International Civil Aviation Organization
South American Regional Office
Twelfth Multilateral Meeting of the SAM Region for the Transition from AIS to AIM (SAM/AIM/12)
Lima, Peru, 3 to 7 June 2019

Agenda Item 4: Analysis of objectives, metrics and dates for the implementation of elements of the second phase of the AIS-to-AIM transition plan: Digital

Global Air Navigation Plan – Sixth Edition AIM-Related Aspects

(Presented by the Secretariat)

SUMMARY

This paper presents the implications of the Sixth Edition of the Global Air Navigation Plan for AIM, and reminds of the need to draft a National Plan for the Transition from AIS to AIM that leads to automation.

REFERENCES

- Annex 15 to the Convention on International Civil Aviation
- Doc 9750 - Global Air Navigation Plan
- Roadmap for the Transition from AIS to AIM

***ICAO strategic objectives*:**	*A - Safety* *B – Air navigation capacity and efficiency* *E – Environmental protection*

1. Background

1.1 A plan for the implementation of the second phase of the AIS-to-AIM roadmap was presented at the SAM/AIM/8 meeting.

1.2 The Global Air Navigation Plan, in its fourth edition, introduced the ASBU methodology, which was ratified in the fifth edition.

1.3 The Global Air Navigation Plan is under constant review. The sixth edition of the aforementioned document was restructured in terms of its content and approach.

2. Discussion

2.1 The second phase of the Roadmap for the transition from AIS to AIM should start once Phase 1 has been completed. The second phase includes the implementation of Steps 1, 2, 6, 7, 11, 13, 14 and 15 of the Roadmap.

2.2 Under the ASBU methodology, specifically PIA 2, the Global Air Navigation Plan (Doc 9750) includes module B0-DATM in Block 0, and extends into Block 1 as B1-DATM.

2.3 The Meeting should recall that the GANP is an important planning tool for the establishment of global priorities to foster the evolution of the global air navigation system and ensure that the vision of an integrated, harmonised, globally interoperable and seamless system becomes a reality. The GANP was developed in collaboration with, and for the benefit of, all stakeholders. It is a key contributing factor for the achievement of ICAO strategic objectives and plays an important role in support of the United Nations SDGs.

2.4 ICAO is working on the sixth edition of the GANP. This edition will be organised in four levels, two strategic layers, and two technical levels. This will allow a better communication with top technical managers and allows stakeholders to access and use detailed information that is most relevant for their area of interest. The strategic level, the highest level of the GANP, is geared to policy makers and executives, while the target audience of the subsidiary levels of the GANP are the subject matter experts.

2.5 Unlike previous versions, where the technical level only included the ASBU framework, the sixth edition includes two technical frameworks, the basic building blocks (BBBs), and the updates of the aviation system block upgrades (ASBU), accompanied by their associated performance framework, which includes performance objectives and performance key indicators (KPIs). The BBB framework describes the fundamentals of a robust air navigation system. It may also be considered as the State commitment under the Convention on International Civil Aviation (Doc 7300) to provide essential air navigation services for the conduction of safe and orderly international civil aviation operations.

2.6 Regarding AIM, **Appendix A** shows the BBB framework for AIM. The BBB is considered as an independent framework rather than an ASBU framework block, since it represents a baseline rather than an evolutionary step. This baseline is defined by the essential services recognised by ICAO member States as required for international civil aviation to develop in a safe and orderly manner. Once these essential services are provided, the benchmark for any operational improvement is established. The BBB framework will be updated every two years, taking into account the amendments to ICAO provisions. Although an initial draft of the BBB framework is shown on line in the GANP portal (https://www4.icao.int/ganpportal/BBB), BBBs will be included in a web-based application in a format similar to the ASBU framework.

2.7 The sixth edition of the GANP includes the catalogue of performance objectives and the catalogue of performance key indicators (KPIs). The aforementioned catalogues are posted on the aforementioned portal, but are also included as Appendix B and C to this working paper (available only in English).

2.8 Appendix D contains a survey on how AIM can contribute to the achievement of performance objectives and KPIs.

National plan for the migration from AIS to AIM

2.9 The National Plan for the Transition from AIS to AIM should contain a description of the strategy to be implemented for the migration to an electronic environment. It will be very important to manage the database, the communication infrastructure, and the networks to support data transmission, as well as the electronic aeronautical information management software or packages to be purchased or developed by the State.

2.10 The GANP can help with the drafting of this national plan, since the GANP deals with opportunities. The proper way of using the GANP is by applying a performance-based approach. A performance-based approach is driven by results and helps decision makers to establish priorities and to assume the proper commitment to support an optimum allocation of resources while maintaining an acceptable level of safety performance, and promoting transparency and accountability among stakeholders.

2.11 The first step for drafting the National Plan for AIS-to-AIM is to see BBB implementation as a baseline, and then, to plan improvements.

3. Suggested action

3.1 The Meeting is invited to:

a) establish working groups to study the contribution of AIM to performance objectives and GANP KPIs;

b) review this working paper and provide information on the services implemented within the BBB framework;

c) promote workshops on GANP AIS/AIM aspects in the States; and

d) review any other action it may deem appropriate.

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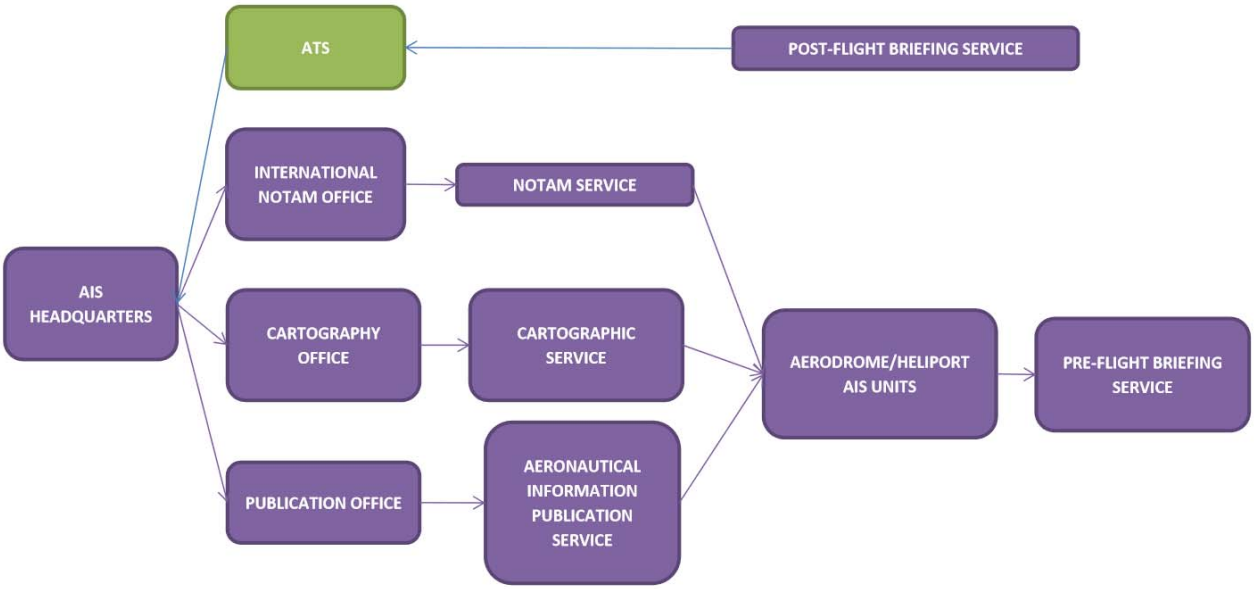
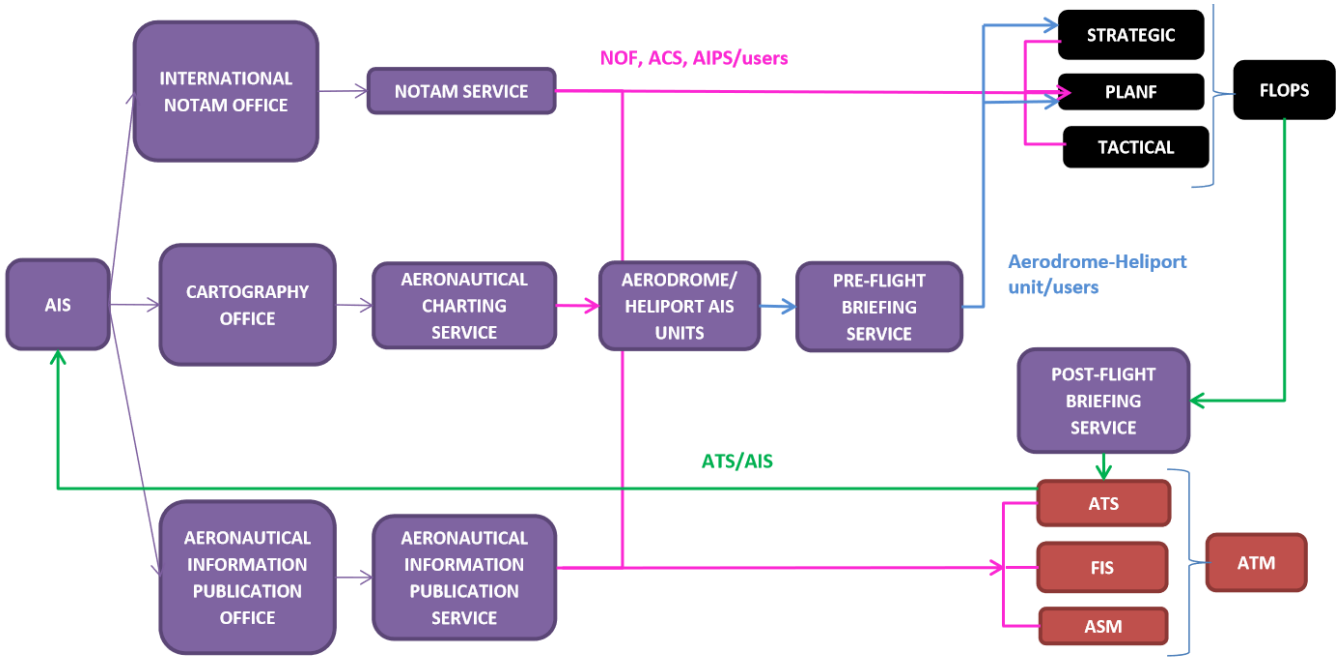
Appendix A

Frame of Reference of the Basic Constituent Elements (BBBs) for aeronautical information services / Aeronautical information management

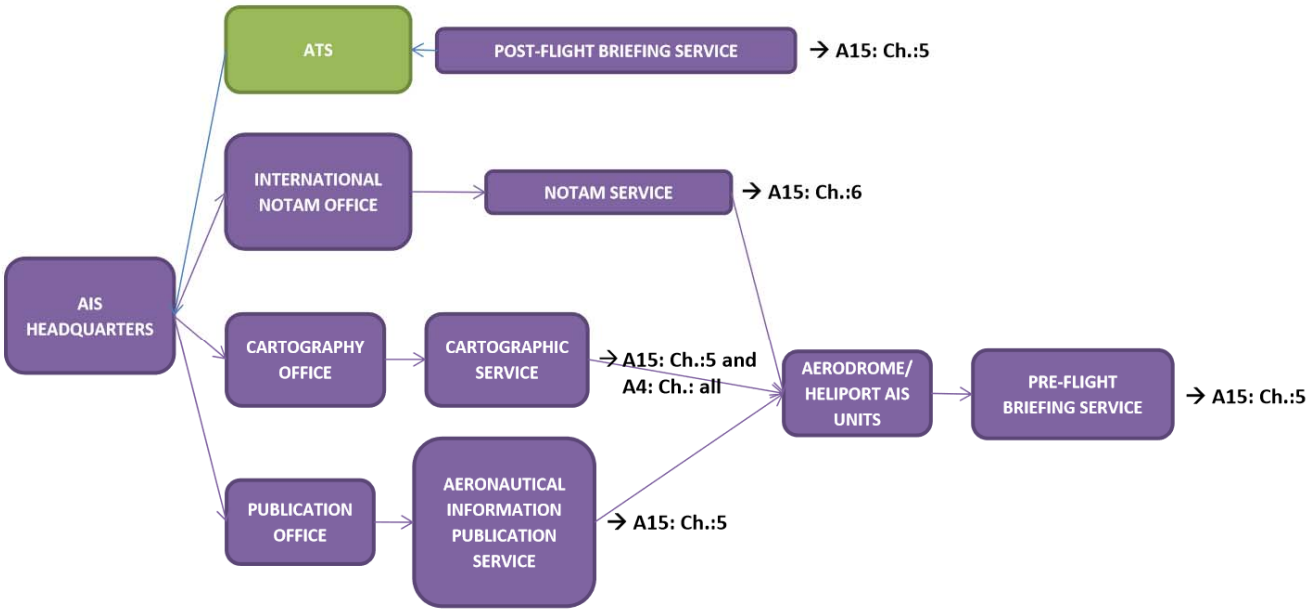
Módules and basic elements of AIS/AIM



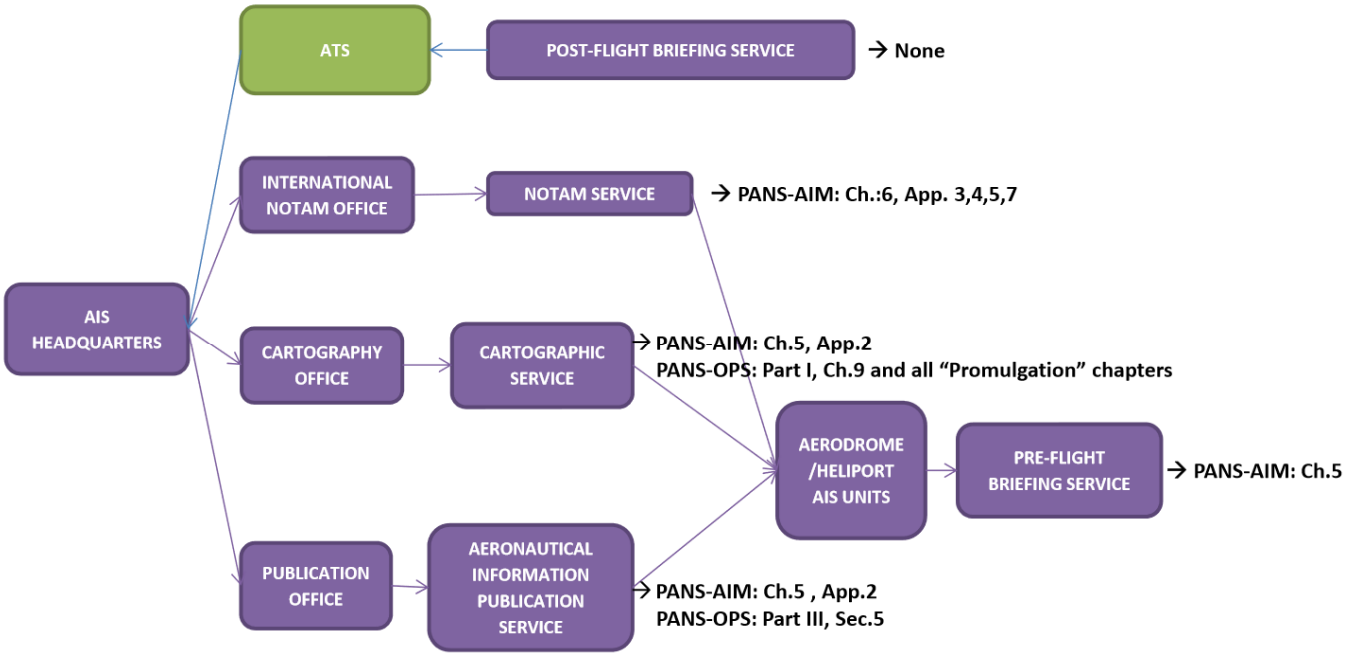
Support and final users of the aeronautical information services / Aeronautical Information Management



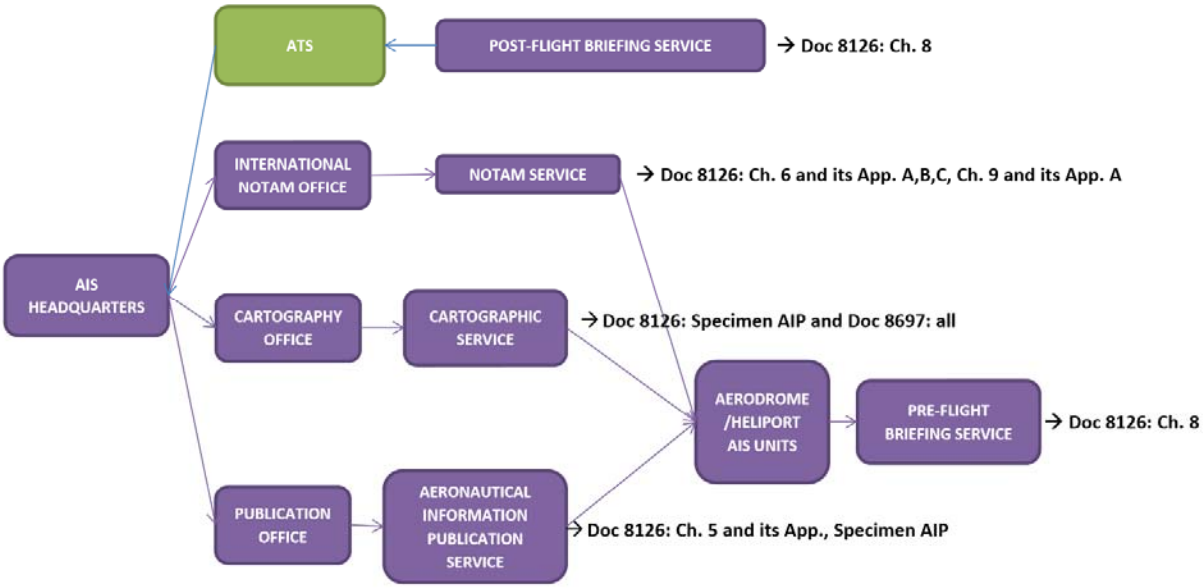
Basic elements of aeronautical information services / Reference of ICAO SARPs



Basic elements of aeronautical information services / Reference of PANS AIM documents



Basic elements of aeronautical information services / Reference documents and ICAO Guidelines



Reference Documents

- Annex 15: Aeronautical information services
- Annex 4: Aeronautical Charts
- PANS-AIM (Doc 10066): Aeronautical Information Management
- PANS-OPS (Doc 8168): Aircraft operations
- Doc 8126: Manual of the Aeronautical Information Service

APÉNDICE B

ICAO GANP PORTAL

ASBU ELEMENTS

DAIM

Functional Description | Enablers | Deployment Applicability | Performance Impact Assessment

DAIM

DAIM-B1/1	Provision of quality-assured aeronautical data and information
Main Purpose	The main purpose of this element is to ensure that aeronautical data and information comply with quality standards in order to meet the needs of airspace users and support the safety of flight operations.
New Capabilities	Provision of high quality aeronautical data and information; consistent interpretation and timely exchange of aeronautical data and information; and, automatic management, processing, verification, usage and exchange of aeronautical data and information.
Description	This element ensures that processes, procedures and systems are improved to allow for an enhanced quality of aeronautical information products and services. This element includes: 1. Implementation of quality management systems to ensure that aeronautical data and information comply with the required standards. 2. Use of common reference systems (spatial – WGS84 and temporal- AIRAC) to facilitate consistent interpretation of aeronautical data and information and facilitate their timely exchange. 3. Full move into an automated data-centric environment so that the management, processing, verification, usage and exchange can be done in a structured, automatic manner and human intervention is reduced. 4. Aeronautical data and information is of high quality if it is aggregated and provided by authoritative sources. This requires to properly control relationships along the whole data chain from the origination to the distribution to the next intended user (formal arrangements with data originators, neighbouring States, data and information service providers and others).
Maturity Level	Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **Yes**
2. Does it imply processing of new information by the user? **No**
3. Does it imply the use of new equipment? **Yes**
4. Does it imply a change to levels of automation? **Yes**

PLANNING LAYERS

Strategical | Pre-tactical

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Procedures for the provision of aeronautical information services in an AIM environment	ANSPs should define in an AIM Manual of operations the procedures to be followed for the provision of quality assured aeronautical information. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management ICAO Doc 8126 - Aeronautical Information Services	ANSP	2018
Operational procedures	Quality	Procedures for the application of a quality management system to the AIM processes.	ANSPs should define in a Quality Manual the procedures to be followed to apply a quality management system to the AIM processes. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 9839 - Manual on the Quality Management System for Aeronautical Information Services	ANSP	2018
Ground system infrastructure	Information exchange	Automated aeronautical information management systems and infrastructure.	Automated systems and infrastructure to support the collection, processing, distribution and quality control of the aeronautical information products and services.	ANSP	2018

Training	-	Training requirements for the provision of quality-assured aeronautical data and information	Training for AIS/AIM personnel	ANSP	2018
Regulatory provisions	National regulatory framework	National framework for the provision of quality assured aeronautical data and information	Development of State Regulatory framework to support the provision of quality-assured aeronautical data and information. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management	CAA	2018
Regulatory provisions	Formal arrangements	Formal arrangements for data quality assurance	Formal arrangements between ANSP and the aeronautical data originators to ensure data quality. Reference ICAO documents: Aeronautical Data Catalogue (PANS – Aeronautical Information Management, Appendix 1)	ANSP CAA	2018

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

DAIM-B1/2	Provision of digital Aeronautical Information Publication (AIP) data sets
Main Purpose	To make available digital AIP data and information in an interoperable manner and mutually-understood manner.
New Capabilities	Provision of digital AIP data sets. This will facilitate the exchange of aeronautical information that becomes easy to be integrated and filtered, thus increasing cost effectiveness and efficiency.

Description The need for interoperable exchange of AIP data and information requires providing them in digital form and complying with digital data exchange requirements. This element consists in the replacement of existing sections of the AIP by digital AIP data sets. Therefore, this element supports the migration to a data-centric environment where aeronautical data and information (AIP) will be provided in a structured and digital form through the use of information exchange models (e.g. AIXM).

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **Yes**
2. Does it imply processing of new information by the user? **No**
3. Does it imply the use of new equipment? **Yes**
4. Does it imply a change to levels of automation? **Yes**

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Procedures for the provision of digital AIP data set	Updated AIM Manual of operations to include information about the provisions of digital AIP data sets. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS - Aeronautical Information Management Doc 8126 - Aeronautical Information Services	ANSP	2018
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018

Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of digital AIP data sets using AIXM	Automated systems and infrastructure to support the processing and distribution of the digital Aeronautical Information Publication (AIP) data sets.	ANSP	2018
Ground system infrastructure	Information exchange	Airspace user systems to be updated to leverage the benefits of digital AIP data sets using AIXM.	Automated systems and infrastructure for the users to make use of the digital Aeronautical Information Publication (AIP) data sets.	Airspace user	2018
Training	-	Training requirements for the provision of digital AIP data sets	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2018
Regulatory provisions	National regulatory framework	National framework for the provision of digital Aeronautical Information Publication (AIP) data sets	Development of State Regulatory framework to support the provision of digital Aeronautical Information Publication (AIP) data sets Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2018

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

Main Purpose To make available digital terrain data and information in an interoperable manner and mutually-understood manner.

New Capabilities Provision of terrain data as digital data sets. This will facilitate the exchange of terrain data that becomes easy to integrate and easily filtered, thus increasing cost effectiveness and efficiency.

Description The need for interoperable exchange of terrain data requires providing the data in digital form and complying with digital data exchange requirements. This element consists in the replacement of existing terrain data by digital terrain data sets. Therefore, this element supports the migration to a data-centric environment where terrain data will be provided in a digital form and in a structured way.

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **Yes**
2. Does it imply processing of new information by the user? **No**
3. Does it imply the use of new equipment? **Yes**
4. Does it imply a change to levels of automation? **Yes**

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Procedures for the provision of digital terrain data set	Updated AIM Manual of operations to include information about the provisions of digital terrain data sets. ICAO reference documents : Annex 15 - Aeronautical Information Services PANS- Aeronautical Information Management Doc 8126 - Aeronautical Information Services	ANSP	2018

Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of digital terrain data sets using AIXM	Automated systems and infrastructure to support the processing and distribution of the digital terrain data sets.	ANSP	2018
Ground system infrastructure	Information exchange	Airspace user systems to be updated to leverage the benefits of digital terrain data sets using AIXM.	Automated systems and infrastructure for the users to make use of the digital terrain data sets.	Airspace user	2018
Training	-	Training requirements for the provision of digital terrain data sets	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2018
Regulatory provisions	National regulatory framework	National framework for the provision of digital terrain data sets	Development of State Regulatory framework to support the provision of digital terrain data sets Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2018

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

DAIM-B1/4 Provision of digital obstacle data sets

Main Purpose To make available digital obstacle data in an interoperable and mutually-understood manner.

New Capabilities Provision of obstacle data as digital data sets. This will facilitate the exchange of obstacle data that becomes easy to integrate and easily filtered, thus increasing cost effectiveness and efficiency.

Description The need for interoperable exchange of obstacle data requires providing the data in digital form and complying with digital data exchange requirements. This element consists in the replacement of existing obstacle data by digital obstacle data sets. Therefore, this element supports the migration to a data centric environment where obstacle data will be provided in a structured and digital form through the use through the use of information exchange models (e.g. AIXM).

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **Yes**
2. Does it imply processing of new information by the user? **No**
3. Does it imply the use of new equipment? **Yes**
4. Does it imply a change to levels of automation? **Yes**

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018

Operational procedures	Information exchange	Procedures for the provision of digital obstacle data set	Updated AIM Manual of operations to include information about the provisions of digital obstacle data sets. Reference ICAO document: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	ANSP	2018
Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of digital obstacle data sets using AIXM	Automated systems and infrastructure to support the processing and distribution of the digital obstacle data sets.	ANSP	2018
Ground system infrastructure	Information exchange	Airspace user systems to be updated to leverage the benefits of digital obstacle data sets using AIXM.	Automated systems and infrastructure for the users to make use of the digital obstacle data sets.	Airspace user	2018
Training	-	Training requirements for the provision of digital obstacle data sets	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2018
Regulatory provisions	National regulatory framework	National framework for the provision of digital obstacle data sets	Development of State Regulatory framework to support the provision of digital obstacles data sets Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2018

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

DAIM-B1/5 Provision of digital aerodrome mapping data sets

Main Purpose To make available digital aerodrome mapping data and information in an interoperable and mutually-understood manner.

New Capabilities Provision of aerodrome mapping data as digital data sets. This will facilitate the exchange of aerodrome mapping data that becomes easy to integrate and easily filtered, thus increasing cost effectiveness and efficiency.

Description The need for interoperable exchange of aerodrome mapping data requires providing the data in digital form and complying with digital data exchange requirements. This element consists in the replacement of existing aerodrome mapping data by digital aerodrome mapping data sets. Therefore, this element supports the migration to a data centric environment where aerodrome mapping data will be provided in a structured and digital form through the use through the use of information exchange models (e.g. AIXM).

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **Yes**
2. Does it imply processing of new information by the user? **No**
3. Does it imply the use of new equipment? **Yes**
4. Does it imply a change to levels of automation? **Yes**

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018
Operational procedures	Information exchange	Procedures for the provision of digital aerodrome mapping data set	Updated AIM Manual of operations to include information about the provisions of digital aerodrome mapping data sets. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	ANSP	2018
Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of digital aerodrome mapping data sets using AIXM	Automated systems and infrastructure to support the processing and distribution of the digital aerodrome mapping data sets.	ANSP	2018
Ground system infrastructure	Information exchange	Airspace user systems to be updated to leverage the benefits of digital aerodrome mapping data sets using AIXM.	Automated systems and infrastructure for the users to make use of the digital aerodrome mapping data sets.	Airspace user	2018
Training	-	Training requirements for the provision of digital aerodrome mapping data sets	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2018

Regulatory provisions	National regulatory framework	National framework for the provision of digital aerodrome mapping data sets	Development of State Regulatory framework to support the provision of digital aerodrome mapping data sets Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2019

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

DAIM-B1/6 Provision of digital instrument flight procedure data sets

Main Purpose

To make available digital instrument flight procedure data in an interoperable and mutually-understood manner.

New Capabilities

Provision of instrument flight procedure data as digital data sets; and, compliance with the navigation specifications, consistency in design, coding and operation of performance-based navigation (PBN) procedures to avoid differences in the aircraft behaviour in response to the coded path terminators by the use specific criteria for coding instrument flight procedures. This will facilitate the exchange of instrument flight procedure data that becomes easy to integrate and easily filtered, thus increasing cost effectiveness and efficiency.

Description

The need for interoperable exchange of instrument flight procedure data requires providing the data in digital form and complying with digital data exchange requirements. This element consists in the replacement of existing instrument flight procedure data by digital instrument flight procedure data sets. In addition, it includes consistent coding of procedures to match the procedure design intent and ensure more repeatable flight paths. Applying new rules for coding Instrument flight procedures will limit the number of allowable path terminators for PBN procedures in compliance with the PBN Navigation Specifications. Therefore, this element supports the migration to a data centric environment where instrument flight procedure data will be provided in a structured and digital form through the use of information exchange models (e.g. AIXM).

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **Yes**
2. Does it imply processing of new information by the user? **No**
3. Does it imply the use of new equipment? **Yes**
4. Does it imply a change to levels of automation? **Yes**

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Departure | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018
Operational procedures	Information exchange	Procedures for the provision of digital instrument flight procedures data set	Updated AIM Manual of operations to include information about the provisions of digital instrument flight procedure data sets. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	ANSP	2018

Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of digital instrument flight procedures data sets using AIXM	Automated systems and infrastructure to support the processing and distribution of the digital instrument flight procedures data sets.	ANSP	2018
Ground system infrastructure	Information exchange	Airspace user systems to be updated to leverage the benefits of digital instrument flight procedure data sets using AIXM.	Automated systems and infrastructure for the users to make use of the digital instrument flight procedures data sets.	Airspace user	2018
Training	-	Training requirements for the provision of digital instrument flight procedure data sets	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2018
Regulatory provisions	National regulatory framework	National framework for the provision of digital instrument flight procedures sets	Development of State Regulatory framework to support the provision of digital instrument flight procedures data sets Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2018

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

DAIM-B1/7 NOTAM improvements

Main Purpose To provide timely and relevant information about status and condition of the ANS infrastructure to the next intended users via NOTAM.

New Capabilities Identification of clear operational conditions to determine when a NOTAM shall or shall not be originated, thus ensuring that the information provided meets the needs of the users; provision of digital NOTAMs to enhance the quality of the information provided and allow the graphical representation and better filtering of information to assist operators in retrieving the relevant information.

Description In order to meet the operational needs of the users, it is essential to provide information that is timely and fit for purpose. This can be done by refining the criteria to ensure that the users receive the right information. This element consists in the identification of clear operational conditions under which a NOTAM shall or shall not be originated and replacement of paper NOTAMs by a digital version through the use of information exchange models (e.g. AIXM).

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **Yes**
2. Does it imply processing of new information by the user? **No**
3. Does it imply the use of new equipment? **Yes**
4. Does it imply a change to levels of automation? **Yes**

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information
Relation-information need	DAIM-B1/2 - Provision of digital Aeronautical Information Publication (AIP) data sets
Relation-information need	DAIM-B1/4 - Provision of digital obstacle data sets
Relation-information need	DAIM-B1/5 - Provision of digital aerodrome mapping data sets
Relation-information need	DAIM-B1/6 - Provision of digital instrument flight procedure data sets

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018
Operational procedures	Information exchange	Procedures for the provision of an enhanced NOTAM service	Updated AIM Manual of Operations to include information about the provisions of NOTAM. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	ANSP	2019
Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of NOTAM using AIXM.	Automated systems and infrastructure to support the processing and distribution of NOTAM	ANSP	2019
Ground system infrastructure	Information exchange	Airspace user systems need to be updated to leverage the benefits of digital NOTAM using AIXM.	Automated systems and infrastructure for the users to make use of NOTAM	Airspace user	2019
Training	-	Training requirements for the provision of enhanced NOTAM	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2019
Regulatory provisions	National regulatory framework	National framework for the provision of NOTAM	Development of State Regulatory framework to support the provision of NOTAM Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2018

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

DAIM-B2/1	Dissemination of aeronautical information in a SWIM environment
Main Purpose	Integrated aeronautical information service in a SWIM environment in support of enhanced operational ground and air decision-making processes for all phases of flight.
New Capabilities	Implementation of a data-centric AIM, integrated into the System Wide Information Management (SWIM) environment; user-defined products derived from aeronautical information in a standardized Information Exchange Model (e.g. AIXM) that can be provided alone or integrated with other information domains (e.g. Meteorological or FF-ICE information); wider use of secure web services and starts the decommissioning of current distribution mechanism; commencement of the use of business-to-business services that allows integration of aeronautical information into ATM systems.
Description	This element represents the full integration of aeronautical information into the SWIM environment. The use of AIM SWIM services will allow the user to access relevant and mutually understood aeronautical information in an interoperable manner. This will include the ability not only to communicate and exchange aeronautical information but also to interpret it in a meaningful manner. AIM-SWIM information services will support request/reply or publish/subscribe access mechanisms and will provide quality & timely information to users in a range of formats to best enable their optimal decision making. AIM-SWIM information services will also include web-services supporting the graphical representation of aeronautical information in a geo-referenced environment.

Maturity Level Validation

Human Factor Considerations

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	DAIM-B1/2 - Provision of digital Aeronautical Information Publication (AIP) data sets
Evolution	DAIM-B1/3 - Provision of digital terrain data sets
Evolution	DAIM-B1/4 - Provision of digital obstacle data sets
Evolution	DAIM-B1/5 - Provision of digital aerodrome mapping data sets
Evolution	DAIM-B1/6 - Provision of digital instrument flight procedure data sets
Relation-information need	DAIM-B2/3 - Aeronautical information to support higher airspace operations
Relation-information need	DAIM-B2/4 - Aeronautical information requirements tailored to UTM
Relation-operational need	SWIM-B2/1 - Information service provision
Relation-operational need	SWIM-B2/2 - Information service consumption
Relation-operational need	SWIM-B2/3 - SWIM registry
Relation-operational need	DAIM-B2/2 - Daily Airspace Management information to support flight and flow

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018

Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of aeronautical information over SWIM	Automated systems and infrastructure for the dissemination of aeronautical information in a SWIM environment.	ANSP	2025
Ground system infrastructure	Information exchange	Airspace user systems to be updated to subscribe or access the aeronautical information services over SWIM	Automated systems and infrastructure for the users to subscribe or access the aeronautical information in a SWIM environment.	Airspace user	2025
Training	-	Training requirements for the provision of aeronautical information over SWIM	Training for AIS/AIM personnel	ANSP	2025
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.x	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2025

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

DAIM-B2/2	Daily Airspace Management information to support flight and flow

Main Purpose To establish common practices and data formats for daily airspace management initiatives continuously updated as events take place for flight and flow planning and execution.

New Capabilities Daily Airspace Management operational changes are packaged and made accessible for use in all local and regional flight and flow operations.

Description Airspace Management, in daily operations, will continuously adjust airspace status, adjust airspace volumes (e.g. advanced flexible use of airspace) and add temporary airspace initiatives. This element mirrors the modernization efforts ongoing for scheduled AIP modifications with global best practices for packaging and making this information available for dissemination to improve local and regional flight planning in keeping with the flight and flow initiatives engendered in Block 2 FICE and NOPS. This best practice DAIM service enable by SWIM will ensure that information regarding status airspace configurations (Fixes, FIR Boundaries, static zones etc...) and information regarding airspace evolution (reroutings, sector configurations, airspace use plan and updated airspace use plan, airspace reservations, route restrictions and availability, dynamic zones etc.) will be available in formats that support NOPS and FICE automation.

Maturity Level Validation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **Yes**
2. Does it imply processing of new information by the user? **Yes**
3. Does it imply the use of new equipment? **No**
4. Does it imply a change to levels of automation? **Yes**

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B2/1 - Dissemination of aeronautical information in a SWIM environment
Relation-information need	FRTO-B0/1 - Direct routing (DCT)
Relation-information need	FRTO-B0/2 - Airspace planning and Flexible Use of Airspace (FUA)
Relation-information need	FRTO-B0/3 - Pre-validated and coordinated ATS routes to support flight and flow
Relation-information need	FRTO-B1/1 - Free Route Airspace (FRA)
Relation-information need	FRTO-B1/2 - Required Navigation Performance (RNP) routes

Relation-information need	FRTO-B1/3 - Advanced Flexible Use of Airspace (FUA) and management of real time airspace data
Relation-information need	FRTO-B1/4 - Dynamic sectorization
Relation-information need	FRTO-B2/1 - Local components of integrated ATFM and ATC Planning function (INAP)
Relation-information need	FRTO-B2/2 - Local components of Dynamic Airspace Configurations (DAC)
Relation-information need	FRTO-B2/3 - Large Scale Cross Border Free Route Airspace (FRA)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Operational procedures for aeronautical information requirements to support network operations	New procedures will be required to produce and distribute the new aeronautical information in support of network operations. Updated AIM Manual of operations to address the requirements for aeronautical information to support network operations. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS-Aeronautical Information Management Doc 8126 - Aeronautical Information Services	ATM network function	2025
Ground system infrastructure	Information exchange	Automated systems and infrastructure to include aeronautical information requirements to support network operations	Update to the national aeronautical data management system, including systems supporting data collection, verification and distribution. For instance, automated functions should be introduced to generate the airspace usage plan information service.	ATM network function	2025
Training	-	Training requirements for aeronautical information requirements regarding network operations	For personnel managing the ATM information and for their users if the interfaces and access conditions change.	ATM network function	2025

Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.x	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2025

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

DAIM-B2/3 Aeronautical information to support higher airspace operations

Main Purpose To provide higher airspace management information in an airspace service that is complementary to standard AIS.

New Capabilities Higher airspace definitions and status are packaged and made accessible to operators flying in the airspace.

Description Long endurance and near space tourism operators' space crafts are subject to all applicable AIS. In addition, there may be a need to manage operations in the airspace by changing the status of volumes of airspace solely related to these operators. Since this information is applicable only to these operators, there is limited value in including this as information in ATM airspace management. A complementary, separate service is desired.

Maturity Level Validation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **No**
2. Does it imply processing of new information by the user? **Yes**
3. Does it imply the use of new equipment? **No**
4. Does it imply a change to levels of automation? **No**

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/2 - Provision of digital Aeronautical Information Publication (AIP) data sets

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Operational procedures to support higher airspace operations	Rules to describe higher airspace information. Updated AIM Manual of operations to include information about the requirements for aeronautical information in higher airspace. Standards and guidance material: ICAO Annex 15 - Aeronautical Information Services PANS-AIM ICAO Doc 7383 - Aeronautical Information Services Provided by States	ANSP	2025
Ground system infrastructure	Information exchange	Automated systems and infrastructure to include aeronautical information requirements to support higher airspace operations	Update to the national aeronautical data management system, including data collection, verification and distribution.	ANSP ATM network function	2025
Training	-	Training requirements for aeronautical information requirements regarding higher airspace operations.	Training for AIS/AIM personnel	ANSP	2025

Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.x	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2025

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

DAIM-B2/4 Aeronautical information requirements tailored to UTM

Main Purpose To provide low altitude airspace management information in a UAS Traffic Management (UTM) service that is complementary to standard AIS.

New Capabilities UTM airspace definitions and status are packaged and made accessible to UAS operators flying in UTM.

Description UAS flying in UTM are subject to all applicable AIS.

In addition, UTM will manage UAS in the airspace by changing the status of volumes of airspace solely related to UAS operations. For example, the publishing of maps where UAS may operate near airports in class B, or locations where state operations are occurring for which UAS need to stay clear.

Given the manner in which UAS operations occur it is likely that the operator must be in continuous contact with the network to access this information.

Since the volume of such airspace management information would overwhelm ATM airspace management, a complementary, separate service is desired.

Maturity Level Validation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **No**
2. Does it imply processing of new information by the user? **Yes**
3. Does it imply the use of new equipment? **No**
4. Does it imply a change to levels of automation? **No**

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/2 - Provision of digital Aeronautical Information Publication (AIP) data sets

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Operational procedures for aeronautical information requirements to support UTM	New procedures will be required to produce and distribute the AIP data for UTM users. Updated AIM Manual of operations to address the requirements for aeronautical information in low-altitude. Standards and guidance material: ICAO Annex 15 - Aeronautical Information Services PANS-AIM ICAO Doc 7383 - Aeronautical Information Services Provided by States	ANSP	2025
Ground system infrastructure	Information exchange	Automated systems and infrastructure to include aeronautical information requirements to support UTM	Automated systems and infrastructure to include aeronautical information requirements to support provision of digital AIM data for UTM users.	ANSP	2025
Airborne system capability	Information exchange	UAS logic to make use of the AIM information	Automated systems and infrastructure for UAS to make use of the AIM information.	Airspace user	2025

Training	-	Training requirements for aeronautical information requirements regarding UTM	Training for AIS/AIM personnel	ANSP	2025
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.x	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2025

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

DAIM-B2/5 NOTAM replacement

Main Purpose To introduce a more efficient mechanism to exchange aeronautical information that is currently provided by the NOTAM system.

New Capabilities Airspace user will be allowed to tailor the AIM updates to their operational needs as well as subscribe to airspace constraint alerts so that changes to any constraint are immediately available.

Description This element consists in the establishment of an information service through SWIM that serves as a replacement for the information currently provided by NOTAMs. The replacement of the current NOTAM system by this information service is expected to solve identified deficiencies such as NOTAM proliferation or the operational irrelevance of the information provided.

Maturity Level Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **Yes**
2. Does it imply processing of new information by the user? **Yes**
3. Does it imply the use of new equipment? **No**
4. Does it imply a change to levels of automation? **Yes**

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	DAIM-B1/7 - NOTAM improvements

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Operational procedures to produce and distribute the new "NOTAM"	Updated AIM Manual of operations to include information about the new "NOTAM". Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	ANSP	2025
Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision new "NOTAM"	Automated systems and infrastructure to support the provision of dynamic AIM updates including data collection, verification and distribution.	ANSP	2025
Ground system infrastructure	Information exchange	Airspace user systems need to be updated to take advantage of the new “NOTAM”	Automated systems and infrastructure for the users to make use of the new “NOTAM”.	Airspace user	2025
Training	-	Training requirements for the provision of new "NOTAM"	Training for AIS/AIM personnel	ANSP	2025

Regulatory provisions	National regulatory framework	National framework for the provision of the new “NOTAM”	Development of State Regulatory framework to support the provision of the new “NOTAM” Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2025

DEPLOYMENT APPLICABILITY

Operational conditions:

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

APÉNDICE C

ICAO GANP PORTAL

KPI OVERVIEW

KPI01	Departure punctuality
Definition	Percentage of flights departing from the gate on-time (compared to schedule).
Mesurement Units	% of scheduled flights
Operations Measured	IFR departures of scheduled airlines
Variants	Variant 1A – % of departures within ± 5 minutes of scheduled time of departure Variant 1B – % of departures delayed ≤ 5 minutes versus schedule Variant 2A – % of departures within ± 15 minutes of scheduled time of departure Variant 2B – % of departures delayed ≤ 15 minutes versus schedule
Objects Characterized	The KPI is typically computed for traffic flows, individual airports, or clusters of airports (selection/grouping based on size and/or geography).
Utility of the KPI	This is an airspace user and passenger focused KPI: departure punctuality gives an overall indication of the service quality experienced by passengers, and the ability of the airlines to execute their schedule at a given departure location.
Parameters	On-time threshold (maximum positive or negative deviation from scheduled departure time) which defines whether a flight is counted as on-time or not. Recommended values: 5 minutes and 15 minutes.
Data Requirement	For each departing scheduled flight: • Scheduled time of departure (STD) or Scheduled off-block time (SOBT) • Actual off-block time (AOBT)
Data Feed Providers	Schedule database(s), airports, airlines and/or ANSPs

Formula / Algorithm	At the level of individual flights: 1. Exclude non-scheduled departures 2. Categorize each scheduled departure as on-time or not At aggregated level: 3. Compute the KPI: number of on-time departures divided by total number of scheduled departures
References & Examples of Use	• Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • China / Europe benchmarking study (CAUC - EUROCONTROL, 2017)

KPI02	Taxi-out additional time
Definition	Actual taxi-out time compared to an unimpeded/reference taxi-out time.
Mesurement Units	Minutes/flight
Operations Measured	The duration of the taxi-out phase of departing flights
Variants	Variant 1 – basic (computed without departure gate and runway data) Variant 2 – advanced (computed with departure gate and runway data)
Objects Characterized	The KPI is typically computed for individual airports, or clusters of airports (selection/grouping based on size and/or geography).
Utility of the KPI	This KPI is intended to give an indication of the efficiency of the departure phase operations on the surface of an aerodrome. This may include the average queuing that is taking place in front of the departure runways, non-optimal taxi routing and intermediate aircraft stops during taxi-out. The KPI is also typically used to estimate excess taxi-out fuel consumption and associated emissions (for the Environment KPA). The KPI is designed to filter out the effect of physical airport layout while focusing on the responsibility of ATM to optimize the outbound traffic flow from gate to take-off.
Parameters	Unimpeded/reference taxi-out time: • Recommended approach for the basic variant of the KPI: a single value at airport level, e.g. the 20th percentile of actual taxi times recorded at an airport, sorted from the shortest to the longest. • Recommended approach for the advanced variant of the KPI: a separate value for each gate/runway combination, e.g. the average actual taxi-out time recorded during periods of non-congestion (needs to be periodically reassessed).

Data Requirement	For each departing flight: • Actual off-block time (AOBT) • Actual take-off time (ATOT) In addition, for the advanced KPI variant: • Departure gate ID • Take-off runway ID
Data Feed Providers	Airports (airport operations, A-CDM), airlines (OOOI data), ADS-B data providers and/or ANSPs
Formula / Algorithm	At the level of individual flights: 1. Select departing flights, exclude helicopters 2. Compute actual taxi-out duration: ATOT minus AOBT 3. Compute additional taxi-out time: actual taxi-out duration minus unimpeded taxi-out time At aggregated level: 4. Compute the KPI: sum of additional taxi-out times divided by number of IFR departures
References & Examples of Use	• Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • Singapore / US / Europe benchmarking study (CAAS - FAA - EUROCONTROL, 2017) • China / Europe benchmarking study (CAUC - EUROCONTROL, 2017) • PRC Performance Review Report (EUROCONTROL 2017) • European ANS Performance Data Portal • Single European Sky Performance Scheme • CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI03	ATFM slot adherence
Definition	Percentage of flights taking off within their assigned ATFM slot (Calculated Take-Off Time Compliance).
Mesurement Units	% of flights subject to flow restrictions
Operations Measured	The take-off of IFR flights subject to flow restrictions.
Variants	Variants are possible depending on the size of the ATFM slot window.
Objects Characterized	The KPI is typically computed for individual airports, or clusters of airports (selection/grouping based on size and/or geography).

Utility of the KPI	This KPI gives an indication of the capability of an airport to contribute to ATFM effectiveness by delivering outbound traffic in a predictable manner to the departure runway, in compliance with assigned ATFM slots.
Parameters	Size of the ATFM slot window. Variant 1: the period between 5 minutes before and 10 minutes after the CTOT. Variant 2: the period between 5 minutes before and 5 minutes after the CTOT.
Data Requirement	For each departing IFR flight subject to an ATFM regulation: • Calculated Take-Off Time (CTOT) • Actual take-off time (ATOT)
Data Feed Providers	Airports, ATFM service
Formula / Algorithm	At the level of individual flights: 1. Exclude flights not subject to an ATFM regulation 2. Categorize each departing flight as compliant with its ATFM slot window or not At aggregated level: 3. Compute the KPI: number of compliant departures divided by total number of departing flights subject to an ATFM regulation
References & Examples of Use	• PRC Performance Review Report (EUROCONTROL 2017) • European ANS Performance Data Portal • Slot Tolerance Window (STW) compliance (Single European Sky Performance Scheme) • EDCT Window compliance (US) • CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI04	Filed flight plan en-route extension
Definition	Flight planned en-route distance compared to a reference ideal trajectory distance.
Mesurement Units	% excess distance
Operations Measured	The planned en-route distance, as selected during the preparation of flight plans.
Variants	Variant 1, using a 40 NM cylinder around the departure and destination airport as the start/end of en-route airspace. Variant 2, using a 40 NM cylinder around the departure airport and a 100 NM cylinder around the destination airport as the start/end of en-route airspace.

Objects Characterized	The KPI can be computed for any volume of en-route airspace; this implies that it can be computed at State level (covering the FIRs of a State).
Utility of the KPI	This KPI measures the en-route horizontal flight (in)efficiency contained in a set of filed flight plans crossing an airspace volume. Its value is influenced by route network design, route & airspace availability, airspace user choice (e.g. to ensure safety, to minimize cost and to take into account wind and weather) and airspace user constraints (e.g. overflight permits, aircraft limitations). A significant gap between this KPI and the Actual en-Route Extension KPI indicates that many flights are not flown along the planned route, which should trigger an analysis of why this is happening.
Parameters	A '*Measured area'* is defined for which the KPI is computed. For example, a State. A '*Reference area*' is defined as a (sub)regional boundary considered, containing all '*Measured areas*', for example States within the same ICAO Region. Departure terminal area proxy: a cylinder with 40 NM radius around the departure airport. Destination terminal area proxy: a cylinder with 40 NM radius around the destination airport (variant 1). For variant 2 the radius is 100 NM.
Data Requirement	For each flight plan: • Departure airport (Point A) • Destination airport (Point B) • Entry point in the '*Reference area'* (Point O) • Exit point from the '*Reference area'* (Point D) • Entry points in the '*Measured areas'* (Points N) • Exit points from the '*Measured areas'* (Points X) • Planned distance for each NX portion of the flight
Data Feed Providers	ANSPs

Formula / Algorithm

For the horizontal trajectory of each flight, different parts (trajectory portions) are considered (see Figure 1 for the example of a flight departing outside the '*Reference Area*' and overflying a measured State; Figure 2 for the example of a domestic flight within a measured State):

1. The part of the flight which is within the reference area (segment OD). If airports A and/or B are located within the reference area, the points O and/or D are placed on the airport reference point (ARP).
2. The part of the flight for which the State level indicator is computed (between points N and X). If points A and/or B (the airports) are located within the measured State, the points N and/or X are placed on the 40 NM circle (variant 1) around the airport reference point as shown in Figure 2, to exclude terminal route efficiency from the indicator.

Between points N and X, three quantities can be computed: the planned distance (length of flight plan trajectory), the local direct distance (great circle distance between N and X, not required for this indicator), and the contribution of the trajectory between N and X to the completion of the great circle distance between O and D. This contribution is called the "achieved distance". The formula for computing this is based on four great circle distances interconnecting the points O, N, X and D: achieved distance = [(OX-ON)+(DN-DX)]/2.

When a given flight traverses multiple States, the sum of the planned distance in each State equals the total planned distance from O to D. Likewise the sum of all achieved distances equals the direct distance from O to D.

The extra distance for a portion NX of a given flight is the difference between the actual/flight planned distance and the achieved distance. The total extra distance observed within a measured area (e.g. a State) over a given time period is the sum of the planned distances across all traversing flights, minus the sum of the achieved distances across all traversing flights.

The KPI is computed as the total extra distance divided by total achieved distance, expressed as a percentage.

References & Examples of Use

- ICAO EUR Doc 030 EUR Region Performance Framework Document (July 2013)
- Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016)
- PRC Performance Review Report (EUROCONTROL 2017)
- European ANS Performance Data Portal
- Single European Sky Performance Scheme
- CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

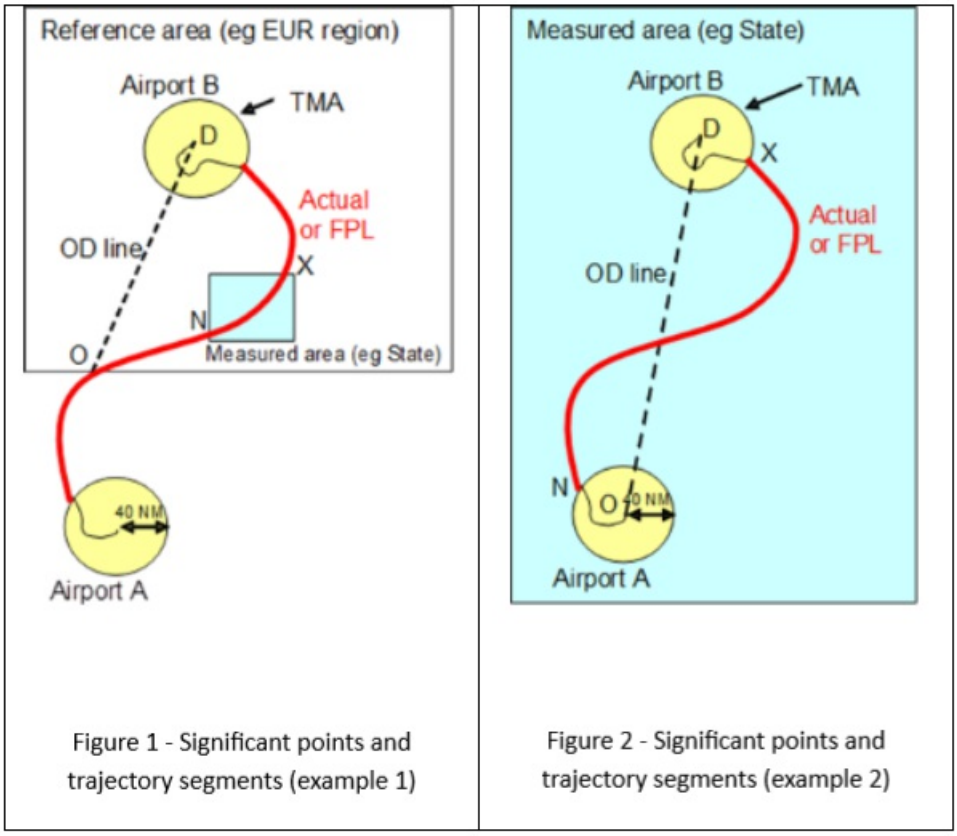


Figure 1 - Significant points and trajectory segments (example 1)

Figure 2 - Significant points and trajectory segments (example 2)

Significant points and trajectory segments (examples 1 and 2)

KPI05	Actual en-route extension
Definition	Actual en-route distance flown compared to a reference ideal distance.
Mesurement Units	% excess distance
Operations Measured	The actual distance flown by flights in en-route airspace.
Variants	Variant 1, using a 40 NM cylinder around the departure and destination airport as the start/end of en-route airspace. Variant 2, using a 40 NM cylinder around the departure airport and a 100 NM cylinder around the destination airport as the start/end of en-route airspace.
Objects Characterized	The KPI can be computed for a traffic flow or a volume of en-route airspace; this implies that it can be computed at State level (covering the FIRs of a State).

Utility of the KPI	This KPI measures the en-route horizontal flight (in)efficiency as actually flown, of a set of IFR flights crossing an airspace volume. Its value is influenced by route network design, route & airspace availability, airspace user choice (e.g. to ensure safety, to minimize cost and to take into account wind and weather) and airspace user constraints (e.g. overflight permits, aircraft limitations), and tactical ATC interventions modifying the trajectory (e.g. reroutings and 'direct to' clearances). The KPI is also typically used to estimate the excess fuel consumption and associated emissions (for the Environment KPA) attributed to horizontal flight inefficiency.
Parameters	Identical to the parameters of the 'Filed Flight Plan en-Route Extension' KPI.
Data Requirement	For each actual flight trajectory: • Departure airport (Point A) • Destination airport (Point B) • Entry point in the 'Reference Area' (Point O) • Exit point from the 'Reference Area' (Point D) • Entry points in the 'Measured Areas' (Points N) • Exit points from the 'Measured Areas' (Point X) • Distance flown for each NX portion of the actual flight trajectory, derived from surveillance data (radar, ADS-B...).
Data Feed Providers	ANSPs, ADS-B data providers
Formula / Algorithm	Identical to the formula/algorithm of the 'Filed Flight Plan en-Route Extension' KPI.
References & Examples of Use	• ICAO EUR Doc 030 EUR Region Performance Framework Document (July 2013) • Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • PRC Performance Review Report (EUROCONTROL 2017) • European ANS Performance Data Portal • Single European Sky Performance Scheme • CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI06	En-route airspace capacity
Definition	The maximum volume of traffic an airspace volume will safely accept under normal conditions in a given time period.
Mesurement Units	Variant 1: Movements/hr Variant 2: Number of aircraft (occupancy count)
Operations Measured	TThe nominal capability of an ANSP to deliver ATM services to IFR traffic in a given volume of en-route airspace, as seen at a given planning horizon. For each horizon a different type of capacity is to be considered: • Planned capacity: expected values one or more years ahead for planning and investment purposes • Declared capacity: values used during the strategic and pre-tactical ATFM processes • Expected capacity: values as finalised at the end of the pre-tactical process • Actual capacity: values as actually used on the day of operation during tactical ATFM and ATC.

Variants	Variant 1: airspace throughput (entry flow rate) Variant 2: airspace occupancy count
Objects Characterized	The KPI is typically used at the level of individual sectors (sector capacity) or en-route facilities (ACC capacity).
Utility of the KPI	The KPI measures an upper bound on the allowable throughput or occupancy count of an en-route facility or sector. Planned capacities are primarily used for multi-year and investment planning. Declared, expected and actual capacities are used in traffic flow management as well as for measuring and monitoring service delivery and efficiency. Some ANSPs may prefer not to declare capacities, and only have these capacities established on a daily basis based on known/current operational factors. Establishing capacities at different planning horizons provides an important reference for understanding the total system performance under normal operating conditions and provides a basis to work from when determining the impact of operational factors limiting capacity. These factors include – but are not limited to – ATCO availability and workload.
Parameters	Variant 1: time interval at which the throughput declaration is made. Variant 2: time interval at which the average occupancy count declaration is made.
Data Requirement	The various capacities are determined by the ANSP, and are dependent on traffic pattern, sector configuration, ATCO and system capability, etc.
Data Feed Providers	ANSPs
Formula / Algorithm	At the level of an individual en-route facility: 1. Select highest value from the set of established capacities (the maximum configuration capacity). 2. Compute the KPI: for variant 1, convert the value to an hourly movement rate, if the declaration is at smaller time intervals.
References & Examples of Use	• Brazil / Europe benchmarking study (DECEA - EUROCONTROL, 2017) • CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI07	En-route ATFM delay

Definition	ATFM delay attributed to flow restrictions in a given en-route airspace volume
Mesurement Units	Minutes/flight
Operations Measured	The management of (temporary) capacity shortfalls in en-route airspace due to high demand and/or capacity reductions for a variety of reasons, resulting in the allocation of ATFM delay
Variants	None
Objects Characterized	The KPI can be computed for any volume of en-route airspace which participates in the ATFM process.
Utility of the KPI	This KPI is a time aggregation of the ATFM delay generated by flow restrictions which are established to protect a given volume of en-route airspace against demand/capacity imbalances. These flow restrictions (also called ATFM regulations) normally have a delay cause associated with them. This allows the KPI to be disaggregated by cause, which allows better diagnosis of the reasons for demand/capacity imbalances. Typically, the KPI is used to check whether ANSPs provide the capacity needed to cope with demand.
Parameters	None
Data Requirement	For each IFR flight: - Estimated Take-off Time (ETOT) computed from the last filed flight plan - Calculated Take-off Time (CTOT) - ID of the flow restriction generating the ATFM delay - Airspace volume associated with the flow restriction - Delay code associated with the flow restriction
Data Feed Providers	ATFM
Formula / Algorithm	At the level of individual flights: 1. Select the flights crossing the volume of en-route airspace 2. Select the subset of flights which are affected by the flow restrictions in this airspace 3. Compute ATFM delay: CTOT minus ETOT At aggregated level: 4. Compute the KPI: sum of ATFM delays divided by number of IFR flights crossing the airspace
References & Examples of Use	• ICAO EUR Doc 030 EUR Region Performance Framework Document (July 2013) • Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • PRC Performance Review Report (EUROCONTROL 2017) • European ANS Performance Data Portal • Single European Sky Performance Scheme • CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI08	Additional time in terminal airspace
Definition	Actual terminal airspace transit time compared to an unimpeded time. Actual trajectories are generally longer in time and distance due to path stretching and/or holding patterns. In the example below the unimpeded trajectories are shown in red, and the actual trajectories in green and blue. See Figure 1: Terminal trajectories.
Mesurement Units	Minutes/flight
Operations Measured	The terminal airspace transit time during the arrival flight phase.
Variants	Variants are possible depending on the chosen size of terminal airspace (40 NM or 100 NM cylinder) and the richness of the data feed: basic (without arrival runway ID) or advanced (with arrival runway ID) Variants with 100 NM cylinder are useful if airports have holding patterns outside the 40 NM cylinder. The use of generic cylinders abstracts local specifics in terms of approach airspace design (e.g. TMA) and ensures comparability across different airports. See table 1: Cylinder variants
Objects Characterized	The KPI is typically computed for individual airports, or clusters of airports (selection/grouping based on size and/or geography).
Utility of the KPI	This KPI is intended to give an indication of the average queuing that is taking place in terminal airspace. This queuing is the result of sequencing and metering. The KPI captures the extent to which arriving flights are subjected to speed reductions, path extensions and holding patterns to absorb the queuing time. The KPI is also typically used to estimate excess fuel consumption and associated emissions (for the Environment KPA) attributable to horizontal flight inefficiency in terminal airspace. The KPI is designed to filter out the operational variability of terminal airspace transit time (e.g. due to wind, aircraft speed and length of the approach procedure, such as the difference between a straight-in approach and a downwind arrival) while focusing on the responsibility of ATM to optimize the inbound traffic flow from terminal airspace entry to landing.

Parameters

Destination terminal area proxy (also called Arrival Sequencing and Metering Area – ASMA): a cylinder with 40 NM radius around the destination airport. For variants A100 and B100 the radius is 100 NM.

For the advanced variants only: list of terminal airspace entry segments (used to group flights entering the cylinder from ± the same direction).

Unimpeded terminal airspace transit time:

- Recommended approach for the basic variants of the KPI: a single value at airport level = the 20th percentile of actual terminal airspace transit times recorded at an airport, sorted from the shortest to the longest.
- Recommended approach for the advanced variants of the KPI: a separate value for each entry segment/landing runway combination = the average terminal airspace transit time recorded during periods of non-congestion (needs to be periodically reassessed).

Data Requirement

For each arriving flight:

- Terminal airspace entry time, computed from surveillance data (radar, ADS-B...)
- Actual landing time (ALDT)

In addition, for the advanced KPI variants:

- Terminal airspace entry segment, computed from surveillance data (radar, ADS-B...)
- Landing runway ID

Data Feed Providers

Airlines (OOOI data), airports, ADS-B data providers and/or ANSPs

Formula / Algorithm

At the level of individual flights:

1. Select arrivals, exclude helicopters

2. Compute actual terminal airspace transit time: ALDT minus terminal airspace entry time

3. Compute additional terminal airspace transit time: actual terminal airspace transit time minus unimpeded terminal airspace transit time

At aggregated level:

4. Compute the KPI: sum of additional terminal airspace transit times divided by number of IFR arrivals

References & Examples of Use

- Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016)
- Singapore / US / Europe benchmarking study (CAAS - FAA - EUROCONTROL, 2017)
- PRC Performance Review Report (EUROCONTROL 2017)
- European ANS Performance Data Portal
- Single European Sky Performance Scheme
- CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

	40 NM cylinder	100 NM cylinder
Advanced data feed	Variant A40	Variant A100
Basic data feed	Variant B40	Variant B100

Table 1: Cylinder variants

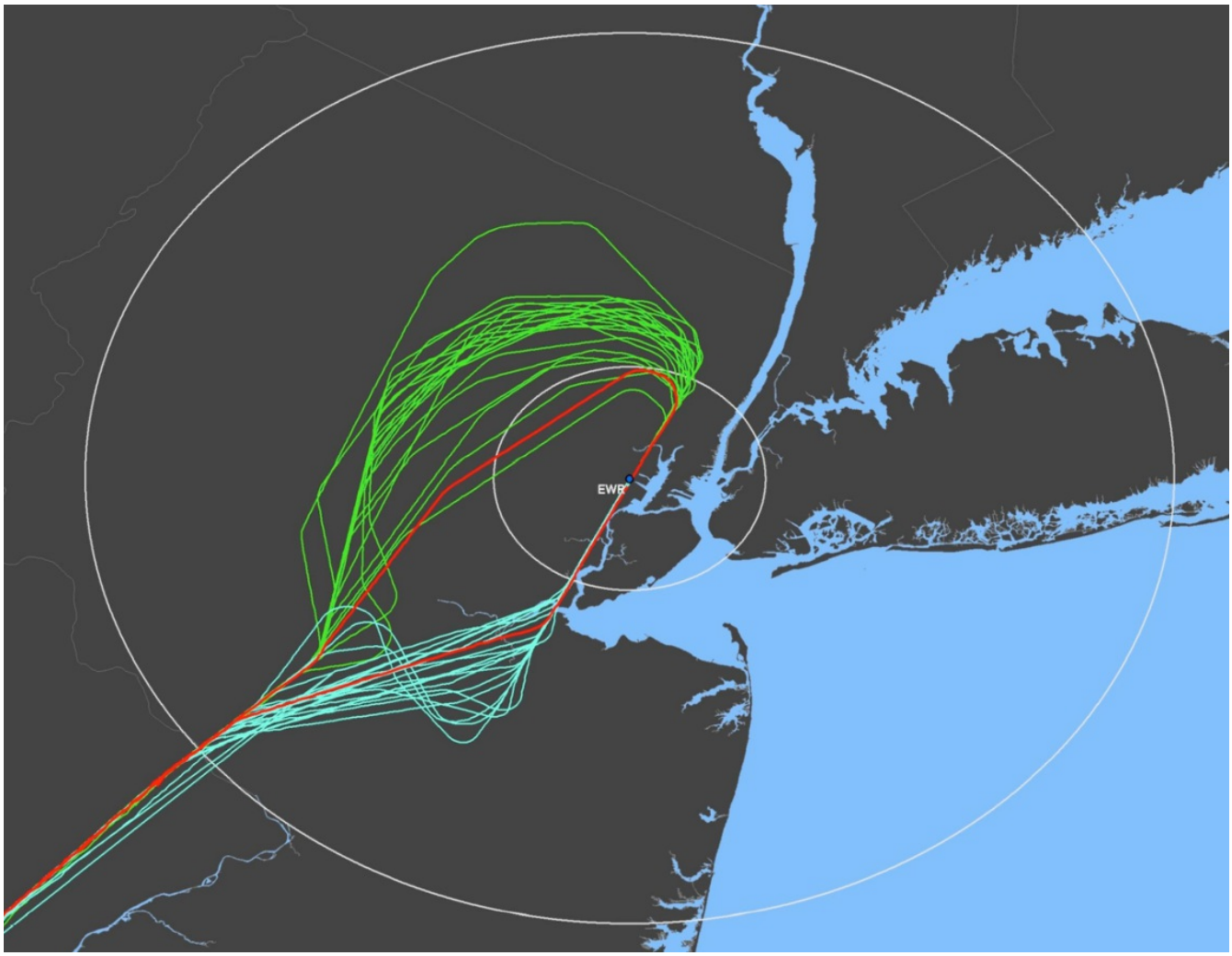


Figure 1: Terminal trajectories

KPI09	Airport peak capacity
Definition	The highest number of operations an airport can accept in a one-hour time frame (also called declared capacity). Can be computed for arrivals, departures or arrivals+departures.
Mesurement Units	Number of departures / hour, Number of landings / hour, Number of (departures+landings) / hour
Operations Measured	The capacity declaration of an airport.
Variants	Variant A: Airport peak arrival capacity Variant D: Airport peak departure capacity Variant AD: Airport peak movement capacity (departures + arrivals)
Objects Characterized	The KPI is computed for individual airports.
Utility of the KPI	This KPI indicates the highest number of operations that an airport will accept, using the most favorable runway configuration under optimum operational conditions. The runways may or may not be the most constraining factor for airport capacity: at some airports the most constraining factor may be the terminal airspace, the taxiways, the number of gates, passenger handling capacity etc. The KPI is typically used for scheduling and ATFM purposes, and to develop capacity investment plans.
Parameters	None
Data Requirement	Scheduling parameters for slot controlled airports Airport Acceptance Rates (AAR), Airport Departure Rates (ADR)
Data Feed Providers	Airports
Formula / Algorithm	At the level of an individual airport: 1. Select highest value from the set of declared capacities. 2. Compute the KPI: convert the value to an hourly rate, if the declaration is at smaller time intervals.
References & Examples of Use	• Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • Brazil / Europe benchmarking study (DECEA - EUROCONTROL, 2017) • CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI10	Airport peak throughput
Definition	The 95th percentile of the hourly number of operations recorded at an airport, in the “rolling” hours sorted from the least busy to the busiest hour. Can be computed for arrivals, departures or arrivals+departures.
Mesurement Units	Number of departures / hour, Number of landings / hour, Number of (departures+landings) / hour
Operations Measured	The actual number of operations at an airport.
Variants	Variant 1: IFR operations only Variant 2: IFR + VFR operations (relevant for airports with a high percentage of VFR traffic) To be combined with: Variant A: Airport peak arrival throughput Variant D: Airport peak departure throughput Variant AD: Airport peak movement throughput (departures + arrivals)
Objects Characterized	The KPI is computed for individual airports.
Utility of the KPI	This KPI gives an indication of “busy-hour” actual movement rates at an airport, as recorded during a given time period. For congested airports, this throughput is an indication of the effectively realized capacity; for uncongested airports it is a measure of demand.
Parameters	Time interval for “rolling” hours. Recommended value: 15 minutes. The percentile chosen to exclude outliers. Recommended value: 95th percentile.
Data Requirement	For each flight: • Actual landing time (ALDT) • Actual take-off time (ATOT).
Data Feed Providers	Airports

Formula / Algorithm	At the level of individual flights: 1. Select flights, exclude helicopters At the level of individual “rolling” hours: 2. Convert the set of flights to hourly landing rates and departure rates by “rolling” hour 3. Sort the “rolling” hours from the least busy to the busiest hour 4. Compute the KPI: it equals the rate value of the 95th percentile of the “rolling” hours
References & Examples of Use	• Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • Singapore / US / Europe benchmarking study (CAAS - FAA - EUROCONTROL, 2017) • China / Europe benchmarking study (CAUC - EUROCONTROL, 2017) • Brazil / Europe benchmarking study (DECEA - EUROCONTROL, 2017)

KPI11	Airport throughput efficiency
Definition	Airport throughput (accommodated demand) compared to capacity or demand, whichever is lower. Can be computed for arrivals, departures or arrivals+departures.
Mesurement Units	Average Over/Under Delivery or % of accommodated operations.
Operations Measured	The number of unaccommodated operations at an airport.
Variants	Variant A: IFR arrivals Variant D: IFR departures Variant AD: IFR Operations (arrivals + departures)
Objects Characterized	The KPI is computed for individual airports.
Utility of the KPI	This KPI assesses how effectively capacity is managed by the ANSP. It is a measure of accommodated demand, compared to the available capacity of the airport, irrespective of the delay incurred by arriving traffic. Seen in another way, it captures the “missed” slots. At congested airports, the KPI relates the throughput to the declared capacity. At uncongested airports (or airports without declared capacity) the KPI relates the throughput to the unconstrained demand based on flight plans.
Parameters	Time interval at which to perform the most granular calculations. Recommended value: 15 minutes.

Data Requirement

For each arriving and/or departing flight:

- Actual landing time (ALDT) and take-off time (ATOT)
- Estimated landing time (ELDT) and take-off time (ETOT) (from flight plan)

For each time interval:

- Declared landing capacity of the airport
- Declared departure capacity of the airport
- Declared total capacity of the airport

Data Feed Providers

Airports

Formula / Algorithm

Example for arrivals:

For each time interval:

1. Compute the throughput: count the number of actual landings based on ALDT

2. Compute the demand: count the number of estimated landings based on ELDT

3a. if demand >= capacity: efficiency = throughput / capacity

3b. if demand < capacity: efficiency = throughput / demand

At aggregated level (longer time periods):

4. Compute the KPI: sum(efficiency*demand) / sum(demand)

Note: See Table 1: Example for arrivals. The average percentage weighted by actual arrivals is 96.1%. The average under-delivery of arrivals is -1.8. The same process can be used for departures or combined operations.

References & Examples of Use

- Singapore / US / Europe benchmarking study (CAAS - FAA - EUROCONTROL, 2017)
- Brazil / Europe benchmarking study (DECEA - EUROCONTROL, 2017)
- CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

Hour	15	16	17	18	19	20	21	22	23
Data									
Demand	41	58	59	70	67	59	63	72	66
Capacity	35	35	35	35	35	35	40	45	45
Throughput	30	38	36	36	36	32	35	37	44
Performance Score									
Throughput / Min (Demand, Capacity)	85.7%	108%	103%	103%	103%	91.4%	87.5%	82.2%	97.8%
Throughput minus Min (Demand, Capacity)	-5	3	1	1	1	-3	-5	-8	-1

Table 1: Example for arrivals

KPI12	Airport/Terminal ATFM delay
Definition	ATFM delay attributed to arrival flow restrictions at a given airport and/or associated terminal airspace volume.
Mesurement Units	Minutes/flight
Operations Measured	The management of (temporary) capacity shortfalls at and around destination airports due to high demand and/or capacity reductions for a variety of reasons, resulting in the allocation of ATFM delay.
Variants	None
Objects Characterized	The KPI is typically computed for individual airports, or clusters of airports (selection/grouping based on size and/or geography).
Utility of the KPI	This KPI is a time aggregation of the ATFM delay generated by flow restrictions which are established to protect a destination airport or its terminal area against demand/capacity imbalances. If a terminal area covers multiple airports, each individual flight delay is attributed to the corresponding destination airport. These flow restrictions (also called ATFM regulations) normally have a delay cause associated with them. This allows the KPI to be disaggregated by cause, which allows better diagnosis of the reasons for demand/capacity imbalances. Typically, the KPI is used as a proxy to check whether airports and ANSPs provide the capacity needed to cope with demand.

Parameters	None
Data Requirement	For each IFR flight: • Estimated Take-off Time (ETOT) computed from the last filed flight plan • Calculated Take-off Time (CTOT) • ID of the flow restriction generating the ATFM delay • Airport or terminal airspace volume associated with the flow restriction • Delay code associated with the flow restriction
Data Feed Providers	ATFM
Formula / Algorithm	At the level of individual flights: 1. Select the flights arriving at this airport 2. Select the subset of flights which are affected by the flow restrictions at this airport or its terminal airspace 3. Compute ATFM delay: CTOT minus ETOT At aggregated level: 4. Compute the KPI: sum of ATFM delays divided by number of arrivals at the airport
References & Examples of Use	• ICAO EUR Doc 030 EUR Region Performance Framework Document (July 2013) • PRC Performance Review Report (EUROCONTROL 2017) • European ANS Performance Data Portal • Single European Sky Performance Scheme • CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI13	Taxi-in additional time
Definition	Actual taxi-in time compared to an unimpeded/reference taxi-in time
Mesurement Units	Minutes/flight
Operations Measured	The duration of the taxi-in phase of arriving flights
Variants	Variant 1 – basic (computed without landing runway and arrival gate data) Variant 2 – advanced (computed with landing runway and arrival gate data)
Objects Characterized	The KPI is typically computed for individual airports, or clusters of airports (selection/grouping based on size and/or geography).

Utility of the KPI	This KPI is intended to give an indication of the various taxi-in inefficiencies that occur after landing. Its value may be influenced by unavailability of the arrival gate and effects such as non-optimal taxi routing and intermediate aircraft stops during taxi-in. The KPI is also typically used to estimate excess taxi-in fuel consumption and associated emissions (for the Environment KPA). The KPI is designed to filter out the effect of physical airport layout while focusing on the responsibility of the airport to provide parking space and ATM to optimize the inbound traffic flow from landing to in-blocks.
Parameters	Unimpeded/reference taxi-in time: • Recommended approach for the basic variant of the KPI: a single value at airport level, e.g. the 20th percentile of actual taxi times recorded at an airport, sorted from the shortest to the longest • Recommended approach for the advanced variant of the KPI: a separate value for each runway/gate combination, e.g. the average actual taxi-in time recorded during periods of non-congestion (needs to be periodically reassessed)
Data Requirement	For each arriving flight: • Actual landing time (ALDT) • Actual in-block time (AIBT) In addition, for the advanced KPI variant: • Landing runway ID • Arrival gate ID
Data Feed Providers	Airports (airport operations), airlines (OOOI data), ADS-B data providers and/or ANSPs
Formula / Algorithm	At the level of individual flights: 1. Select arriving flights, exclude helicopters 2. Compute actual taxi-in duration: AIBT minus ALDT 3. Compute additional taxi-in time: actual taxi-in duration minus unimpeded taxi-in time At aggregated level: 4. Compute the KPI: sum of additional taxi-in times divided by number of IFR arrivals
References & Examples of Use	• Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • China / Europe benchmarking study (CAUC - EUROCONTROL, 2017) • PRC Performance Review Report (EUROCONTROL 2017) • CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI14	Arrival punctuality

Definition	Percentage of flights arriving at the gate on-time (compared to schedule)
Mesurement Units	% of scheduled flights
Operations Measured	IFR arrivals of scheduled airlines
Variants	Variant 1A – % of arrivals within ± 5 minutes of scheduled time of arrival Variant 1B – % of arrivals delayed ≤ 5 minutes versus schedule Variant 2A – % of arrivals within ± 15 minutes of scheduled time of arrival Variant 2B – % of arrivals delayed ≤ 15 minutes versus schedule
Objects Characterized	The KPI is typically computed for traffic flows, individual airports, or clusters of airports (selection/grouping based on size and/or geography).
Utility of the KPI	This is an airspace user and passenger focused KPI: arrival punctuality gives an overall indication of the service quality experienced by passengers, and the ability of the airlines to execute their schedule at a given destination.
Parameters	On-time threshold (maximum positive or negative deviation from scheduled arrival time) which defines whether a flight is counted as on-time or not. Recommended values: 5 minutes and 15 minutes.
Data Requirement	For each arriving scheduled flight: • Scheduled time of arrival (STA) or Scheduled in-block time (SIBT) • Actual in-block time (AIBT)
Data Feed Providers	Schedule database(s), airports, airlines and/or ANSPs
Formula / Algorithm	At the level of individual flights: 1. Exclude non-scheduled arrivals 2. Categorize each scheduled arrival as on-time or not At aggregated level: 3. Compute the KPI: number of on-time arrivals divided by total number of scheduled arrivals
References & Examples of Use	• Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • China / Europe benchmarking study (CAUC - EUROCONTROL, 2017) • PRC Performance Review Report (EUROCONTROL 2017)

KPI15	Flight time variability

Definition	Distribution of the flight (phase) duration around the average value.
Mesurement Units	Minutes/flight
Operations Measured	Scheduled flights with the same flight ID on a given airport-pair (flight XYZ123 from A to B): the gate-to-gate duration, and at more detailed level the duration of the individual flight phases (taxi-out, airborne, taxi-in)
Variants	Different parameter values possible (see 'Parameters').
Objects Characterized	The KPI is typically computed for the scheduled traffic flows interconnecting a given cluster of airports (two or more; selection/grouping based on size and/or geography).
Utility of the KPI	The "variability" of operations determines the level of predictability for airspace users and hence has an impact on airline scheduling. It focuses on the variance (distribution widths) associated with the individual phases of flight as experienced by airspace users. The higher the variability, the wider the distribution of actual travel times and the more costly time buffer is required in airline schedules to maintain a satisfactory level of punctuality. In addition, reducing the variability of actual block times can potentially reduce the amount of excess fuel that needs to be carried for each flight in order to allow for uncertainties.
Parameters	Minimum monthly flight frequency filter: flights with a frequency less than 20 times per month are not included in the indicator. Outlier filter: Variant 1: Only 70% of the (remaining) flights are considered in the indicator, i.e. the 15th percentile (percentile 1) is used to determine the shortest duration, the 85th percentile (percentile 2) is used to determine the longest duration Variant 2: Only 60% of the (remaining) flights are considered in the indicator, i.e. the 20th percentile (percentile 1) is used to determine the shortest duration, the 80th percentile (percentile 2) is used to determine the longest duration
Data Requirement	For each flight: OOOI data: gate "out" (AOBT), wheels "off," wheels "on," and gate "in" (AIBT) actual times.
Data Feed Providers	Airlines

Formula / Algorithm	At the level of flights with the same flight ID, at monthly or longer (e.g. annual) time aggregation level: 1. Exclude flight IDs not meeting the minimum monthly frequency requirement 2. Sort flights in ascending order of flight (phase) duration 3. Identify shortest (percentile 1) and longest (percentile 2) duration 4. Compute variability: (longest – shortest) / 2 At the more aggregated level: 5. Compute the KPI: weighted average of the individual flight ID variabilities
References & Examples of Use	• Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • PRC Performance Review Report (EUROCONTROL 2017) • CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI16	Additional fuel burn
Definition	Additional flight time/distance and vertical flight inefficiency converted to estimated additional fuel burn attributable to ATM
Mesurement Units	kg fuel/flight
Operations Measured	Actual IFR flights
Variants	Variant 1 – simple approach: calculation based on the average value other KPIs for groups of flights and corresponding average fuel burn values Variant 2 – advanced approach: calculation based on values computed for individual flights
Objects Characterized	This KPI is a conversion of the additional flight time/distance and vertical flight inefficiency KPIs to a corresponding (estimated) additional fuel consumption; hence it describes a performance characteristic of the same objects as the additional flight time/distance and vertical flight inefficiency KPIs: en-route airspace, terminal airspace and airports. Typically the KPI is published at the level of a State or (sub)region.

Utility of the KPI	This KPI is designed to provide a simple method for estimating ATM-related fuel efficiency at aggregated level, without the need to model fuel burn at the level of individual flights. By adding the average additional fuel burn value of the individual flight phases, a gate-to-gate value is produced which is representative for an “average flight”. The KPI is often further converted into additional CO2 emission (for the environment KPA) and/or the monetary value of fuel savings (for the cost effectiveness KPA). The KPI is sometimes called the “benefit pool”: it gives an indication of the ATM-induced flight inefficiency that is theoretically actionable by ATM. In practice the actionable “benefit pool” is smaller: real optimum performance is achieved at a residual non-zero value of the KPI.
Parameters	Average fuel flow (kg/min) during taxi Average fuel flow (kg/min) during arrival in terminal airspace Average fuel flow (kg/km) in en-route airspace Average additional fuel flow (kg/FL/km) during cruise due to flying lower
Data Requirement	Indicator values to be converted to estimated additional fuel burn: KPI02 Taxi-Out Additional Time (min/flight) KPI13 Taxi-In Additional Time (min/flight) KPI05 Actual en-Route Extension (%) & average en-route distance flown (km/flight) KPI08 Additional time in terminal airspace (min/flight) KPI17 Level-off during climb KPI18 Level capping during cruise & average cruise (ToC-ToD) distance flown (km/flight) KPI19 Level-off during descent
Data Feed Providers	Performance analysts
Formula / Algorithm	At aggregated level: Compute the KPI: (KPI02 Taxi-Out Additional Time x Average fuel flow during taxi) + (KPI13 Taxi-In Additional Time x Average fuel flow during taxi) + (KPI05 Actual en-Route Extension (%) x Average en-route distance flown x Average fuel flow in en-route airspace) + (KPI08 Additional time in terminal airspace x Average fuel flow during arrival in terminal airspace) + (KPI17 Level-off distance during climb x Average additional fuel flow during climb) + (KPI18 Average number of FL too low x Average distance during cruise x Average additional fuel flow per FL too low during cruise) + (KPI19 Level-off distance during descent x Average additional fuel flow during descent).

References & Examples of Use	• Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016)

KPI17	Level-off during climb
Definition	Distance and time flown in level flight before Top of Climb.
Mesurement Units	NM/flight and minutes/flight
Operations Measured	Actual IFR flights
Variants	Variant 1: Average distance flown in level flight before Top of Climb Variant 2: Average time flown in level flight before Top of Climb
Objects Characterized	The KPI is typically computed for traffic flows, individual airports, or clusters of airports (selection/grouping based on size and/or geography).
Utility of the KPI	This KPI is intended to give an indication of the amount of level flight during the climb phase. Ideally, there should be no level flight during climbs because level flight results in a higher fuel burn and possibly more noise. Aircraft should reach their cruising altitudes as soon as possible since the fuel consumption is lower at higher altitudes.
Parameters	• Analysis radius: the radius around the analysed airport within which the climb trajectory is analysed (e.g. 200NM). • Vertical speed limit: maximum vertical speed used to detect the start and end of a level segment (e.g. 300 feet/minute). • Level band limit: altitude band within which data points have to stay to be included in a level segment (e.g. 200 feet). • Minimum level time: minimum time duration for a level segment to be considered in the results (e.g. 20 seconds). • Exclusion box percentage: percentage of the Top of Climb altitude which is used to define the lower altitude of the exclusion box (e.g. 90%). E.g. level segments occurring above the lower altitude limit of the exclusion box and longer than the exclusion box time are excluded from the results. • Exclusion box time: a level segment in the exclusion box and longer than the exclusion box time is excluded (e.g. 5 minutes). • Minimum altitude: the altitude where the level segment detection during the climb starts. The trajectory below this altitude is not analysed (e.g. 3000 feet).
Data Requirement	For each flight trajectory: • 4D data points (latitude, longitude, altitude and time) • Departure airport ARP coordinates
Data Feed Providers	Trajectory data providers (reporting archived actual trajectories based on ADS-B and/or other surveillance data sources) and/or ANSPs.

Formula / Algorithm	Level segments in the climb trajectory within the analysis radius are detected using the vertical speed limit and level band limit. The methodology considers a data point as the start of a level segment when the following conditions are met: • the altitude difference with the next data point is less than or equal to the level band limit; and • the vertical speed towards the next data point is less than or equal to the vertical speed limit. The level segment ends when the altitude difference between the altitude of the beginning of the level segment and the altitude of a data point is more than the level band limit or when the vertical speed between two consecutive data points is more than the vertical speed limit.
References & Examples of Use	• Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • PRC Performance Review Report (EUROCONTROL 2017) • European ANS Performance Data Portal

KPI18	Level capping during cruise
Definition	Flight Level difference between maximum Flight Levels on a measured airport pair and maximum Flight Levels on similar unconstrained airport pairs.
Mesurement Units	Flight Levels/flight
Operations Measured	The cruise phase of IFR flights.
Variants	Variant 1: based on the maximum cruise Flight Level in the last filed flight plans Variant 2: based on the maximum cruise Flight Level of actual trajectories (surveillance data)
Objects Characterized	The KPI is typically computed for traffic flows on individual airport pairs or groups of airport pairs (weighted average).
Utility of the KPI	This KPI is intended to give an indication of the amount of vertical flight inefficiency related to maximum Flight Levels during the cruise phase (level capping). It measures the average Flight Level difference between the maximum Flight Levels of respectively flights on the analysed airport pair and flights on similar unconstrained airport pairs. The KPI is purely based on statistical processing of vertical flight profiles; it does not require any data on operational level capping constraints.

Parameters

- Great Circle Distance (GCD) interval: the width of the ranges of great circle distances (e.g. 10NM). If 10 NM is used, reference distributions are built for airport pairs with a great circle distance in the following ranges: [0NM, 10NM), [10NM, 20NM), [20NM, 30NM)...
- Number of reference flights: minimum number of flights in every GCD interval (e.g. 1000 flights).
- Percentile interval: the interval between the calculated percentiles of the distributions (e.g. 1 percent).
- Excluded flights percentage: percentage of flights excluded from the higher and lower end of the distributions to account for outliers (e.g. 10%).

Data Requirement

For each flight trajectory:

- Maximum cruise Flight Level
- Departure airport
- Arrival airport

Data Feed Providers

For variant 1: ANSPs; For variant 2: Trajectory data providers (reporting archived actual trajectories based on ADS-B and/or other surveillance data sources) and/or ANSPs

Formula / Algorithm

Reference distributions of the maximum Flight Levels of reference flights are built for every GCD interval. Reference flights are flights on airport pairs which have a great circle distance similar to the great circle distance of the analysed airport pair and which have no flight level capping constraints. The reference distributions are then converted into percentiles for every percentile interval.

Distributions and percentiles for the analysed airport pair are calculated in the same way.

For each percentile interval, the Flight Level value of the airport pair is subtracted from the Flight Level value of the reference. When the airport pair value is higher than the reference value, the result of the subtraction is negative. This might appear as if the flights are more efficient than the reference flights. Nevertheless, the focus is put on finding the inefficiencies, so negative values are set to 0.

The result of the percentile interval is then multiplied by the number of flights corresponding to the percentile interval (e.g. if the width of the percentile interval is 1%, the number of flights corresponding to the percentile interval is 1% of the total number of flights on the airport pair).

Summing up over all percentile intervals gives the total vertical flight inefficiency (number of Flight Levels summed over all flights). The vertical flight inefficiency per flight value is then calculated by dividing the total vertical flight inefficiency by the number of flights on the considered airport pair. The number of flights for this calculation step is 80% of the total number of flights on the airport pair if the excluded flights percentage is 10% (lowest 10% and highest 10% of the flights are not used).

This methodology is done for groups of aircraft types having similar performance to avoid comparing e.g. jet aircraft and turboprop aircraft which have significantly different nominal cruising altitudes.

References & Examples of Use

- PRC Performance Review Report (EUROCONTROL 2017)

KPI19	Level-off during descent
Definition	Distance and time flown in level flight after Top of Descent.
Mesurement Units	NM/flight and minutes/flight
Operations Measured	Actual IFR flights.
Variants	Variant 1: Average distance flown in level flight after Top of Descent Variant 2: Average time flown in level flight after Top of Descent
Objects Characterized	The KPI is typically computed for traffic flows, individual airports, or clusters of airports (selection/grouping based on size and/or geography).
Utility of the KPI	This KPI is intended to give an indication of the amount of level flight during the descent phase. Ideally, there should be no level flight during descents because level flight results in a higher fuel burn and possibly more noise. Ideally, aircraft should be able to descend from Top of Descent until touchdown.
Parameters	• Analysis radius: the radius around the analysed airport within which the descent trajectory is analysed (e.g. 200NM). • Vertical speed limit: maximum vertical speed used to detect the start and end of a level segment (e.g. 300 feet/minute). • Level band limit: altitude band within which data points have to stay to be included in a level segment (e.g. 200 feet). • Minimum level time: minimum time duration for a level segment to be considered in the results (e.g. 20 seconds). • Exclusion box percentage: percentage of the Top of Descent altitude which is used to define the lower altitude of the exclusion box (e.g. 90%). E.g. level segments occurring above the lower altitude limit of the exclusion box and longer than the exclusion box time are excluded from the results. • Exclusion box time: a level segment in the exclusion box and longer than the exclusion box time is excluded (e.g. 5 minutes). • Minimum altitude: the altitude where the level segment detection during the descent ends. The trajectory below this altitude is not analysed (e.g. 1800 feet).
Data Requirement	For each flight trajectory: • 4D data points (latitude, longitude, altitude and time) • Arrival airport ARP coordinates
Data Feed Providers	Trajectory data providers (reporting archived actual trajectories based on ADS-B and/or other surveillance data sources) and/or ANSPs.

Formula / Algorithm	Level segments in the descent trajectory within the analysis radius are detected using the vertical speed limit and level band limit. The methodology considers a data point as the start of a level segment when the following conditions are met: • the altitude difference with the next data point is less than or equal to the level band limit; and • the vertical speed towards the next data point is less than or equal to the vertical speed limit. The level segment ends when the altitude difference between the altitude of the beginning of the level segment and the altitude of a data point is more than the level band limit or when the vertical speed between two consecutive data points is more than the vertical speed limit.
References & Examples of Use	• Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016) • PRC Performance Review Report (EUROCONTROL 2017) • European ANS Performance Data Portal

Appendix D

Assessment of the Impact of Aeronautical Information Management on Performance Objectives and GANP KPIs

1- Upon analyzing the performance objectives of the Global Air Navigation Plan, organise group discussions on how the following issues would affect said objectives:

   a) Aeronautical information management in paper format
   b) The provision of aeronautical information without quality assurance
   c) Untimely provision of aeronautical information
   d) The provision of erroneous aeronautical information

2- When analyzing GANP KPIs, indicate the impact of the following issues thereon:
   a) The provision of information without quality assurance
   b) Delayed provision of aeronautical information in digital format
   c) The provision of aeronautical information in a non interoperable format
   d) The provision of erroneous aeronautical information

3- List aspects related to aeronautical information management that could help attain the GANP performance objectives.