectives limit the scope by describing the applicable ATM planning environment. For example, each instantiated objective is focused within a given geographic area, time period or other criteria. At the highest level, the geographic area may be a planning region as a whole, and the time period may be a year or a multi-year period. Other scope-limiting criteria may include the type of flight rules (i.e. IFR vs VFR).

1.2.12 Once instantiated objectives are defined, a means of knowing when the objective has been met is required. This is accomplished through the establishment of a set of targets on numerical performance indicators. It is expected that reaching the set of numerical targets corresponds to meeting the instantiated objective. Performance targets can only be specified after indicators have been defined. These must not only reflect the achievement of the objective, but must also be defined so as to be reachable.

1.2.13 It should be highlighted that, depending on the goal of the framework, not all the elements in Figure 4 need to be defined in a performance framework. Following the approach outlined above, the development of the safety performance framework resulted in the definition of the elements hereafter:

- Scope and focus areas (chapter 3),
- Performance objectives and influence diagram (chapter 4),

Note -The safety ambition, in chapter 2, is a special type of objective, a high-level objective, with political visibility.

- Performance indicators and supporting metrics (chapter 5),
- Dimensions and taxonomies (chapter 6).

The need for a structured view of the air navigation system

1.2.14 The prior description of a measurement taxonomy highlighted the need for precise definitions in the areas of instantiated objectives, performance indicators and supporting metrics. This level of definitional precision can only be achieved through a consistent and structured description of the air navigation system. This structured description requires an understanding of the entities, activities and interactions involved in the air navigation system.

Performance process maturity

1.2.15 The purpose of performance management is to ensure a better performance outcome. For this reason, embarking on the performance-based approach should certainly focus on the evaluation and improvement of the performance of the air navigation system. It is recognized, that this performance evaluation and improvement will be conducted through a performance management process tailored to the needs of the individual organization. However, if this performance management process is poor, it is likely that the outcome of the process will be suspect. For this reason, an assessment of the performance management process itself provides a structured mechanism to ensure the quality of the process.

1.2.16 In a manner analogous to the derivation of KPAs for the air navigation system, the evaluation of the performance process maturity can be described in terms of focus areas, performance objectives and indicators in various process capability areas (PCAs). It must be highlighted that whereas the above mentioned KPAs focus on a particular type of performance outcome (e.g. safety, capacity), PCAs focus on the quality, maturity and completeness of the performance management processes that ATM community members have implemented. The process-oriented perspective helps to diagnose weaknesses in the existing performance management processes, after which specific initiatives can be taken (i.e. with appropriate objectives, indicators and targets) to improve these processes and/or their deployment across the ATM community. Since it is expected that organizations will tailor the process to their needs, these PCAs will not likely be uniform like the KPA. However, an example of various PCAs is provided in Table I-A-1 of Doc 9883.

Chapter 2

PERFORMANCE AMBITION

“Safety, security and environment are high on the public agenda. Society – both from a passive and active customer perspective – not only expects to reap the benefits of aviation, but also expects that all airspace users’ flight operations will remain safe, environmentally sustainable and will not jeopardize the security or privacy of individual citizens, businesses and States. These social expectations originate from the need to prevent aviation safety from becoming negative “headline news”, and from higher-level aviation and transport policy goals.

Safety is and will continue to be paramount. Flying is extremely safe, and all stakeholders have continuously cooperated to improve the air navigation system with a view to making flying even safer. In this regard, the aviation community is committed not only to completely eliminating air navigation service-related accidents, but also, as part of its robust commitment to safety, to reducing the number of air navigation service-related serious incidents by half.

As part of this commitment, the safety strategy set forth by ICAO in the GASP supports the prioritization and continuous improvement of aviation safety. The purpose of the GASP is to continually reduce fatalities with the aspirational safety goal of zero fatalities in commercial operations by 2030 and beyond, and reduce the risk of fatalities associated with accidents.”

“Zero ANS-related accidents and a significant (50%) reduction of ANS-related serious incidents”

Figure 4 Safety Performance Ambition in the Sixth Edition of the GANP

2.1 The analysis of the safety performance ambition contained in the GANP (see Figure 2) underlined a scoping difference between the safety performance ambition³ in the GANP “Zero ANS-related accidents and a significant (50%) reduction of ANS-related serious incidents” and the aspirational safety goal defined by the GASP “Achieve and maintain zero fatalities in commercial operations by 2030 and beyond”, although both ambition and aspirational goal aspire to the improvement of safety performance. While the performance ambition in the GANP covers all types of operations, the aspirational goal in the GASP focuses on commercial operations. At the same time, while the ambition in the GANP focuses on Air Navigation Service (ANS) related causes, the aspirational goal in the GASP covers all causes and contributing factors. Finally, while the ambition in the GANP covers zero accidents and significant reduction in serious incidents and, therefore, includes the amount of damage and its secondary impact, the aspirational goal in the GASP focuses on zero fatalities.

2.2 In order to ensure a common direction in safety performance, it is important to harmonize the scope the safety performance ambition in the GANP to address the combined scope of the GANP and the GASP. Based on this, a proposal for a high-level safety ambition, which could be embraced by both global plans, was developed. A common high-level safety ambition would allow both global strategies, with different scopes, to be integrated under the same umbrella and contribute to the same outcome.

2.3 The aim for aviation safety started with the Chicago Convention in 1947, which set out as its prime objective the development of international civil aviation “... in a safe and orderly manner”, and

³ While the highest safety expectation was referred to as safety performance ambition in the GANP, in the GASP it was called aspirational safety goal.

such that air transport services would be established “on the basis of equality of opportunity and operated soundly and economically”.

2.4 Air travel has become safer over the years and nowadays, flying is the safest mode of transportation when compared to the number of fatal accidents attributed to automobiles, boats, and trains.

2.5 Recognizing the safety records of the aviation industry, it is acknowledged that the aviation community should maintain the current safety level as the minimum while striving to make aviation as safe as practicable. Based on this, the following high-level safety ambition is proposed:

“Achieve continual safety improvement in aviation in each ICAO region”

2.6 It is highlighted that this proposed ambition:

- Is challenging but realistic with a focus on success observed through trend over time and addresses the challenges of changes and innovation potentially threatening current safety levels;
- Is in the spirit of and contributes to many of the United Nations Sustainable Development Goals (SDGs);
- Addresses the combined scope of the GANP and the GASP;
- No longer states a theoretical aspiration but instead communicates the more pragmatic ambition to achieve continual improvement that focuses on all facets of safety outcomes, e.g. accidents, incidents, fatalities, injuries, damage and its secondary impact, over a long period of time with a focus on safety risk management;
- Is comprehensive, strategic and future-proof, in that it implicitly covers:
 - a) at least the next 20 years, not just in terms of the target date, but also in terms of the expected aviation environment at that time horizon;
 - b) all aviation segments, i.e. not just commercial operations, but all currently existing other airspace user segments, all new entrants such as low altitude operations (drones, urban air mobility etc.) and high altitude operations (including space launch and re-entry);
 - c) all aircraft operating environments, ground as well as airspace;
 - d) all safety risk categories;
 - e) all operational planning horizons, not just tactical/flight-ops (safety nets as well as normal ops), but also pre-tactical (planning several days ahead), strategic (annual planning), long-term planning (multi-year, including institutional setup);
 - f) "standard" operating environments as well as "enhanced" environments (with operational changes);
- Recognises different regional contexts and the need to improve safety performance regionally, as well as globally.

Chapter 3

SCOPING AND FOCUS AREAS

3.1 This chapter defines, within the safety KPA, focus areas to identify and delineate the broad areas in which there are intentions to establish a performance policy via the definition of generic objectives. However, it must be highlighted that some focus areas would be populated with performance objectives, while others would remain empty. In addition, when the focus areas have a hierarchical structure, they provide the basis for a performance objective tree.

3.2 From a top-down perspective, the scope of the proposed high-level ambition in the safety KPA is “aviation at large”. It not only addresses all aviation community members but covers far more than the current safety ambition in the GANP, which focuses only on the avoidance of aircraft accidents. In order to better understand the scope of the ambition and to focus on more specific scopes to define objectives, the safety KPA needs to be subdivided into focus and sub-focus areas.

3.3 From a bottom-up perspective, there is no need to have many focus and sub-focus areas, but the minimum to attach the performance objectives within the sixth edition of the GANP and the goals in the GASP in order to develop an integrated performance objective tree. While the existing objectives in the GANP could be covered under operational safety outcomes, the goals in the GASP as well as the basic services and operational safety improvements in the GANP address two ways of controlling/mitigating safety risks, through organizational safety processes and the provision of air navigation services. Therefore, the main focus areas, immediately below the safety KPA, should be “operational safety outcomes” but also in order to move to a proactive safety provision approach, “organizational safety processes” and “provision of air navigation services”.

Note – In general, Organizational safety (safety processes) includes operational safety (safety outcomes) as it refers to the Safety Performance of the Organization. The reason why “safety outcomes” is defined as a separate Focus Area is to highlight the importance of safety risk management and to allow alignment with the existing GANP safety performance objectives.

3.4 Following a bottom-up approach within the “operational safety outcomes” focus area, the ICAO definition of accidents focuses on a specific operational context - flight operations. However, from a top down perspective, the performance ambition covers “aviation at large”. Therefore, in order to align the bottom-up and the top-down approaches, the hazard taxonomy and occurrence categories of the Commercial Aviation Safety Team (CAST)/ICAO Common Taxonomy Team (CICCTT)⁴ were used. It should be noted that the names of these categories were adapted to the performance needs. As a result, the “operational safety outcomes” focus area was subdivided into the following sub-focus areas: flight operations safety, aerodrome operations safety, air navigation service provision safety, aircraft maintenance safety and design and manufacturing safety.

3.5 A third level of sub-focus areas was defined within the “flight operations” sub-focus area due to the already existing performance objectives in the GANP, which were originated from the main airspace user categories: traditional operations and new entrants such as drones, urban air mobility and high altitude operators.

⁴ <http://www.intlaviationstandards.org/apex/f?p=240:3:.....>

3.6 On the other hand, the “organizational safety processes” focus area was subdivided into: State Safety Programme (including safety oversight), safety management system and safety collaboration to be aligned with the goals defined in the GASP. And the “provision of air navigation services” focus area was subdivided on “basic building blocks” and “operational safety improvements” to be aligned with the GANP.

3.7 In summary, the focus areas proposed are as follows:

KPA: SAFETY

FA: OPERATIONAL SAFETY OUTCOMES

- Flight operations safety
 - Safety of traditional operations
 - Safety of new entrants
 - Safety of very low level operations (typically operating below 500ft AGL)
 - Safety of high level operations (typically operating above FL600)
 - Safety of urban air mobility
- Aerodrome operations safety
- Air navigation service provision safety
- Aircraft maintenance safety
- Design and manufacturing safety

FA: ORGANIZATIONAL SAFETY PROCESSES

- State Safety Programme (including safety oversight)
- Safety Management System
- Safety Collaboration

FA: PROVISION OF INFRASTRUCTURE AND AVIATION SERVICES

- Basic Building Blocks
- Operational safety improvements

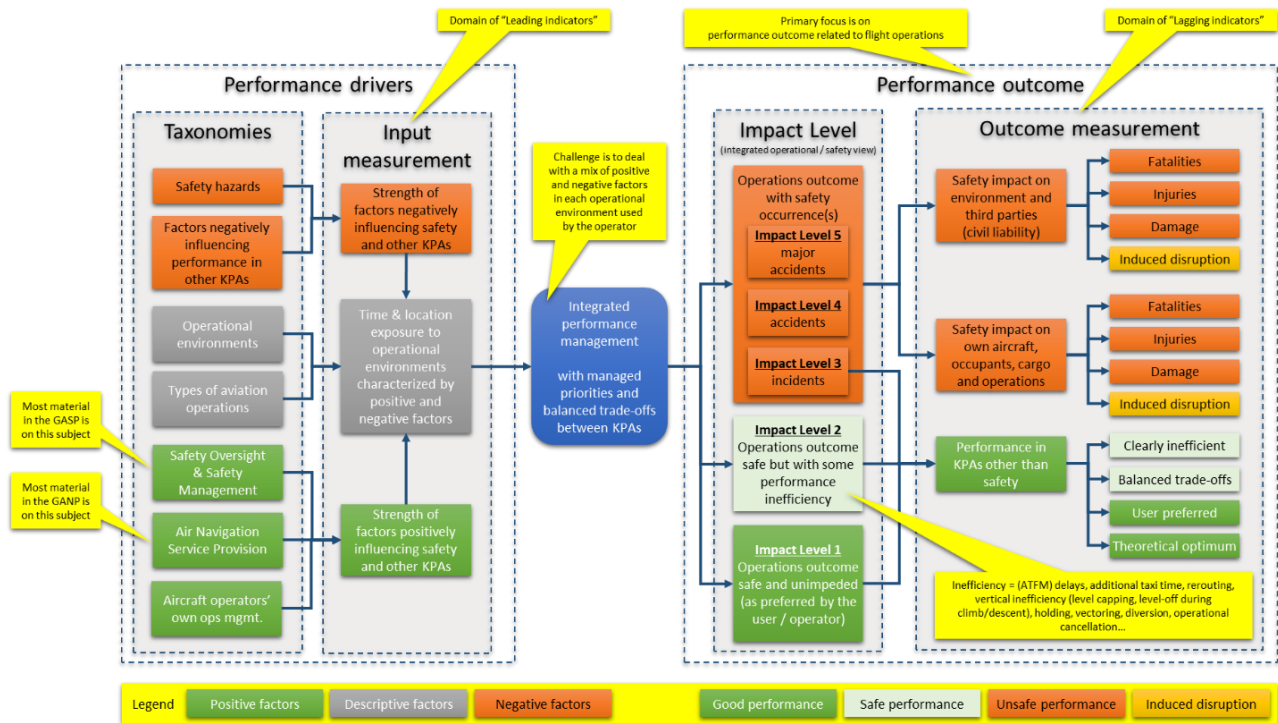
Note – The scope within the operational focus areas is limited to aviation safety. For example, while each time an aircraft design flaw is identified during operations would count as an aviation safety occurrence under design and manufacturing safety, an occupational health and safety event at the manufacturing premises of an aircraft is outside of the scope of the design and manufacturing focus area and would not count as an aviation safety occurrence. Processes that impact the aviation safety outcomes should be found under organizational safety.

Chapter 4

INFLUENCE DIAGRAM AND PERFORMANCE OBJECTIVE

4.1 Influence diagrams help to qualitatively understand the cause-effect relationships, between performance variables, which show how influencing factors propagate to performance outcome metrics, as well as vice-versa, what are the different drivers for a given outcome. They are powerful visualization and education tools to facilitate discussions about where strengths, weaknesses, opportunities and threats are and to explore where the focus of future performance objectives should or could be. This chapter presents a set of generic objectives within the defined safety focus areas based on the influence diagram in Figure 4.

4.2 The influence diagram in Figure 4 provides, taking an approach to performance which manages priorities and balances trade-offs between KPAs, a high-level view on how performance⁵ is driven by various factors. Furthermore, it shows how the GANP and the GASP ways of controlling/mitigating safety risks, identified in the focus and sub-focus areas, have a positive effect on safety performance and how this effect propagates. It also shows other factors, which may have a negative effect on safety performance. It should be noted that although the diagram places a magnifying glass on all aspects related to safety, it reflects the remaining KPAs in order to approach performance from a holistic perspective. The following paragraphs provide a more detail explanation of the influence diagram seeking for options, types of objectives, on the driver side that can be used as a toolbox to improve performance outcome.



⁵ The purely operational KPAs in the GANP are: Cost-effectiveness, capacity, efficiency, predictability and flexibility (see https://www4.icao.int/ganportal/GanpDocument#/lessons/sKX_rle6SOH4QcBvYFbcjG-V4xaWosA?k=aou1kf); however, operational safety could be also consider operational performance.

Figure 5 High-level influence diagram for all KPAs

4.3 On the right side of the diagram, taking safety as a priority, flight operations are conceptually positioned on a scale of increasing “impact levels” based on their performance:

- a) Level 1 – Safe and efficient: performance is as desired by the aviation community, e.g. airspace users’ preferred trajectory.
- b) Level 2 – Safe but with performance inefficiency, i.e. with one or more of the following: (ATFM) delays, additional taxi time, rerouting, vertical inefficiency (level capping, level-off during climb/descent), holding, vectoring, diversion or operational cancellation.
- c) Level 3 – With incident(s), i.e. with occurrence(s), other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.
- d) Level 4 – With accident(s) as defined in Annex 13.
- e) Level 5 – With major accident(s) causing an exceptional disruption, i.e. where the accident causes an exceptional disruption that results in human, material, economic or environmental loss that exceeds the impact normally associated with a single aviation accident.

4.4 Levels 3, 4 and 5 are operations that resulted in safety occurrences of various impacts. The impact of the safety occurrences that resulted from level 4 and 5 operations, accidents and major accidents, and to some extent of occurrences from level 3 operations, incidents, can be quantified in terms of human loss (fatalities and injuries), damage caused (direct material, economic and/or environmental loss) and operational or economic disruption.

4.5 In addition, the impact of the safety occurrences can be divided into:

- a) own impact (on the involved aircraft, their cargo and occupants, and the aircraft operators), and
- b) third party impact (other loss or disruption, typically on the ground, i.e. civil liability aspects).

4.6 On the left side of the diagram, the drivers of performance resulted from different flight operations are divided in two categories:

- a) Negative factors (such as hazards) which threaten good performance, and
- b) Positive factors, which generate or reinforce good performance. With regard to safety two main categories of positive factors can be distinguished:
 - a. Safety oversight and safety management (most material in the GASP is on this subject),
 - b. Air Navigation Service (ANS) provision (most material in the GANP is on this subject).

4.7 Positive and negative factors are highly dependent on the operational environment in which the flight operation takes place, e.g. surface movement areas, runways, airspace. However, in terms of influencing performance, these factors only play a role to the extent that the flight operation is exposed to them. Exposure is to be understood as:

- a) The extent to which the flight operation is taking place in the operational environment;
- b) The extent to which the negative factors are occurring in the operational environment (frequency and strength) and the flight operation is exposed to them;

- c) The extent to which the positive factors are applicable/active in the operational environment and the flight operation is exposed to them. In the case of ANS this means making use of the service(s).

4.8 Therefore, to achieve good performance on the outcome side (right side of the diagram), it is imperative that an appropriate balance between the exposure to positive and negative factors on the driver side (left side of the diagram) exists. This means that there is a spectrum of options, types of objectives, on the driver side that can be used as a toolbox to improve performance outcome:

- a) To reduce (or prevent an increase of) the strength and/or frequency of negative factors;
- b) To reduce (or prevent an increase of) the exposure to negative factors;
- c) To increase (or prevent a reduction of) the strength and/or frequency of positive factors;
- d) To increase (or prevent a reduction of) the exposure to positive factors.

4.9 The safety focus and sub-focus areas in chapter 2 outline the areas in which performance policy should be established via the definition of generic objectives. As stated in chapter 1 (see paragraph 1.2.1.10), generic objectives define — in a qualitative but focused way — a desired trend from today's performance (e.g. improvement). The generic performance objective within the safety KPA of the sixth edition of the GANP provided hereafter is aligned with the types of objectives listed above:

- Maintain or improve safety

4.10 Aligned with the performance objective above, the following generic sub-objectives are defined within the proposed safety focus and sub-focus areas:

Note. – Sub-objectives in bold are not part of the sixth edition of the GANP.

- **Maintain or improve operational safety outcomes**
 - **Maintain or improve safety of flight operations**
 - **Maintain or improve safety of traditional operations**
 - **Maintain or improve safety of new entrants**
 - Maintain or improve safety of very low level operations (typically operating below 500ft AGL)
 - Maintain or improve safety of high altitude operations (typically operating above FL600)
 - **Maintain or improve safety of urban air mobility**
 - **Maintain or improve safety of aerodrome operations**
 - **Maintain or improve safety of the air navigation service provision**
 - **Maintain or improve safety in aircraft maintenance**
 - **Maintain or improve safety in design and manufacturing**
- **Maintain or improve organizational safety processes**
 - **Strengthen State safety oversight capabilities**
 - **Increase the implementation of States' Safety Programmes**

- **Improve safety management systems implementation**
- **Increase safety enhancement initiatives**
- **Improve safety collaboration at global, regional and national levels**
- **Maintain or improve the provision of infrastructure and aviation services**
 - **Enhance the implementation of the Basic Building Blocks**
 - **Optimize the implementation of operational safety improvements within the ASBU framework**

4.10 The objectives and sub-objectives above consider the positive factors within the influence diagram. However, the diagram also provides details on how negative factors can propagate and have an effect on flight operations performance. Therefore, following the approach in paragraph 4.8, performance sub-objectives to the performance sub-objective “Maintain or improve safety of flight operations” defined above, can be defined by addressing the hazards, either collision or non-collision related, within flight operations.

4.11 Table 1 presents a safety occurrence scenario framework for flight operations in which the flight operations taxonomy, broken down into seven categories of flight operations⁶, is linked to the operational hazards taxonomy⁷, broken down into thirty-one operational hazard categories. The resulting matrix provides two hundred and seventeen (7 x 31) individual occurrence scenarios where safety needs to be ensured. For example, cell A1 is the scenario of a manned IFR flight potentially colliding with another manned IFR flight, cell C16 is the scenario of a VFR flight potentially encountering wake turbulence, and so on.

4.12 The operational hazard taxonomy considers various types of identified hazards related to collisions as well as other operational hazards. In this regard, it is distinguished between:

- a) Collision related hazards: associated with actors or obstacles which could potentially contribute to a collision, including collisions between aircraft and aircraft in traditional operations, and aircraft and new entrants in the new entrants category;
- b) Location hazards: associated with designated volumes of airspace or locations on the aerodrome. These include protection of the volumes of airspace/location against aircraft entering or inversely protecting the aircraft against hazardous activities taking place inside the location or the aircraft ending up at a hazardous location;
- c) Operating environment condition hazards: associated with temporary and volatile conditions which in general represent a hazard to aviation, and where an encounter needs to be avoided or the hazard mitigated;
- d) Capability hazards: associated with situations where, to undertake a flight, robust system elements (the aircraft, the crew, supporting systems and services) are moved beyond their structural or physical limits, or beyond their performance capabilities;

⁶ The break-down of the flight operations taxonomy into seven categories [GAT- IFR manned, GAT – IFR unmanned (RPAS), GAT-VFR, OAT, Urban Air Mobility (UAM), Low altitude users (drones) and High altitude users] is necessary to map the top-down approach to the categorization of occurrence scenarios presented in Table 1 to the bottom-up approach in the GANP and the GASP presented in Table 2. See paragraph 3.4.9.

⁷ Traditional operations, new entrants, moving hazards, fixed hazards, location hazards, operating environment condition hazards, capability hazards and failure hazards.

- e) Degradation hazards: associated with performance unreliability, degradation, or failure such that any of the system components (the aircraft, the crew, passengers, supporting systems and services) or their interactions result in unexpected responses (e.g. lack of response, inappropriate response, poorly-timed response).

Matrix oriented Focus Area framework for defining the safety of various types of flight operations (7 rows) with respect to various operational hazards (31 columns) 7 x 31 = 217 Focus Areas = 217 Safety Occurrence scenarios		Operational hazards																														
		Aircraft/aircraft collision related hazards							Other collision related hazards				Hazards non-collision related																			
		Traditional operations			New entrants				Moving hazards		Fixed hazards		Location hazards		Operating environment condition hazards						Capability hazards					Degradation hazards						
		GAT - IFR manned	GAT - IFR unmanned (RPAS)	GAT - VFR	OAT	Urban Air Mobility (UAM)	Low altitude users (drones)	High altitude users	Ground vehicles & mobile equipment	Birds, animals, humans	Obstacles	Terrain	Surface movement related	Airspace related	Surface movement area conditions	Hazardous weather (incl. turbulence)	Wake vortex	Volcanic ash	Hazardous space weather (solar activity)	Other operating environment hazards	Excessive mission requirements	Aircraft capabilities exceeded	Flight crew capabilities exceeded	Remote flight support capabilities exceeded	Take-off/landing site capabilities exceeded	ANS capabilities exceeded	Hazards caused by mission execution failure	Aircraft failure / performance degradation	Flight crew performance issues	Remote flight support issues	Take-off/landing site performance issues	ANS performance issues
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Flight operations	Traditional operations	GAT - IFR manned	A																													
		GAT - IFR unmanned (RPAS)	B																													
		GAT - VFR	C																													
		OAT	D																													
	New entrants	Urban Air Mobility (UAM)	E																													
		Low altitude users (drones)	F																													
		High altitude users	G																													

Table 1 Occurrence scenario framework for flight operations

4.13 The risks associated with the identified hazards described above result, at a high-level, in the following type of sub-objectives:

- Reduce the risk of aircraft/aircraft collision
- Reduce the risk of other collisions
- Reduce the risk of non-collision related occurrences

4.14 Historically, in accidents and incidents investigations, safety occurrences are categorized in a different way namely in CICTT Occurrence Categories⁸. Table 2 maps the CICTT Occurrence Categories to the operational context focus and sub-focus areas as well as the GANP and GASP.

4.15 In order to map the existing performance objectives in the GANP, which correspond to the operational improvements defined in the Aviation System Block Upgrade (ASBU) Framework, the sub-focus area of “Safety of traditional operations” has been subdivided in Table 2 in operational environments. This subdivision results in the following tree of performance sub-objectives:

- Maintain or improve safety on the ramp (aircraft not moving)
- Maintain or improve safety during surface movement
- Maintain or improve safety on the runway

⁸ The Occurrence Categories have specific definitions which can be found here: <http://www.intlaviationstandards.org/Documents/OccurrenceCategoryDefinitions.pdf>

- Maintain or improve safety in the air
- Maintain or improve safety on-board

Note - It would be possible to refine the mapping of “Occurrence Categories” or “Safety of new entrants” to link them to more specific low-level objectives. However, at the current state of developing the performance framework there is no need yet to define sub-trees of operational environments for new entrants. The new entrants did not exist when the CICTT categories were created. Furthermore, at the current state of developing the performance framework it is not known whether these categories will be used for the new entrants. Therefore, the new entrants have not been mapped to these categories. However, it must be highlighted that States, as part of their State Safety Programme (SSP), are expected to be managing all the risks to civil aviation across the whole system including the new entrants.

4.16 The combination of the above taxonomies and the definition of associated performance objectives result in the following performance sub-objective tree under “Maintain or improve safety of traditional operations”, which focuses on the reduction of risks (stemming from the operational hazards outlined above) that may require mitigation measures to reduce the likelihood as well as the severity of the consequences:

*Note. – Sub-objectives in bold are not part of the sixth edition of the GANP, the ones marked with (**) have safety contributions from ASBU Elements.*

- **Maintain or improve safety on the ramp (aircraft not moving)**
- Maintain or improve safety during surface movement (**)
 - **Reduce the risk of taxiway and apron aircraft/aircraft collision**
 - **Reduce the risk of other collisions while using taxiways and aprons**
 - **Reduce the risk of non-collision related occurrences associated with incorrect or unsafe usage of taxiways and aprons**
- Maintain or improve safety on the runway (**)
 - **Reduce the risk of runway aircraft/aircraft collisions**
 - **Reduce the risk of other collisions while using the runway**
 - **Reduce the risk of non-collision related occurrences associated with incorrect or unsafe usage of runways**
- Maintain or improve safety in the air
 - **Reduce the risk of mid-air collisions (aircraft/aircraft)**
 - **Reduce the risk of other collisions while airborne**
 - Reduce risk of non-collision related occurrences
- **Maintain or improve safety on-board**

4.17 The existing safety performance objectives in the GANP can then be mapped as follows:

*Note. – Sub-objectives in bold are not part of the sixth edition of the GANP, the ones marked with (**) have safety contributions from ASBU Elements.*

- **Maintain or improve safety on the ramp (aircraft not moving)**
- Maintain or improve safety during surface movement (**)
 - **Reduce the risk of taxiway and apron aircraft/aircraft collisions**
 - Improve collision avoidance during taxi operations (safety net) (**)
 - **Reduce the risk of other collisions while using taxiways and aprons**
 - **Reduce the risk of non-collision related occurrences associated with incorrect or unsafe usage of taxiways and aprons**
 - Avoid incorrect taxiing (cases of non-conformance with clearance) (**)
 - Avoid flights attempting to land/take-off on/from taxiways
 - Improve early detection of conflicting ATC Clearances (CATC) related to taxi operations (**)
- Maintain or improve safety on the runway (**)
 - **Reduce the risk of runway aircraft/aircraft collisions**
 - Improve runway collision avoidance (safety net) (**)
 - **Reduce the risk of other collisions while using the runway**
 - Improve runway collision avoidance (safety net) (**)
 - **Reduce the risk non-collision related occurrences associated with incorrect or unsafe usage of runways**
 - Reduce number of runway incursions
 - Avoid incorrect entries of aircraft or vehicles onto the runway protected area (without or contrary to ATC clearance or due to incorrect ATC clearance) (**)
 - Avoid incorrect presence of vacating aircraft or vehicles onto the runway protected area (**)
 - Avoid incorrect runway crossings by aircraft or vehicles (without or contrary to ATC clearance or due to incorrect ATC clearance) (**)
 - Avoid incorrect spacing between successive arriving or arriving and departing or departing and arriving or successive departing aircraft
 - Avoid landings without ATC clearance
 - Avoid landings on wrong runway at right airport
 - Avoid landings at wrong airport
 - Avoid take-offs without ATC clearance
 - Improve early detection of conflicting ATC Clearances (CATC) related to runway usage (**)
 - Avoid runway excursions
- Maintain or improve safety in the air
 - **Reduce the risk of mid-air collisions (aircraft/aircraft)**

- Improve mid-air collision avoidance (safety net) (**)
- Improve separation provision (at a planning horizon > 2 minutes) (**)
- Improve early detection of conflicting ATC Clearances (CATC) (en-route / departure / approach) (**)
- **Reduce the risk of other collisions while airborne**
 - Avoid vertical & lateral navigation errors during flight (cases of non-conformance with clearance) (**)
 - Avoid unauthorized penetration of segregated airspace (**)
 - Avoid controlled flight into terrain (CFIT) and obstacle collision risk (**)
- Reduce the risk of non-collision related occurrences
 - Avoid hazardous weather (including turbulence)
 - Avoid volcanic ash
 - Avoid en-route wake vortex encounters (**)
 - Avoid exposure to hazardous space weather
- **Maintain or improve safety on-board**

4.18 The GASP and GANP address, in terms of solutions and actions, different subsets of safety occurrence scenarios. The High Risk Categories (HRC) in the GASP are the top-five areas with the most impact on overall safety levels in the CICTT occurrence categories (see Table 2, column GASP HRC). The Safety Enhancement Initiatives (SEI) in the OPS Roadmap, which is part of the GASP Global Aviation Safety Roadmap, are specifically focussed on these five risk categories. The GANP, through its ASBU Elements, which contribute to specific GANP safety performance objectives⁹, addresses a different subset

of occurrence categories (see

▲	ANS - Air Navigation Service related (GANP)
■	HRC - High Risk Category (GASP)
●	Other risk category

)

Table 2, column GANP ANS Related).

⁹ See <https://www4.icao.int/ganportal/ASBU/PerformanceObjective>

Code	Occurrence Category Title	GANP ANS related	GASP HRC	Flight Operations										Aero- drome Ops	ANSP Ops	Main- tenance Ops	Design & Manu- facturing
				Traditional Operations						New Entrants							
				Ramp	Surface movement	Runway	In the air	Off- airport	On- board	Very low level operations	High altitude operations	UAM					
ADRM	Aerodrome	▲												▲			
AMAN	Abrupt Maneuver				•	•	•										
ARC	Abnormal Runway Contact					•											
ATM	ATM/CNS	▲													▲		
BIRD	Bird	▲				▲	▲										
CABIN	Cabin Safety Events									•							
CFIT	Controlled Flight into or toward Terrain	▲	■				▲	■	▲	■							
CTOL	Collision with Obstacle(s) during Takeoff and Landing	▲					▲	▲									
EVAC	Evacuation			•	•	•				•							
EXTL	External Load Related Occurrences									•							
F-NI	Fire/Smoke (Non-Impact)									•							
F-POST	Fire/Smoke (Post-Impact)									•							
FUEL	Fuel Related									•							
GCOL	Ground Collision	▲			▲												
GTOW	Glider Towing Related Events																
ICE	Icing	▲						▲									
LALT	Low Altitude Operations							•	•								
LOC-G	Loss of Control-Ground				•	•											
LOC-I	Loss of Control-Inflight		■					■									
LOLI	Loss of Lifting Conditions En Route							•	•								
MAC	Airprox/TCAS Alert/Loss of Separation/Near Midair Collisions/Midair Collisions	▲	■					■									
MED	Medical									•							
NAV	Navigation Errors	▲			▲	▲	▲										
OTHR	Other																
RAMP	Ground Handling			•													
RE	Runway Excursion	▲	■														
RI	Runway Incursion	▲	■														
SCF-NP	System/Component Failure or Malfunction (Non-Powerplant)									•						•	•
SCF-PP	System/Component Failure or Malfunction (Powerplant)									•						•	•
SEC	Security Related									•							
TURB	Turbulence Encounter	▲						▲						•	•		
UIMC	Unintended Flight in IMC	▲						▲									
UNK	Unknown or Undetermined																
USOS	Undershoot/Overshoot	▲					▲										
WILD	Wildlife	▲			▲	▲											
WSTRW	Wind Shear or Thunderstorm	▲			▲	▲	▲										

Legend	▲ ANS - Air Navigation Service related (GANP)
	■ HRC - High Risk Category (GASP)
	• Other risk category

Table 2 Mapping of the CICTT Occurrence Categories to the Focus Areas, traditional operation operational environments, GANP and GASP

4.19 Table 1 provides a top-down approach to the categorization of safety occurrence scenarios based on the hazard and type of operations taxonomies, whereas Table 2 provides the bottom-up approach reflected in the GANP, the GASP and other data collection practices such as accidents and incidents investigation. These two approaches can be mapped to each other as shown in Table 3, which facilitates the identification of new performance objectives as follows, for example: the BIRD – Bird occurrence category of the CICTT taxonomy, which is ANS-related, is related in Table 2 to the “runway” and “in the air” subdivisions of the focus area “traditional operations”. At the same time, the BIRD category is mapped, in Table 3, to “moving hazards” within the “other collision related hazard category” (see example highlighted in the tree below). Therefore, from a bottom-up approach perspective, the following new performance sub-objectives are defined within the previous tree:

Note. – Sub-objectives in bold are not part of the current edition of the GANP; New sub-objectives from the mapping of the two approaches are marked with (*); those marked with (**) have safety contributions from ASBU Elements.

- **Maintain or improve safety on the ramp (aircraft not moving)**
- Maintain or improve safety during surface movement (**)
- **Reduce the risk of taxiway and apron aircraft/aircraft collisions**
 - Improve collision avoidance during taxi operations (safety net) (**)

- **Reduce the risk of other collisions while using taxiways and aprons**
 - **Avoid collisions with ground vehicles and mobile equipment on taxiways and aprons (*)**
 - **Avoid collisions with animals or humans on taxiways and aprons (*)**
 - **Avoid collisions with obstacles and buildings (*)**
 - **Avoid encounters with FOD and/or patches of poor taxiway or apron condition (*)**
- **Reduce the risk of non-collision related occurrences associated with incorrect or unsafe usage of taxiways and aprons**
 - Avoid incorrect taxiing (cases of non-conformance with clearance) (**)
 - Avoid flights attempting to land/take-off on/from taxiways
 - Improve early detection of conflicting ATC Clearances (CATC) related to taxi operations (**)
- **Maintain or improve safety on the runway (**)**
 - **Reduce the risk of runway collisions**
 - Improve runway collision avoidance (safety net) (**)
 - **Reduce the risk of other collisions while using the runway**
 - Improve runway collision avoidance (safety net) (**)
 - **Avoid bird strike while on the runway (*)**
 - **Avoid collisions with animals or humans on the runway (*)**
 - **Avoid encounters with FOD and/or patches of poor RWY condition (*)**
 - **Avoid wake vortex encounters on the runway (*)**
 - **Reduce the risk of non-collision related occurrences associated with incorrect or unsafe usage of runways**
 - Reduce number of runway incursions
 - Avoid incorrect entries of aircraft or vehicles onto the runway protected area (without or contrary to ATC clearance or due to incorrect ATC clearance) (**)
 - Avoid incorrect presence of vacating aircraft or vehicles onto the runway protected area (**)
 - Avoid incorrect runway crossings by aircraft or vehicles (without or contrary to ATC clearance or due to incorrect ATC clearance) (**)
 - Avoid incorrect spacing between successive arriving or arriving and departing or departing and arriving aircraft
 - Avoid landings without ATC clearance
 - Avoid landings on wrong runway at right airport
 - Avoid landings at wrong airport

- Avoid take-offs without ATC clearance
 - Improve early detection of conflicting ATC Clearances (CATC) related to runway usage (**)
 - Avoid runway excursions
 - **Maintain or improve safety in the air**
 - **Reduce the risk of mid-air collisions(aircraft/aircraft)**
 - Improve mid-air collision avoidance (safety net) (**)
 - Improve separation provision (at a planning horizon > 2 minutes) (**)
 - Improve early detection of conflicting ATC Clearances (CATC) (en-route / departure / approach) (**)
 - **Reduce the risk of other collisions while airborne**
 - **Avoid bird strike while airborne (*)**
 - Avoid vertical & lateral navigation errors during flight (cases of non-conformance with clearance) (**)
 - Avoid unauthorized penetration of segregated airspace (**)
 - Avoid controlled flight into terrain (CFIT) and obstacle collision risk (**)
 - Reduce the risk of non-collision related occurrences
 - Avoid hazardous weather (including turbulence)
 - Avoid volcanic ash
 - Avoid en-route wake vortex encounters (**)
 - Avoid exposure to hazardous space weather
 - **Avoid exposure to laser light (*)**
 - **Avoid being shot down (*)**
 - **Maintain or improve safety on-board**

4.21 The mapping in Table 3 also shows that there is no one to one mapping between scenarios themselves and that although many safety occurrences categories of the CICTT taxonomy appear on all the flight operations sub-categories rows, there are categories which are not applicable to all the sub-flight operations categories. This is the reason why it is important to break down the flight operations taxonomy into seven categories.

4.22 Table 3 also emphasizes the non-applicability of CICTT taxonomy to the new entrants category, as highlighted above, as well as the gaps on the CICTT taxonomy of safety occurrence scenarios associated to certain hazards, probably due to the lack of safety occurrences within these scenarios.

Matrix oriented Focus Area framework for defining the safety of various types of flight operations (7 rows) with respect to various operational hazards (31 columns) 7 x 31 = 217 Focus Areas = 217 Safety Occurrence scenarios		Operational hazards																																	
		Aircraft/aircraft collision related hazards				Other collision related hazards		Hazards non-collision related																											
		Traditional operations		New entrants		Moving hazards	Fixed hazards	Location hazards	Operating environment condition hazards											Capability hazards					Degradation hazards										
		GAT - IFR manned	GAT - IFR unmanned (RPAS)	GAT - VFR	OAT	Urban Air Mobility (UAM)	Low altitude users (drones)	High altitude users	Ground vehicles & mobile equipment	Birds, animals, humans	Obstacles	Terrain	Surface movement related	Airspace related	Surface movement area conditions	Hazardous weather (incl. turbulence)	Wake vortex	Volcanic ash	Hazardous space weather (solar activity)	Other operating environment hazards	Excessive emission requirements	Aircraft capabilities exceeded	Flight crew capabilities exceeded	Remote flight support capabilities exceeded	Take-off/landing site capabilities exceeded	ANS capabilities exceeded	Hazards caused by mission execution failure	Aircraft failure / performance degradation	Flight crew performance issues	Remote flight support issues	Take-off/landing site performance issues	ANS performance issues			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	31	31					
Flight operations	Traditional operations	GAT - IFR manned	A	GCOL MAC	GCOL MAC	GCOL MAC	GCOL MAC				BIRD WILD	CTOL	CFIT USOS	NAV RE RI	NAV	ICE TURB WSTRW LOLI				SEC	EXTL RAMP	AMAN ARC LOC-G LOC-I UIMC	UIMC					CABIN EVAC EXTL MED RAMP	F-NI F-POST FUEL LOU SCF-NP SCF-PP	MED	ADRM	ATM			
		GAT - IFR unmanned (RPAS)	B	GCOL MAC	GCOL MAC	GCOL MAC	GCOL MAC					BIRD WILD	CTOL	CFIT USOS	NAV RE RI	NAV	ICE TURB WSTRW LOLI				SEC	EXTL RAMP	AMAN ARC LOC-G LOC-I UIMC	UIMC					CABIN EVAC EXTL MED RAMP	F-NI F-POST FUEL LOU SCF-NP SCF-PP	MED	ADRM	ATM		
		GAT - VFR	C	GCOL MAC	GCOL MAC	GCOL MAC	GCOL MAC					BIRD WILD	CTOL LALT	CFIT LALT USOS	NAV RE RI	NAV	ICE TURB WSTRW LOLI				SEC	EXTL RAMP	AMAN ARC LOC-G LOC-I UIMC	UIMC					CABIN EVAC EXTL GTOW MED RAMP	F-NI F-POST FUEL LOU SCF-NP SCF-PP	MED	ADRM	ATM		
		OAT	D	GCOL MAC	GCOL MAC	GCOL MAC	GCOL MAC					BIRD WILD	CTOL LALT	CFIT LALT USOS	NAV RE RI	NAV	ICE TURB WSTRW LOLI				SEC	EXTL RAMP	AMAN ARC LOC-G LOC-I UIMC	UIMC					CABIN EVAC EXTL MED RAMP	F-NI F-POST FUEL LOU SCF-NP SCF-PP	MED	ADRM	ATM		
	New entrants	Urban Air Mobility (UAM)	E																																
		Low altitude users (drones)	F																																
		High altitude users	G																																

Table 3 Mapping of the CICTT Occurrence Categories to the occurrence scenario framework for flight operations

4.23 Therefore, the safety performance sub-objective tree in the GANP is proposed to be updated as follows:

Note. – Sub-objectives in bold are not part of the current edition of the GANP; New sub-objectives from the mapping of the two approaches are marked with (*); those marked with (**) have safety contributions from ASBU Elements.

- **Maintain or improve operational safety outcomes**
 - **Maintain or improve safety of flight operations**
 - **Maintain or improve safety of traditional operations**
 - **Maintain or improve safety on the ramp (aircraft not moving)**
 - Maintain or improve safety during surface movement (**)
 - **Reduce the risk of taxiway and apron aircraft/aircraft collisions**
 - Improve collision avoidance during taxi operations (safety net) (**)
 - **Reduce the risk of other collisions while using taxiways and aprons**
 - **Avoid collisions with ground vehicles and mobile equipment on taxiways and aprons (*)**
 - **Avoid collisions with animals or humans on taxiways and aprons (*)**
 - **Avoid collisions with obstacles and buildings (*)**

- **Avoid encounters with FOD and/or patches of poor taxiway or apron condition (*)**
 - **Reduce the risk of non-collision related occurrences associated with incorrect or unsafe usage of taxiways and aprons**
 - Avoid incorrect taxiing (cases of non-conformance with clearance) (**)
 - Avoid flights attempting to land/take-off on/from taxiways
 - Improve early detection of conflicting ATC Clearances (CATC) related to taxi operations (**)
- **Maintain or improve safety on the runway (**)**
 - **Reduce the risk of runway aircraft/aircraft collisions**
 - Improve runway collision avoidance (safety net) (**)
 - **Reduce the risk of other collisions while using the runway**
 - Improve runway collision avoidance (safety net) (**)
 - **Avoid bird strike while on the runway (*)**
 - **Avoid collisions with animals or humans on the runway (*)**
 - **Avoid encounters with FOD and/or patches of poor RWY condition (*)**
 - **Avoid wake vortex encounters on the runway (*)**
 - **Reduce the risk of non-collision related occurrences associated with incorrect or unsafe usage of runways**
 - Reduce number of runway incursions
 - Avoid incorrect entries of aircraft or vehicles onto the runway protected area (without or contrary to ATC clearance or due to incorrect ATC clearance) (**)
 - Avoid incorrect presence of vacating aircraft or vehicles onto the runway protected area (**)
 - Avoid incorrect runway crossings by aircraft or vehicles (without or contrary to ATC clearance or due to incorrect ATC clearance) (**)
 - Avoid incorrect spacing between successive arriving or arriving and departing or departing and arriving or successive departing aircraft
 - Avoid landings without ATC clearance
 - Avoid landings on wrong runway at right airport
 - Avoid landings at wrong airport
 - Avoid take-offs without ATC clearance
 - Improve early detection of conflicting ATC Clearances (CATC) related to runway usage (**)
 - Avoid runway excursions

- **Maintain or improve safety in the air**
 - **Reduce the risk of mid-air collisions (aircraft/aircraft)**
 - Improve mid-air collision avoidance (safety net) (**)
 - Improve separation provision (at a planning horizon > 2 minutes) (**)
 - Improve early detection of conflicting ATC Clearances (CATC) (en-route / departure / approach) (**)
 - **Reduce the risk of other collisions while airborne**
 - **Avoid bird strike while airborne (*)**
 - Avoid vertical & lateral navigation errors during flight (cases of non-conformance with clearance) (**)
 - Avoid unauthorized penetration of segregated airspace (**)
 - Avoid controlled flight into terrain (CFIT) and obstacle collision risk (**)
 - Reduce the risk of non-collision related occurrences
 - Avoid hazardous weather (including turbulence)
 - Avoid volcanic ash
 - Avoid en-route wake vortex encounters (**)
 - Avoid exposure to hazardous space weather
 - **Avoid exposure to laser light (*)**
 - **Avoid being shot down (*)**
 - **Avoid flight into conditions which are in itself non-hazardous, but beyond the capabilities of aircraft or crew (*)**
- **Maintain or improve safety on-board**
- **Maintain or improve safety of new entrants**
 - Maintain or improve safety of very low level operations (typically operating below 500ft AGL)
 - Maintain or improve safety of high altitude operations (typically operating above FL600)
 - **Maintain or improve safety of urban air mobility**
- **Maintain or improve safety of aerodrome operations**
- **Maintain or improve safety of the air navigation service provision**
- **Maintain or improve safety in aircraft maintenance**
- **Maintain or improve safety in design and manufacturing**
- **Maintain or improve organizational safety processes**
 - **Strengthen State safety oversight capabilities**
 - **Increase the implementation of States' Safety Programmes**
 - **Improve safety management systems implementation**

- **Increase safety enhancement initiatives**
- **Improve safety collaboration at global, regional and national levels**
- **Maintain or improve the provision of infrastructure and aviation services**
 - **Enhance the implementation of the Basic Building Blocks**
 - **Optimize the implementation of operational safety improvements within the ASBU framework**

4.24 In order to provide an integrated tree for the GANP and the GASP, the goals in the GASP were mapped to the performance objective tree. Only one of the six goals of the GASP relates to operational safety outcomes:

- a) The scope of Goal 1 of the GASP “Achieve continuous reduction of operational safety risks” was not limited to the set of five High Risk Categories (HRC), but covered all risk categories (the HRC are a subset of the full set of risk categories). Goal 1 therefore was mapped to the safety performance sub-objective “Maintain or improve safety of traditional flight operations”.

4.25 The rest of the goals in the GASP address organizational safety processes and provision of air navigation services, and were mapped to the tree as follows:

- a) Goal 2 of the GASP “*Strengthen States oversight capabilities*” was mapped to the sub-objective “Strengthen State safety oversight capabilities”;
- b) Goal 3 of the GASP “*Implement effective State Safety Programmes*” was mapped to the sub-objective “Increase the implementation of States’ Safety Programmes”;
- c) Goal 4 of the GASP “*Increase collaboration at the regional level*” was mapped to two sub-objectives “Increase safety enhancement initiatives” and “Improve safety collaboration at global, regional and national levels”;
- d) Goal 5 of the GASP “*Expand the use of industry programmes and safety information sharing networks by service providers*” was mapped to two sub-objectives: “Improve safety management systems implementation” of the industry and “Improve safety collaboration at global, regional and national levels”; and
- e) Goal 6 of the GASP “*Ensure the appropriate infrastructure is available to support safety operations*” was mapped to the sub-objectives: “Strengthen States’ safety oversight capabilities”, as well as “Enhance the implementation of the Basic Building Blocks” and “Optimize the implementation of operational safety improvements within the ASBU framework” under the sub-objective “Maintain or improve the provision of infrastructure and aviation services”.

Chapter 5

PERFORMANCE INDICATORS AND UNDERLYING METRICS

5.1 In order to define instantiated objectives from the generic ones, performance indicators need to be defined. This chapter proposes the methodology for development of different Key Performance Indicators (KPIs) and associated metrics for monitoring the development of performance, notably in the field of Safety. The proposed methodology can be applied to all other ICAO KPAs.

5.2 Each identified safety performance objective could have associated performance indicators. However, not all performance objectives should have associated KPIs. Within both Focus Areas: “operational safety outcomes” and “organizational safety processes”, instantiated performance objectives should have associated indicator values and, if needed, associated targets.

5.3 Instantiated objectives require precisely defined numerical performance indicators, which serve to establish quantitative measures that, collectively, will indicate progress towards achieving an objective. Performance indicators should precisely describe how the indicators should be derived using supporting metrics, including considerations such as limits on scope, statistical derivation, or other mathematical derivation (Doc 9883). The supporting metrics define which data needs to be collected and/or forecasted to calculate values for the performance indicators. Definitions must be sufficiently precise to allow individuals to duplicate the exact measurement without “insider knowledge”.

5.4 Besides detailed indicator description, it is also important to define minimum data specification requirements, i.e. a set of dimensions and taxonomies necessary and used in order to populate any future data collection mechanism. As an example, of what is meant by this, a detailed explanation of these principles are given for the objectives within the operational safety outcome focus area, where safety performance is measured in terms of safety occurrences and their characteristics. These are consequently used in two different ways:

- a) At the level of individual occurrences for in depth analysis to draw up lessons-learned in order to prevent similar occurrences (or occurrences resulting from the same root cause) from happening in the future. This is the function of accident/incident investigation.
- b) At aggregated level, to support policy-making. Aggregation is done to measure performance indicators to determine if progress is made in achieving performance objectives. The performance indicators can be sliced across different dimensions for deep-dive analysis. When time series is available, trend analysis can be done, and if targets are set, it is possible to check whether they are being reached.

5.5 For both applications, it is necessary to categorize each individual occurrence in multiple ways, i.e. along multiple dimensions. The categories themselves are defined in value lists and taxonomies. For example, in such value lists the element “accident” (with its Annex 13 definition) is a subcategory of the element “operational safety occurrence”, which itself is a subcategory of the more generic element “event” (which is not safety-specific anymore: for example other types of events are flight phase events such as take-off, top-of-climb).

5.6 Generally, it is proposed to define indicators at a generic level, and to obtain specific indicator values by filtering on specific dimension values. For example, rather than defining an indicator “number of accidents”, it is better practice to define the indicator as “number of safety occurrences” and to

obtain the desired value by filtering the indicator's dimension "safety occurrence type" on the value "accident".

5.7 To produce indicators quantifying the number of occurrences: each occurrence can be counted; appropriate descriptive (including impact level) and explanatory dimensions allow filtering and aggregation by category. Moreover, considering high level influence diagram (Figure 4), in order to produce indicators quantifying the impact of occurrences (as the outcome of a safety occurrence may involve a different number of entities impacted) from a data design perspective, it is necessary to keep each entity's impact in a separate record: one for each involved aircraft, and one for each impacted "third party".

5.8 Considering all this, for KPIs that are based on safety occurrence outcomes, for each data record the following attributes/inputs (the basic dimensions and metrics) are proposed:

- Dimension: ID of the associated safety occurrence
- Dimension: impacted entity type (aircraft or type of third party)
- Dimension: ID of the impacted entity
- Dimension: flight operations type (traditional, new entrant)
- Dimension: flight ID (only if type = aircraft)
- Dimension: information as specified in Annex 13 Chapter 4
 - Metric: number of persons (by function and injury level)
 - Function: occupant/crew, occupant/passenger, third party
 - Injury level: fatal, serious, minor, none, unknown
- Dimension: level of sustained damage (destroyed, substantial, minor, none, unknown)
 - Metric: cost of sustained damage
- Dimension: type of induced disruption
- Dimension: magnitude of induced disruption
 - Metric: duration of induced disruption
 - Metric: cost of induced disruption

5.9 The aforementioned list should be seen as minimum data specification requirement.

5.10 Using proposed attributes/inputs (the basic dimensions and metrics) several examples how safety performance indicators measuring events with safety occurrence outcome are presented below.

Example 1: General Aviation accident during landing with one pilot on board.

- ID of the associated safety occurrence: 123
- Impacted entity type: aircraft
- ID of the impacted entity: 456
- Flight operations type: traditional
- Flight ID (only if type = aircraft): BH-123
- Annex 13: accident
 - Function: crew
 - Injury level: serious
- Level of sustained damage: substantial
 - Cost: 100k\$
- Type of induced disruption: suspended airport operations

- Magnitude of induced disruption:
 - Duration of induced disruption: 1 day
 - Cost of induced disruption: 10k\$

Example 2: Drone penetration of protected airspace.

- ID of the associated safety occurrence: 789
- Impacted entity type: aircraft
- ID of the impacted entity: 456
- Flight operations type: new entrant
- Flight ID (only if type = aircraft): N/A
- Annex 13: incident
 - Function: third party
 - Injury level: none
- Level of sustained damage: none
 - Cost: 0\$
- Type of induced disruption: none(?)
- Magnitude of induced disruption:
 - Duration of induced disruption: 0 days
 - Cost of induced disruption: 0\$

5.11 Once the KPI in safety is defined, then the GANP KPI template is used to explain the definition and use of the defined KPI in safety. Please see example hereafter:

KPI ID	KPI20
KPI Name	Number of aircraft accidents
Definition	'Accident' is defined in ICAO Annex 13, Chapter 1-Definitions ADREP: Accident Data Report
Measurement Units	Number of accidents / year
Operations measured	Aircraft accidents during all flight phases that occurred in a year within the State/Region of occurrence.
Variants	Variant 1 (GASP): Aircraft MTOW > 2 250 kg 1.1 National accident occurrence level 1.2 Regional accident occurrence level Variant 2: All aircraft 2.1 National accident occurrence level 2.2 Regional accident occurrence level
Object(s) characterized	The KPI is typically computed for individual State, or Region (selection/grouping based on geography)
Utility of the KPI	High-level measurement of safety performance of the aviation system as a whole.
Parameters	None
Data requirement	For each reported occurrence: Date of occurrence Occurrence Category State of occurrence
Data feed providers	ICAO ADREP database iSTARS Application "ADREP et al."
Formula/algorithm	Count accidents if: a) The local date of occurrence is in between 01 January and 31 December of the year in question; b) It is of the type that is notifiable to ICAO; c) The circumstances of the accidents match the definition of Annex 13 definition of 'Accident'; and d) If variant 1, the aircraft involved in the accident is of maximum take-off mass of over 2 250 kg.
References and examples of use	ADREP: Accident Data Report https://www.eurocontrol.int/archive_download/all/node/12148

https://www.eurocontrol.int/archive_download/all/node/9360#page45
https://www.easa.europa.eu/sites/default/files/dfu/easa_asr_2020.pdf
[https://www.gcaa.gov.ae/en/epublication/admin/Publication%20History/Civil%20Aviation%20Regulations%20\(CARs\)/CAR%20PART%20VIII%20-%20AIR%20NAVIGATION%20REGULATIONS/CAR%20PART%20X%20SAFETY%20MANAGEMENT%20SYSTEM%20\(SMS\)%20Issue04rev00.pdf](https://www.gcaa.gov.ae/en/epublication/admin/Publication%20History/Civil%20Aviation%20Regulations%20(CARs)/CAR%20PART%20VIII%20-%20AIR%20NAVIGATION%20REGULATIONS/CAR%20PART%20X%20SAFETY%20MANAGEMENT%20SYSTEM%20(SMS)%20Issue04rev00.pdf)
[https://www.gcaa.gov.ae/en/epublication/admin/Library%20Pdf/Civil%20Aviation%20Advisory%20Publication%20\(CAAP\)/CAAP-22%20-%20INCIDENT%20REPORTING%20-%20ISSUE%2005.pdf](https://www.gcaa.gov.ae/en/epublication/admin/Library%20Pdf/Civil%20Aviation%20Advisory%20Publication%20(CAAP)/CAAP-22%20-%20INCIDENT%20REPORTING%20-%20ISSUE%2005.pdf)

5.12 Following this example, the same can be done for runway incursions, runway excursions and loss of separation in flight.

KPI ID	KPI21
KPI Name	Number of runway incursions
Definition	Number of occurrences at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and take-off of aircraft. (CICIT Taxonomy definition)
Measurement Units	Number of runway incursions / year
Operations measured	The actual number of runway incursions at an aerodrome
Variants	None
Object(s) characterized	The KPI is computed for individual aerodrome
Utility of the KPI	This KPI gives an indication of the incorrect or unsafe usage of the runways and of the safety performance improvement on the runway.
Parameters	None
Data requirement	For each reported occurrence: Date of occurrence Airport of occurrence
Data feed providers	Airports and airlines
Formula/algorithm	Count number of runway incursions: a) the local date of occurrence in between 01 January and 31 December of the year in question; and b) the circumstances of the occurrence match the definition of CICTF ‘RI’; or the occurrence category has been determined to be runway incursion – vehicle, aircraft or person (RI-VAP).
References and examples of use	https://www.mot.gov.sg/docs/default-source/default-document-library/runway-incursion-by-vehicle-in-seletar-airport-7-apr-2018-final-reportcecc69af7fde4718ad39b5127822a05f.pdf https://www.eurocontrol.int/archive_download/all/node/12148 https://www.eurocontrol.int/archive_download/all/node/9360#page45 https://www.gcaa.gov.ae/en/epublication/admin/Publication%20History/Civil%20Aviation%20Regulations%20(CARs)/CAR%20PART%20VIII%20-%20AIR%20NAVIGATION%20REGULATIONS/CAR%20PART%20X%20SAFETY%20MANAGEMENT%20SYSTEM%20(SMS)%20Issue04rev00.pdf https://www.gcaa.gov.ae/en/epublication/admin/Library%20Pdf/Civil%20Aviation%20Advisory%20Publication%20(CAAP)/CAAP-22%20-%20INCIDENT%20REPORTING%20-%20ISSUE%2005.pdf

KPI ID	KPI22
KPI Name	Number of runway excursions
Definition	Number of veer offs or overruns of the runway surface.
Measurement Units	Number of runway excursions / year
Operations measured	<ul style="list-style-type: none"> • Only applicable during either the takeoff or landing phase. • The excursion may be intentional or unintentional. For example, the deliberate veer off to avoid a collision, brought about by a Runway Incursion. In this case, code both categories. • Use RE in all cases where the aircraft left the runway/helipad/helideck regardless of whether the excursion was the consequence of another event.
Variants	None

Object(s) characterized	The KPI is computed for individual aerodrome
Utility of the KPI	This KPI gives an indication of the incorrect or unsafe usage of the runways and of the safety performance improvement on the runway.
Parameters	None
Data requirement	For each reported occurrence: Date of occurrence Airport of occurrence
Data feed providers	Airports and airlines
Formula/algorithm	Count number of runway excursions: a) the local date of occurrence in between 01 January and 31 December of the year in question; b) the circumstances of the occurrence match the definition of CICTT 'RE'; and c) the Occurrence Category has been determined to be runway excursion (RE).
References and examples of use	https://www.mot.gov.sg/docs/default-source/default-document-library/t-50-runway-excursion-in-changi-airport-6-feb-18-final-report.pdf https://www.eurocontrol.int/archive_download/all/node/12148 https://www.eurocontrol.int/archive_download/all/node/9360#page45 https://www.easa.europa.eu/sites/default/files/dfu/easa_asr_2020.pdf https://www.gcaa.gov.ae/en/epublication/admin/Publication%20History/Civil%20Aviation%20Regulations%20(CARs)/CAR%20PART%20VIII%20-%20AIR%20NAVIGATION%20REGULATIONS/CAR%20PART%20X%20SAFETY%20MANAGEMENT%20SYSTEM%20(SMS)%20Issue04rev00.pdf https://www.gcaa.gov.ae/en/epublication/admin/Library%20Pdf/Civil%20Aviation%20Advisory%20Publication%20(CAAP)/CAAP-22%20-%20INCIDENT%20REPORTING%20-%20ISSUE%2005.pdf

KPI ID	KPI23
KPI Name	Number of airprox/TCAS alert/loss of separation/near midair collisions/midair collisions (MAC)
Definition	Number of airproxes, TCAS alerts, loss of separation as well as near collisions or collisions between aircraft in flight.
Measurement Units	Number of airprox/TCAS alert/loss of separation/near midair collisions/midair collisions (MAC) / year
Operations measured	<ul style="list-style-type: none"> • Includes all collisions between aircraft while both aircraft are airborne. • Both air traffic control and cockpit crew separation-related occurrences are included. • Genuine TCAS alerts are included here.
Variants	None
Object(s) characterized	The KPI is computed for volumes of airspace as designated by the State.
Utility of the KPI	This KPI gives an indication of safety performance improvement in the air.
Parameters	None
Data requirement	For each reported occurrence: Date of occurrence FIR of occurrence
Data feed providers	ANSPs and airlines
Formula/algorithm	Count number of runway excursions: a) the local date of occurrence in between 01 January and 31 December of the year in question; b) the circumstances of the occurrence match the definition of CICTT 'MAC'; and c) the Occurrence Category has been determined to be airprox/TCAS alert/loss of separation/near midair collisions/midair collisions (MAC).
References and examples of use	https://www.eurocontrol.int/archive_download/all/node/9360#page45 https://www.easa.europa.eu/sites/default/files/dfu/easa_asr_2020.pdf https://www.gcaa.gov.ae/en/epublication/admin/Publication%20History/Civil%20Aviation%20Regulations%20(CARs)/CAR%20PART%20VIII%20-%20AIR%20NAVIGATION%20REGULATIONS/CAR%20PART%20X%20SAFETY%20MANAGEMENT%20SYSTEM%20(SMS)%20Issue04rev00.pdf https://www.gcaa.gov.ae/en/epublication/admin/Library%20Pdf/Civil%20Aviation%20Advisory%20Publication%20(CAAP)/CAAP-22%20-%20INCIDENT%20REPORTING%20-%20ISSUE%2005.pdf

Chapter 6

MAIN TAXONOMIES AND DIMENSIONS

6 MAIN TAXONOMIES AND DIMENSIONS

3.6.1 TBD

Chapter 7

LESSONS LEARNT AND CONCLUSIONS

4.1 LESSONS LEARNT

4.1.1 ICAO's "master glossary"

- Therefore GIPEG analyzed the GASP and many other safety related ICAO documents, and compared these to the GANP to determine their relationship (GASeP will be done later)
- Found that there are significant differences in scope between the GANP and the GASP; and while there are some relationships between the two, these are currently not explicitly identified or recognized, as GANP and GASP were developed in isolation until now.
- Found during the document analysis phase of its work, that in general across ICAO documents in different domains, there is a lack of "systems approach". Therefore, GIPEG recommends an integrated, performance driven systems approach for all ICAO endorsed and globally applicable terminology. One concrete recommendation is to:
 - Move away from the current practice of including a separate glossary of terms in each ICAO document (including Annexes), as this leads to duplications, possible divergence, doubts as to which glossary is more authoritative etc. Some (but not all) of these issues find their origin in the fact that documents are not always updated in a synchronized way.
 - Create a new ICAO document serving as ICAO's "master glossary", a "PANS-TERM" similar to Doc 8400 (ICAO Abbreviations and Codes – PANS-ABC), to which all other ICAO documents would refer instead of including their own glossary. That means, there is a consistent analysis that allows systemically modifying, adding or removing terms and definitions
 - Apply a systems approach to this document, meaning that it is not just an alphabetical listing of terminology definitions without duplicates, but that the document also defines the logical relationships between the terminologies and in addition identifies in which ICAO documents the terminology is (formally) used.
 - Ensure that this master glossary is centrally managed, and that all changes and additions that are needed by panels and other groups are only done via a "change request" procedure.
 - Suggest that the group managing this document uses state-of-the-art techniques to maintain the content (e.g. enterprise architecture modelling), and that it is not just published as a document but through interactive on-line means as well. Even allow the traceability of modifications to be consulted
 - It should be obvious that this document needs to be multi-lingual, i.e. available in all ICAO languages.

4.1.2 An integrated GANP/GASP approach in terms of safety performance

- GIPEG found that work at the following three levels is a prerequisite for enabling a future integrated GANP/GASP approach:

- Harmonization of taxonomies in those cases where they are used both by the GANP and the GASP
- Harmonization of the safety-related parts of the performance framework where needed and/or useful (at the various levels: general influence model, safety ambition, focus areas, performance objective (sub)tree, indicators and metrics)
- Ensuring a formal traceability between GANP and GASP at the level of "solutions": mapping between GANP ASBU Elements and relevant bullets/actions in the GASP SEIs (Safety Enhancement Initiatives)

4.1.3 Standardised methodology to follow for the development of other common KPAs (environment, security)

APPENDIX A

GLOSSARY

Air navigation services (ANS). Services provided to air traffic during all phases of operations including air traffic management (ATM), communication, navigation and surveillance (CNS), meteorological services for air navigation (MET), search and rescue (SAR) and aeronautical information services (AIS). They encompass the necessary humans, information, technology, procedures and facilities for their delivery.

Service provider. An organization providing aviation products and/or services. The term thus encompasses approved training organizations, aircraft operators, approved maintenance organizations, organizations responsible for type design or manufacture of aircraft, engines or propellers, air traffic service providers and other air navigation service providers and aerodrome operators.

Air navigation system. A system that supports the safe and orderly development of international civil aviation through the collaborative integration of humans, information, technology, facilities and services. In technical scope, the system comprises aerodrome operations, air traffic management, meteorology, aeronautical information and search and rescue services supported by air, ground and space-based communications, navigation and surveillance capabilities. In operational scope, the system encompasses en-route to en-route operations to integrate airport operations and flight turn around. In community scope, the system is comprised of all stakeholders involved in the provision of, or requiring the use of, air navigation resources.

Air traffic sustainability

Aspirational goal

Aviation community. All stakeholders involved in the provision of, or requiring the use of, air navigation resources, including:

- a) ICAO and other aviation standards making organizations;
- b) States in the role of regulators, airspace sovereigns and sometimes air navigation services providers (ANSPs);
- c) the aerodrome community;
- d) ANSPs, including, information service providers (ISPs);
- e) airspace users;
- f) State aviation;
- g) aircraft and equipment manufacturers;
- h) research and development organizations; and
- i) international organizations including professional staff organizations.

Aviation system. A system that comprises all activities, economic and non-economic, related to air transportation.

Classification Scheme. A classification scheme defines how general object types and event types can be more specifically characterized in terms of subtypes. For example: air vehicle < aircraft < aircraft category < aircraft class < aircraft type < aircraft model < aircraft series < airframe.

Classification schemes allow the breakdown of summary data into details, and vice-versa, they can be used to aggregate detailed (granular) performance data into summary data.

Data model

Dimensions

Focus area. Within each KPA or PCA, a number of more specific areas — focus areas — are identified in which there are potential intentions to establish performance management. Focus areas are typically needed where performance issues have been identified. For example, within the capacity KPA one can identify airport capacity, runway capacity and apron capacity as focus areas. Within the safety KPA, the list of focus areas might include: accidents, incidents, runway incursions, safety management system maturity, etc. There may be a need to define hierarchical groupings of focus areas

Hazard. A condition or an object with the potential to cause or contribute to an aircraft incident or accident. See Annex 19 and Doc 9859.

Impact level: Impact Level means the category assigned “severity” of effect on performance.

Impact level: a position on a continuous performance scale that ranges from extremely efficient and predictable to extremely unsafe with high impact. This unified scale covers multiple key performance and focus areas: at one end of the scale efficiency, predictability and resilience; at the other end safety, security and environment. For safety/operational performance framework definition five levels of impact are proposed:

- a) Level 1 – Safe and efficient: performance is “optimum”.
- b) Level 2 – Safe but with performance inefficiency, i.e. with one or more of the following: (ATFM) delays, additional taxi time, rerouting, vertical inefficiency (level capping, level-off during climb/descent), holding, vectoring, diversion, operational cancellation, etc.
- c) Level 3 – With incident(s), i.e. with occurrence(s), other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.
- d) Level 4 – With accident(s) as defined in Annex 13.
- e) Level 5 – With major accident(s) causing an exceptional disruption, i.e. where the accident causes an exceptional disruption that results in human, material, economic or environmental loss that exceeds the impact normally associated with a single aviation accident.

Influence model

Influence diagram. Influence diagrams are used to depict a chain of (assumed validated) cause-effect relationships. They can be used in a simple way to depict a high-level, qualitative understanding of performance. When such diagrams are used in a more complex way (supported by influence modelling tools), they follow precise conventions which serve to document relationships between (supporting) metrics (via processes and mechanisms), and to link these to well-defined performance indicators. Influence diagrams are useful as a tool to develop and document an initial understanding of the performance behaviour of the system. They can also serve as a communication tool to explain performance behaviour to a non-technical audience. (ICAO Doc 9883)

Integrated Performance Management. The expansion of safety management to cover other key performance areas, the operational key performance areas. ‘Safety’ was replaced by ‘integrated performance’ in order to highlight that the management of risk is expanded to cover the operational key performance areas.

Key Performance Indicators. See performance indicators.

Major accident: an accident which causes a major disruption that results in human, material, economic and/or environmental loss that exceeds the impact associated with aviation accident.

Metric. See: Supporting metric.

Operational safety outcomes. It is a focus area of safety ambition related to aircraft operations and the services associated (implies mainly the services provided by ANSPs, aerodrome operators, aircraft operators, maintenance organizations). It considers safety outcomes, whether an operation is safe or not (with or without accidents).

Organizational safety processes. It considers activities by which a safety outcome is achieved (safety management process, certification, oversight, etc.).

Performance ambition. Qualitative statement providing global priorities on the performance evolution of the global air navigation system. It should not be seen as a target to continuously monitor and report performance against, but rather as a catalyst for change. It is performance-oriented, time-bound and challenging, but at the same time it realistically considers the public environment, timing and available resources.

Performance framework. A performance framework is the set of definitions and terminology describing the building blocks used by a group of ATM community members to collaborate on performance management activities.

This set of definitions includes the levels in the global ATM performance hierarchy, the eleven key performance areas, a set of process capability areas, focus areas, performance objectives, indicators, targets, supporting metrics, lists of dimension objects, their aggregation hierarchies and classification schemes. (ICAO Doc 9883)

Performance indicators. Current/past performance, expected future performance (estimated as part of forecasting and performance modelling), as well as actual progress in achieving performance objectives is quantitatively expressed by means of indicators (sometimes called key performance indicators, or KPIs).

To be relevant, indicators need to correctly express the intention of the associated performance objective. Since indicators support objectives, they should be defined having a specific performance objective in mind.

Indicators are not often directly measured. They are calculated from supporting metrics according to clearly defined formulas, e.g. cost-per-flight-indicator = $\text{Sum}(\text{cost})/\text{Sum}(\text{flights})$. Performance measurement is therefore done through the collection of data for the supporting metrics. (ICAO Doc 9883)

Performance management framework

Performance Objective. Within focus areas, the potential intention to establish performance management is “activated” by defining one or more performance objectives. These define — in a qualitative and focused way — a desired trend from today’s performance (e.g. improvement). A distinction is made between generic objectives and instantiated objectives.

Generic objectives specifically focus on what has to be achieved, but do not make statements about the when, where, who or how much. For example “improve safety” is not specific enough to be an objective, whereas “reduce the total number of accidents” and even more specifically “reduce the number of CFIT accidents” would qualify as performance objectives. Because at the level of generic objectives no mention

is made about the when, where and who, it does not make sense to try to associate numbers (indicator values or targets) with this level.

Instantiated objectives add the when, where, who and how much to the generic objectives. Instantiated objectives can have indicator values and associated targets. (ICAO Doc 9883)

Performance objective tree

Resilience

Safety community

Safety Risk. The predicted probability and severity of the consequences or outcomes of a hazard. See Annex 19 and Doc 9859.

Supporting metric. Supporting metrics are used to calculate the values of performance indicators. For example, cost per-flight-indicator = $\text{Sum (cost)}/\text{Sum (flights)}$. Performance measurement is done through the collection of data for the supporting metrics (e.g. this leads to a requirement for cost data collection and flight data collection).

Taxonomy. See classification scheme.

Traditional flight operations

Value list

APPENDIX B

TERMS OF REFERENCE

Background	<p>The Global ATM Operational Concept (Doc 9854) shifted the focus from a technology-driven approach towards a performance-driven one. Based on this, ICAO published the Manual On Air Traffic Management System Requirements (Doc 9882) and the Manual on Global Performance of the Air Navigation System (Doc 9883).</p> <p>The 39th session of the ICAO Assembly endorsed the fifth edition of the GANP, which included a new chapter dedicated to the application of a performance-based approach (Resolution 39-12 refers).</p> <p>The Thirteenth Air Navigation Conference recognized the need to expedite the work on performance related to the GANP and recommended ICAO to consider establishing a group of performance experts under the new GANP Study Group (GSG) (Recommendation 4.3/1 refers).</p> <p>Furthermore, the 40th session of the ICAO Assembly endorsed the sixth edition of the GANP, which highlighted the importance of a performance driven approach towards the modernization of the air navigation system (Resolution 40-1 refers).</p>
Scope	<p>Maintenance, evolution and development of the global performance management framework of the GANP focused on its effective application at regional and national levels by all members of the aviation community.</p>
Required Expertise	<p>GIPEG is composed of performance management experts from States, international organizations, key industry, ANSPs, airspace users, and airport operators. These members will provide subject matter expertise related to the different KPAs and contextual information (e.g. traffic), as well as on operations research, data science, statistics, or data / technological matters.</p>
Objective(s)	<p>Serve as a coordination point for all Performance-based activities relating to GANP;</p> <p>Maintain, evolve and further develop the GANP Performance Framework, according to the evolution of the air navigation system, including the performance ambitions, objectives, indicators, metrics and dimensions;</p> <p>Contribute to the performance aspects of the GANP maintenance process;</p> <p>Support the development of GANP portal and ensure its evolution and integration of available national and regional planning/implementation and monitoring tools in a unique air navigation modernization and business-intelligence digital platform;</p> <p>Contribute to the coherency and consistency related to the performance of the GASP and GASeP;</p> <p>Develop ICAO provisions related to performance;</p> <p>Facilitate global benchmarking activities and respective results;</p> <p>Foster and promote the understanding and harmonization of the performance-based approach along global, regional and national levels through PIRGs;</p> <p>Develop training material and ensure its promotion and application;</p> <p>Create a library of reference material related to performance.</p>

TASKS RELATED TO OBJECTIVES

WORK PROGRAMME TASKS	ToR OBJECTIVES
Task 1: Exchange experience among GIPEG members	
Task 1A: Collect and share information	j
Task 1B: Develop and maintain a meta-data catalogue	j
Task 2: Direct GANP support	
Task 2A: Contribute to the GANP content maintenance process	a, c
Task 2B: Support the validation of ASBU element performance benefits	a, b
Task 2C: Support development of the GANP portal	d
Task 3: General development of the performance-based approach	
Task 3A: Maintenance of the GANP performance objective catalogue	b, e
Task 3B: Maintenance of the set of GANP indicators	b, e
Task 3C: Identification of suitable or required data and data sources	b, e
Task 3D: Development of data models and influence diagrams	b, e
Task 3E: Development of a glossary	b
Task 4: Global approach to increase the efficiency and effectiveness of performance measurement	
Task 4A: Guidance for (software) implementation of indicators	b
Task 4B: Global Master Data Management (MDM)	b
Task 4C: Management of the end-to-end data processing chain	b
Task 4D: Development of global standards for the generation, exchange and processing of performance data	f
Task 4E: Emerging techniques for performance data management and use	j
Task 5: Application of the performance-based approach	
Task 5A: Regional & international benchmarking	g
Task 5B: Dissemination of regional & international benchmarking results	g
Task 5C: Use of regional & international benchmarking results	g
Task 6: Impact assessment on ICAO provisions	f
Task 7: Promotion & education	
Task 7A: Development of training material	i
Task 7B: Support the dissemination and application of material	h

WORK PROGRAMME

Task 1: Exchange experience among GIPEG member

Task 1A: Collect and share information

Under this task, the GIPEG members will exchange experience on current best practices in performance measurement, review and application of the PBA in various Regions. This serves two purposes: to stimulate discussion amongst the GIPEG members, and to build a library of reference documentation informing other work of the GIPEG.

GIPEG Members are free to table relevant information from any angle they wish, including but not limited to:

- a) Areas covered (KPAs, Focus Areas)

Data availability & coverage, quality, sources and collection process

Indicators

Analysis & review

Use for steering purposes (incl. target setting)

Such material will be submitted as attachment to information papers.

Task 1B: Develop and maintain a meta-data catalogue

The purpose of this task is to analyse the information collected under Task 1A, to build a single catalogue, where the application of the PBA in various Regions is described at meta-data level.

Amongst others, such a catalogue (global performance wiki) would include the lists of indicators and data types used across Regions, link it to the performance objective catalogue, highlight similarities and differences in scope and terminology, include links to source material, identify in which States and organisations it is used etc. The material would be properly structured and classified, allowing the catalogue to be queried in various ways, to support the various other tasks of the GIPEG.

Task 2: Direct GANP support

Task 2A: Contribute to the GANP content maintenance process

This task consists of the processing change requests dispatched to the GIPEG because they relate to (or impact) the performance parts of the GANP portal. Under this task, the GIPEG delivers expertise and resources to support the GANP update campaigns.

For this work, the GIPEG will need to coordinate with the other subgroups of the GSG (ASBU-PPT and the GMVT).

Externally (or GSG-internally) originated change requests that are dispatched to the GIPEG may for example relate to:

- a) New and existing indicators, including their definition and description

Enhancements and modifications of the performance objective catalogue

Link between the performance objectives catalogue and the performance ambitions in the vision part of the GANP portal (Level 1, the Global Strategic Level of the GANP) → coordinate with the GMVT

The performance assessment of new and existing ASBU Elements (link between elements and the performance objective catalogue) → coordinate with the ASBU-PPT

The assessment of performance of the BBB framework

The use of the performance information in the GANP portal

GIPEG will need to define additions to the ASBU maintenance process (performance specific templates).

Task 2B: Support the validation of ASBU element performance benefits

GIPEG will support the ASBU PPT on the validation of expected performance benefits from the ASBU elements.

Task 2C: Support development of the GANP portal

GIPEG expertise will be used to support further development of the GANP portal from a user-friendliness and user requirements perspective.

The GIPEG should test and review the GANP portal and provide inputs/ requirements/ recommendations to the ICAO software development team on the following subjects (with emphasis on the performance related parts of the portal):

- a) Underlying data model

Requirements for additional content

Presentation of performance info to portal visitors

Tools to analyse and modify content, i.e. to increase the productivity of the experts involved and to ensure the consistency and quality of the portal contents

Advanced features (ANS-PA) to bring value to States (NCLB)

Task 3: General development of the performance based approach

Task 3A: Maintenance of the GANP performance objective catalogue

This task consists of the further review and maintenance of the performance objective catalogue, including the extension to other KPAs.

At the moment each objective is only characterised by a title. It seems appropriate to include also a more detailed textual description.

Task 3B: Maintenance of the set of GANP indicators

This task consists of the extension of the current set of 19 GANP indicators. Identification of new useful indicators can be based on National/Regional experience, but they should also properly be positioned within the performance objective catalogue (“what is the indicator for?”). So this task needs to be properly coordinated with Task 3A (maintenance of the performance objective catalogue).

GIPEG will consider Task 5 feedback to assess the feasibility and usability of GANP indicators, data aggregation, performance measurements, metrics and interdependencies in different real-world applications.

Related data availability and suitability questions are worked on in a separate task (Task 3C).

Task 3C: Identification of suitable or required data and data sources

For indicators to be useful, the underlying data must be clearly defined and there should be suitable data availability at a reasonable cost and with sufficient quality, timeliness and coverage. Sometimes it will be necessary to use proxies, and/or to examine whether certain data sources are good enough to support a given indicator. The other way around, a given data source/set may support several indicators.

All work directly related to data and data sources is done under this task. This includes identification of suitable/better data (sources) feeding existing GANP indicators, as well the investigation of potential data feeds for future GANP indicators.

Task 3D: Development of data models and influence diagrams

Within a performance context, develop a set of influence diagram whose practical application is: (a) tailorable to various real life air traffic management conditions, (b) tailorable ASBU Elements considered in isolation or relevant groups and in various stages of maturity; and (c) proportional to the benefits to be realized.

Agree on the requirements for harmonised underlying data model for the measurement of operational, economic, environmental and safety performance indicators

This task will serve to identify interdependencies and trade-offs.

Task 3E: Development of a glossary

GIPEG will agree on definitions to certain terms when necessary. These definitions will be collected in the glossary.

Task 4: Global approach to increase the efficiency and effectiveness of performance measurement

Task 4A: Guidance for (software) implementation of indicators

The current GANP indicator tables on the portal provide a good understanding of what the indicators are all about, but they are not sufficient as a technical specification for software developers. More detailed guidance, and/or even ready-made (reusable) software implementations are needed if we want to achieve global harmonisation of indicators, needed for credible benchmarking. Stakeholders’ involvement should be identified as part of this task.

The GANP portal also foresees the use of “variants” for each indicator. Variants are conceptually the same indicator, but they are different at the level of algorithm, parameters or data source used in the computation. As a result the indicator values of different variants should never be directly compared against each other. The whole subject of variants needs to be worked out in more detail.

All efforts on “working out the details” of the GANP indicators will take place under this task.

Task 4B: Global Master Data Management (MDM)

The Global Master Data Management (MDM) task is about developing a globally standardised catalogue of dimensions and dimension lists, including their coding. Dimension (including taxonomy) definitions determine data aggregation and drilldown, and are fundamental to performance analysis.

While certain dimensions are already globally standardised by ICAO documents (e.g. locations via Doc 7910, aircraft operators via Doc 8585 and aircraft types via Doc 8643), many others are not; or Regions, States and organisations have their own standards (e.g. delay codes, ATM workforce job categories, flight models etc.). Other dimensions seem to be not standardised at all (e.g. flight phases, flight phase events). And new dimensions/categorisations are being introduced (e.g. in the domain of drones). And while the 11 ICAO KPAs are standardised, everything at the more detailed level (Focus Areas within the KPAs) is not.

Today, regional benchmarking exercises spend a lot of effort trying to map the participants’ dimension coding to a common definition.

This task will ensure that common dimension definitions are available for all dimensions (potentially) used by the GANP indicators. Initially, these definitions should be used as the common reference to map other coding systems on; over time it is hoped that data sources will take these definitions into account directly at the source where the data is generated.

Task 4C: Management of the end-to-end data processing chain

This task will produce guidance for an efficient setup and management of the end-to-end data processing chain.

Today in the performance analysis world, data production, collection and processing is all too often a tedious, error-prone and non-transparent process. Huge efficiency improvements, and time and cost savings can be achieved by applying current best practices and state-of-the-art tools.

Significant progress should also be made in the area of (automatically) documenting traceability and dependencies between data sources and indicators. Today, traceability from indicator to the original source of the data is often very difficult. We see the same problem with reverse traceability: getting a full picture of all the dependencies downstream from a given data source (what are the consequences if something happens to this data source?)

Task 4D: Development of global standards for the generation, exchange and processing of performance data

Ultimately, the development of global standards for the future generation, exchange and processing of performance data should be reusing techniques methods and processes used in SWIM. This may for example include the definition of a Performance Information Exchange Model (PIXM).

Such development is key to reaching high automation levels in the production and consumption of performance data, as identified in the performance chapter of the GANP 2016. This was targeted for timeframe 2022 and beyond.

Task 4E: Emerging techniques for performance data management and use

Under this task, GIPEG will maintain awareness of ongoing developments in the field of business data analytics, and their potential (or emerging) application in the ATM world. Emerging techniques for performance data management and use may involve big data, artificial intelligence etc.

Task 5: Application of the performance based approach

Task 5A: Regional & international benchmarking

Under this task, GIPEG will facilitate collaboration on regional & international benchmarking. At regional and global levels, this will demonstrate the feasibility and benefits of the proposed performance measurement, allow the establishment of a performance baseline and the sharing of best practices. At a local level, this will serve to identify constraints.

Many of the GIPEG members are already today collaborating on international performance benchmarking projects. This work is beneficial and new collaboration opportunities may result from the fact that participants are working together under the GIPEG umbrella.

Task 5B: Dissemination of regional & international benchmarking results

This task entails the creation and maintenance of an on-line library/directory where the members of the ATM community can find and access regional & international benchmarking results (and possibly some of the associated data). These results should be properly linked to the GANP (indicators, performance objective catalogue etc.).

Task 5C: Use of regional & international benchmarking results

Under this task the GIPEG will develop guidance on how the ATM community can best generate value from the regional & international benchmarking results that are recorded under Task 5B.

This task should consider the definition of a mechanism to report and monitor regional and national application of performance management framework.

Task 6: Impact assessment on ICAO provisions

Under this task, the GIPEG will review existing ICAO documents to identify which parts refer to the PBA so that consistency can be ensured. As a result of GIPEG work, updates will be proposed as required.

Task 7: Promotion & education

Task 7A: Development of training material

All the work done by the GIPEG will need to be globally disseminated. This entails the development of training material. The expertise of the GIPEG members may be called upon to assist in developing or reviewing such material.

Task 7B: Support the dissemination and application of material

GIPEG members will support the dissemination and application of material by supporting, for instance, workshops, seminars or forums.

APPENDIX C

APPROACH FOLLOWED TO DEVELOP THE CONTENT IN THIS DOCUMENT

The GIPEG agreed with the following four-phase approach to develop the content in this document.

- Phase #1: Finalize the inventory of source material and decide how to use it.
- Phase #2: Analyse the source material and extract relevant elements (i.e. Performance ambitions, Focus Areas, Performance Objectives, Data models, Metric definitions, Dimensions and taxonomies, influence diagrams and KPI definitions) and terminology. Then, place them in the Meta-data catalogue.
- Phase #3: Based on the previous work, define the safety performance framework elements and terminology and decide how it all fits together (define all structures). Then, place it in the Meta-data catalogue
- Phase #4: Draft an annex to the HLSC paper on the GANP based on the safety performance framework that was developed.

The GIPEG recognized that it was essential to develop the safety performance framework in collaboration with other safety experts working on performance and to identify the work already done or in progress in safety performance. Therefore, it should be noted that the content in this document is the result of a joint effort of the GIPEG and experts from the Safety Management Panel, the GASP Study Group, the Regional Aviation Safety Groups (RASGs), the ICAO Regional Offices, the Commercial Aviation Safety Team /ICAO Common Taxonomy Team (CICTT), the European Union Aviation Safety Agency (EASA),

As a result of phase 1, the GIPEG identified the following source material:

- Global level
 - The Sixth Edition of the Global Air Navigation Plan (GANP)
 - The Global Aviation Safety Plan (GASP) 2020-2022
 - The ICAO Safety Report 2019
 - The ICAO Safety Indicators Catalogue
 - The CICTT (CAST/ICAO Common Taxonomy Team)
 - The ICAO Accident/Incident Data Reporting (ADREP) system
 - The ICAO Safety Information Monitoring System (SIMS)
 - The ICAO integrated Safety Trend Analysis and Reporting System (iSTARS)
- Regional level
 - The Asia-Pacific Air Traffic Management Performance Measurement Framework Document
 - The EUR Regional Aviation Safety Plan (RASP) 2020-2024 (currently under development)
 - The EUR Regional Expert Safety Team (IE-REST)
 - The EUR Region Performance Framework Document (EUR Doc 030)
 - EUR Safety Performance Indicators (EUR SPI)
 - The MID Region Safety Strategy
 - The SAM Safety Report

- The SAM Region safety plan (SAMSP)
- Sub-regional level
 - The Single European Sky (SES) II Performance Framework

As part of phase 2, the GIPEG reviewed the material listed above and extracted: performance ambitions, focus areas, performance objectives, data models, metric definitions, dimensions and taxonomies, influence diagrams and KPI definitions. The results of this analysis can be found at XXXXX.

Then the GIPEG analysed this input following the instructions hereafter:

- Performance Ambitions

The safety performance ambition (aspirational) is already defined in the strategic level of the GANP. However, consistency with other high level policy statements needs to be discussed – e.g. ICAO aspirational safety goal “zero fatalities by 2030 and beyond” – and in case of inconsistency, a way forward should be proposed.

- Focus Areas

Focus Areas are subdivisions of a KPA. They are a tool for defining broad scopes within a KPA. They can have a hierarchical structure. At a later stage, some of the Focus Areas will be populated with performance objectives. Others will just stay empty.

So far, no focus areas have been defined in the safety KPA. Once the safety performance framework grows in size, it will be useful to group related material in Focus Areas. One approach could be to define three top-level

Focus Areas:

- a) Operational safety
 - a. Accidents
 - b. Safety risks (e.g. incidents, precursors...)
- b) Organizational safety
 - a. Safety management (characterizing the maturity, effectiveness etc. of the processes that we have defined to manage safety)
 - b. Safety oversight (e.g. how many States have implemented xyz)

Whether we need deeper levels (sub focus areas) will need to be discussed as we progress the work.

- Performance Objectives

At the moment, a basic safety objective subtree is already existing on the GANP portal. It was created prior to the Assembly to document the safety benefits of the ASBU Elements. This safety subtree only includes operational safety outcome. Note that as a minimum, a performance objective subtree should cover all ASBU Element safety benefits, and all chosen safety indicators. In addition, for the sake of completeness, it may contain objectives not linked

to any ASBU Element or to any KPI. In that way the development/refinement of the objective catalogue precedes and leads the definition of new ASBU Elements and KPIs.

- Data models

Object types, their relationships and events relevant to safety will need to be documented/defined. Object types may be defined which are collections (populations) of other object types. Together all of this forms what we call a “data model”. This is the general framework to which the metrics will be attached (metrics do not stand on their own; they are data attributes of objects, relationships and events). This framework defines the basic vocabulary of the “things” for which we measure safety performance. It will for example define item types such as States, airspaces (e.g. FIRs), airports, runways, flights, ANSPs, aircraft, accidents, incidents, etc. Once we start measuring performance in the real world, we measure “instantiated” copies of object types (i.e. we work with lists of each object type).

- Metric definitions

As mentioned above, this is the list of data attributes of the objects for which we measure safety. The objective is not to be “complete”; we only define what we need for the safety performance framework.

Metrics include the so-called “influencing factors”.

The metric catalogue includes the definition of the measurement units used in the metrics. Metrics can be counts (dimensionless numbers, e.g. number of flights, number of accidents, number of fatalities) or physical quantities (e.g. time, distance, and mass). Metrics are always defined in absolute values, never in percentages.

Proposal to first focus on the metrics (quantities that are measured), and not first on the KPIs (quantities that are computed from metrics). The alternative (actually one approach does not exclude the other) is to work bottom-up, and extract the metrics (and measured object types) from existing KPIs.

- Dimensions and taxonomies

Collect and define dimensions and taxonomies relevant for the safety performance framework. For example accident/incident types, severity levels etc. Where possible we should use existing (ICAO) material. Dimensions and taxonomies are relevant for filtering and aggregation/drilldown of performance data.

- Influence diagrams

Document the cause-effect relationships between the identified metrics and indicators. This shows how ‘leading’ metrics (influencing factors) propagate to performance outcome metrics (‘lagging’ metrics) – as well as vice-versa (showing what are the different drivers for a given outcome).

Influence diagrams are an important visualization and education tool for streamlining the discussion about how performance is “manufactured”. In the absence of influence diagrams

people often discuss endlessly about who is right and who is wrong (and maybe both are right, which can be shown with the diagram). An important benefit from these diagrams is that they clearly analyse and show the distinction between direct and indirect effects.

- KPI definitions

KPIs are computed from metrics. In the simplest case this is a ratio between two quantities (e.g. representing an average value, such as total distance flown divided by the total number of flights). A more sophisticated case is the combination of many individual metrics into an overall score (with weighting factors). Other applications are growth rates (e.g. change against previous value or against same period last year), year-to-date values, comparison against a reference value (e.g. for a baseline year) etc. In addition indicator calculations may exclude a certain portion of the measurements (e.g. outliers, percentiles, subcategories...).

The main difference between a metric and an indicator (or KPI) is that a metric should always be related to some ‘physical’ reality, whereas an indicator is a mathematical or statistical construct.

When choosing a KPI definition (formula, algorithm), care has to be taken to ensure that it properly reflects what the qualitative performance objective (or ambition) is trying to achieve. For example is the agreed objective to reduce the absolute number of accidents, the number of accidents per 100,000 flights or the number of accidents per 100,000 flight hours? Depending on the formulation of the objective, one may need to define a different indicator.

The work can be done top-down (derive KPIs from objectives), or bottom-up: give existing KPIs a place in the catalogue and reverse-engineer what the corresponding qualitative objective is. In any case it is important to match all KPIs to performance objectives (no KPI should be allowed to exist without a corresponding performance objective). This answers the question “what is the KPI good for”. Identify variants

Based on this analysis, the GIPEG then structured the material and defined the safety performance framework proposed in this document.

Finally, the GIPEG drafted this document during GIPEG/2 which took place virtually through a series of teleconferences.