International Civil Aviation Organization

AIR NAVIGATION SYSTEMS IMPLEMENTATION GROUP

Third Meeting (ANSIG/3)
(Cairo, Egypt, 2 – 4 July 2018)

Agenda Item 3: Air Navigation Global Developments

13TH AIR NAVIGATION CONFERENCE

(Presented by the Secretariat)

SUMMARY

This paper provides information and update related to preparation for the Thirteenth Air Navigation Conference (AN-Conf/13).

Action by the meeting is at paragraph 3.

REFERENCES

– State Letter Ref.: ST 14/1-1-17/120 dated 15 December 2017

1. INTRODUCTION

1.1 The Thirteenth Air Navigation Conference (AN-Conf/13) is planned to be held at the ICAO Headquarters, Montreal, Canada from 9 to 19 October 2018. The theme of the conference will be: "*From Development to Implementation*". The agenda of the Conference is at **Appendix A**.

1.2 State and Stakeholders are invited to provide their inputs to the Conference by submitting Working/Information Papers (WPs/IPs). To facilitate the timely reproduction of documentation and its use by the meeting, the rules governing the format, content and length of working papers as indicated in the attachments to AN-Conf/13 Invitation Letter, as well as the following deadlines for submission of WPs/IPs, are to be observed:

<table>
<tr><th colspan="2"></th><th>Submissions <u>before</u> <u>14 August 2018</u></th><th>Submissions <u>between</u> <u>14 August and 14 September 2018</u></th><th>Submissions <u>after</u> <u>14 September 2018</u></th></tr>
<tr><td rowspan="2">States</td><td>Working Papers (WPs)</td><td>Translated by ICAO and published in six languages.</td><td>Published in the language(s)* in which they are submitted.</td><td rowspan="4">Will not be processed</td></tr>
<tr><td>Information Papers (IPs)</td><td colspan="2">Published in the language(s)* in which they are submitted.</td></tr>
<tr><td rowspan="2">International Organizations (IOs)</td><td>Working Papers (WPs)</td><td colspan="2">Published in the language(s)* in which they are submitted.</td></tr>
<tr><td>Information Papers (IPs)</td><td colspan="2">Published in the language(s)* in which they are submitted.</td></tr>
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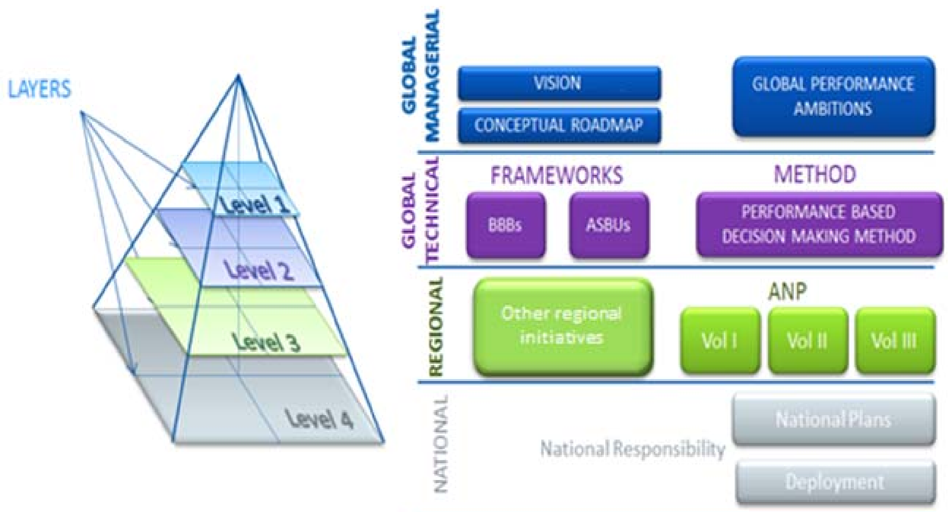
2. DISCUSSION

2.1 The Secretariat has been preparing working paper(s) on each agenda item, defining the problem and providing a brief historical background. The WPs have been already reviewed by the ANC. Some of the important issues addressed in the Secretariat Working Papers are highlighted below:

Proposed multilayer structure for the sixth edition of the Global Air Navigation Plan (GANP) and its global strategic level (WP/18)

2.2 This paper presents the multilayer structure proposed for the sixth edition of the Global Air Navigation Plan (GANP), which highlights the importance of global, regional and national planning alignment.



a) Global strategic level: will provide high-level strategic direction for decision makers to drive the evolution of the global air navigation system. The global strategic level will include a common vision, global performance ambitions and a conceptual roadmap. ICAO, with the support of States, international organizations and industry stakeholders, is developing and will maintain this level of the GANP.

b) Global technical level: will support technical managers in planning implementation of basic services and new operational improvements in a cost-effective manner and according to specific needs, while ensuring interoperability of systems and harmonization of procedures. It will contain:

- two global frameworks:

i. Basic Building Blocks (BBB) framework will outline the foundation for any robust air navigation system by defining the basic services to be provided for international civil aviation; and

ii. ASBU framework will outline the performance benefits expected from specific air navigation operational improvements under certain operational conditions.

- a performance-based method for implementation planning of air navigation operational improvements, including a catalogue of performance objectives and indicators.

c) Regional level: will address regional and sub-regional needs aligned with the global objectives. It will contain the ICAO Regional Air Navigation Plans (ANPs) and consider other regional initiatives.

d) National level: under responsibility of the States, will focus on national planning. The development by States, in coordination with relevant stakeholders, of air navigation plans as a strategic part of their national development plans and aligned with regional and global plans is crucial to achieve the common vision being developed in the GANP. These air navigation plans will serve as reference documents for national investment in air navigation infrastructure.

2.3 Comprehensive information related to the proposed amendments to the GANP and ASBUs framework, including the GANP multilayer structure is available on the GANP Portal at: **https://www4.icao.int/ganpportal**

2.4 This Working Paper proposes the following recommendation:

Recommendation 1.1/x – Vision and overview of the sixth edition of the GANP

That the Conference:

a) *agree to migrate the Global Air Navigation Plan (GANP, Doc 9750) to a web-based platform and make available the global strategic level in the six ICAO languages;*

b) *agree with the proposed multilayer structure for the sixth edition of the GANP;*

c) *agree, in principle, with the proposed vision, performance ambitions and conceptual roadmap proposed for the sixth edition of the GANP, as amended by the Conference;*

d) *request ICAO to develop a national air navigation plan template aligned with the global and regional air navigation plans; and*

e) *request ICAO to continue to work with States, international organizations and other stakeholders on the development of the sixth edition of the GANP for subsequent endorsement at the 40th Session of the ICAO Assembly.*

The proposed global technical level for the sixth edition of the Global Air Navigation Plan (GANP) (WP/19)

2.5 This paper presents the ongoing work with respect to the update of the aviation system block upgrades (ASBU) framework, including the process and guiding principles behind it, as well as a proposed change management process to keep it up to date. It also introduces the concept of a Basic Building Blocks (BBB) framework and explains the rationale for its development. These two global frameworks will be part of the global technical level in the multilayer structure proposed for the sixth edition of the Global Air Navigation Plan (GANP, Doc 9750).

2.6 The meeting may wish to note that a group of experts called ASBU Panel Project Team (ASBU PT) was formed to review the ASBU framework's structure and content. An initial draft of the new ASBU framework is available on the GANP Portal at: https://www4.icao.int/ganpportal/ASBU. Further review and update on the ASBUs framework would be as follows:

a) States and/or International Organization propose comments/changes to the ASBUs framework along with the reason for the proposed amendment and supporting documentation, if applicable;

b) ICAO Secretariat, with the support of the ASBU PPT, will conduct an initial evaluation of the proposal to prepare it for further consideration;

c) if the proposal relates to ICAO Standards and Recommended Practices (SARPs) or Procedures for Air Navigation Services (PANS), the Air Navigation Commission will review and approve, modify or reject the proposal in accordance with the established process. If not related to SARPs or PANS, the ICAO Secretariat will review and accept, modify or reject the proposal; and

d) if the proposal is approved with or without modifications based on the steps mentioned above, the ICAO Secretariat will include it in the ASBU framework. If the proposal is rejected, the ICAO Secretariat will notify the originator and provide the rationale for refusal.

2.7 The Working Paper also introduces the basic building blocks (BBB) framework. The BBB framework outlines the foundation of any robust air navigation system. It identifies basic services to be provided for international civil aviation in accordance with ICAO Standards. These basic services are defined in the areas of aerodromes, air traffic management, search and rescue, meteorology and information management. In addition to basic services, the BBB framework identifies the end users of these services as well as the assets (communications, navigation, and surveillance (CNS) infrastructure) that are necessary to provide them.

2.8 The BBB is considered an independent framework and not a block of the ASBU framework as they represent a baseline rather than evolutionary steps. This baseline is defined by basic services recognized by ICAO Member States as necessary for international civil aviation to develop in a safe and orderly manner. Once these basic services are provided, they constitute the baseline for any operational improvement. An initial draft of the BBB framework is available on the GANP Portal at: https://www4.icao.int/ganpportal/BBB

2.9 This Working Paper proposes the following recommendation:

Recommendation 1.2/x — Global Technical Level of the sixth edition of the GANP
That the Conference:

a) request ICAO to make available the Aviation System Block Upgrade (ASBU) and the basic building block (BBB) frameworks in an interactive format as part of the GANP portal;

b) agree with the proposed change management process to maintain up-to-date the ASBU framework;

c) agree, in principle, with the update of the ASBU framework and the initial version of the BBB framework as amended by the Conference; and

d) request ICAO to continue to work with States, international organizations and other stakeholders on the development of the global technical level of the sixth edition of the GANP for subsequent endorsement at the 40th Session of the ICAO Assembly.

Air Navigation Roadmaps (WP/26)

2.10 This paper presents a new approach to the development of the roadmaps provided in the Global Air Navigation Plan (GANP). This approach will maintain the original objective of the roadmaps, to assist States and stakeholders in their planning and investment decisions, while also allowing the civil aviation community to accommodate new classes of airspace user and to embrace and integrate new technology when it becomes available.

2.11 The paper proposes that the focus of the roadmaps should change from the current technological perspective to a more performance-based and capability-driven approach aligned with the evolution of the air navigation system described in the GANP and the ASBUs framework. Accordingly, the technology roadmaps would become air navigation roadmaps, requiring a change in the content and format of the roadmaps as further explained below. The Roadmaps will provide information on:

a) operational performance and capabilities linked to ASBU elements. In some cases, further research and development may be required and would be indicated;

b) the acceptable means of compliance needed to ensure that a chosen solution (which may comprise single or multiple technologies in combination) can support the required operational performance and capabilities; and

c) known solutions that can support specific operational performance requirements and capabilities.

2.12 This Working Paper proposes the following recommendation:

Recommendation 1.3/xx – Air navigation roadmaps

That the Conference:

a) *request ICAO to provide air navigation roadmaps in the Global Air Navigation Plan (GANP) which support:*

1) *new airspace users and emerging technologies;*
2) *greater flexibility in the choice of technologies for airspace users;*
3) *earlier adoption of new technologies and operational capabilities as they emerge;*

b) *urge States and international organizations to provide ICAO with timely information on States' modernization plans and the equipage plans of airspace users; and*

c) *urge States and international organizations to work collaboratively with ICAO to adopt a performance-based approach for developing performance requirements and acceptable means of compliance to support the implementation of the GANP.*

Implementing minimum Air Navigation Services for international civil aviation through the Basic Building Blocks (BBB) Framework (WP/25)

2.13 This paper highlights the importance of providing the basic services outlined in the BBB framework and requests ICAO to establish an effective process, in cooperation with the planning and implementation regional groups (PIRGs), to verify the provision of these services at a regional and national level. Finally, it encourages the use of advanced technologies for the provision of these basic services.

2.14 This Working Paper proposes the following recommendation:

Recommendation 4.2/x – Implementation of minimum air navigation services

That the Conference:

a) *request ICAO, in coordination with the planning and implementation regional groups (PIRGs), to verify the provision of the minimum air navigation services for international civil aviation outlined in the basic building blocks (BBB) framework, through the methodology for the identification of air navigation deficiencies against the regional air navigation plans;*

b) *encourage States, international organizations and industry stakeholders to consider the use of more advanced technologies to provide these minimum air navigation services taking into account the principles of global interoperability and performance specification compliance;*

c) *request ICAO to task the PIRGs with coordinating the interoperability of systems and harmonization of procedures at a regional level in relation to the use of advanced technologies and concepts of operations, taking into account global requirements;*

d) *urge States to include the planning for implementation of the basic services outlined in the BBB framework within their national air navigation plans; and*

e) *request ICAO to, in line with the No Country Left Behind (NCLB) initiative, provide the necessary technical assistance to States for the provision of basic air navigation services as identified by the PIRGs and as reflected in State national air navigation plans.*

Improving the performance of the Air Navigation System through the Aviation System Block Upgrades (WP/11)

2.15 This paper presents and encourages the adoption of a globally harmonized performance management process for the modernization of the air navigation system and clarifies the role of the aviation system block upgrade (ASBU) framework within this process. It also emphasizes the difference between implementation and performance metrics and highlights the importance of global, regional and national planning alignment to attain a globally harmonized performance management process.

2.16 The WP highlights the ICAO globally harmonized performance management process based on six well-defined steps, as introduced in the *Manual on Global Performance of the Air Navigation System* (Doc 9883).

2.17 In order to support the defining of performance objectives in step 2 (Identify Opportunities, Issues and Set (new) Objectives), ICAO has developed a performance objectives catalogue, available on the GANP Portal, that contains performance objectives expressed in a qualitative and focused way within eleven key performance areas. In addition, ICAO is developing new key performance indicators to be included in the list of potential key performance indicators, available on the GANP Portal (https://www.icao.int/airnavigation/Documents/GANP-Potential_Performance_Indicators.pdf), as at **Appendix B**. These key performance indicators are linked to the relevant objectives in the performance objectives catalogue to support the execution of step three (Quantify Objectives) of the six-step ICAO performance process.

2.18 This Working Paper proposes the following recommendation:

Recommendation 4.3/x – Improving the performance of the air navigation system

That the Conference:

a) *encourage ICAO regions to embrace a performance-based approach and adopt the six-step performance management process, described in the Manual on Global Performance of the Air Navigation System (Doc 9883), by reflecting it in Volume III of the Regional Air Navigation Plans;*

b) *encourage States to adopt the six-step performance management process for the planning and implementation of air navigation improvements and reflect this process in their national air navigation plans;*

c) *urge States to align national air navigation plans with regional plans to attain a globally harmonized performance management process and support the achievement global performance objectives; and*

d) *request ICAO to continue the development of the performance objectives and key performance indicators catalogue as part of the development of the Global Air Navigation Plan (Doc 9750).*

Cost-benefit analysis as part of a business case in support of assets deployment (WP/22)

2.19 This paper presents a cost-benefit analysis (CBA) checklist to support the development of air navigation infrastructure through the aviation system block upgrade (ASBU) framework and to assist in securing funding and financing for asset deployment.

2.20 This Working Paper proposes the following recommendation:

Recommendation 1.4/X – Cost-benefit analysis (CBA) in support of assets deployment

That the Conference:

a) urge States and air navigation service providers (ANSPs) to perform a cost-benefit analysis (CBA) when defining optimum solutions for improved performance of the air navigation system through the use of the aviation system block upgrades (ASBU) framework;

b) encourage States and ANSPs that do not have a process already in place to use a simplified mechanism, such as the checklist available in the GANP Portal for cost-benefit analysis of air navigation infrastructure investment projects, to support improvements as described in the aviation system block upgrade (ASBU) framework; and

c) request ICAO to support the implementation of cost-benefit analysis through dedicated workshops.

3. ACTION BY THE MEETING

3.1 The meeting is invited to encourage:

a) States and Stakeholders to participate actively in the AN-Conf/13; and

b) States to provide their inputs to the Conference by submitting Working/Information Papers (WPs/IPs) according to the guidelines and deadlines indicated at Para. 1.2.

AN-Conf/13-WP/1
17/4/18

International Civil Aviation Organization

WORKING PAPER

THIRTEENTH AIR NAVIGATION CONFERENCE

Montréal, Canada, 9 to 19 October 2018

AGENDA FOR AN-CONF/13

(Presented by the Secretariat)

COMMITTEE A

Agenda Item 1: Air navigation global strategy

1.1: Vision and overview of the sixth edition of the GANP
1.2: Air navigation performance improvement and measurement through the aviation system block upgrades (ASBUs) and basic building blocks (BBBs) framework
1.3: Air navigation roadmaps
1.4: Air navigation business cases

The Conference will be invited to put forward recommendations on:

a) the vision, performance ambitions and overview proposed for the sixth edition of the GANP;
b) the latest developments of the ASBUs framework;
c) the BBBs framework; and
d) the air navigation roadmaps and the methodology for development of business cases.

Agenda Item 2: Enabling the global air navigation system

2.1: Aerodrome operations and capacity
2.2: Integrated CNS and spectrum strategy
2.3: Future provision of aeronautical meteorological service

The Conference will be invited to put forward recommendations on:

a) how to improve aerodrome operations and reinforce its relationship with the ATM environment, and a future strategy to increase aerodrome capacity enabling the enhancement of the whole system capacity through optimized airport planning and design and total airport management;
b) an integrated CNS and spectrum strategy — the evolution and rationalization of the global CNS infrastructure, taking into account its impact on the air navigation system as a whole and increasing pressures on aeronautical frequency spectrum; and
c) how MET services will be provided in the future.

Agenda Item 3: Enhancing the global air navigation system

3.1: System-wide information management (SWIM)
3.2: Flight and flow information for a collaborative environment (FF-ICE) and trajectory-based operations (TBO)
3.3: Air traffic flow management (ATFM)
3.4: Civil/military cooperation
3.5: Other ATM issues

The Conference will be invited to put forward recommendations on:

a) a system to exchange data and information on a global basis which can support the evolution of the air navigation system towards trajectory-based operations;
b) how ATFM can improve and evolve aiming a future trajectory-based operations;
c) how to improve civil-military cooperation and collaboration for the benefit of both airspace users and to attend specific mission requirements; and
d) other ATM issues that are necessary to enhance the performance of the air navigation system as a whole.

Agenda Item 4: Implementing the global air navigation system and the role of planning and implementation regional groups (PIRGs)

4.1: The economic benefits brought by aviation
4.2: Implementing BBBs and minimum service Standards
4.3: Implementing ASBUs for performance improvement
4.4: Implementing search and rescue (SAR) processes and procedures

The Conference will be invited to put forward recommendations on:

a) how aviation can better contribute to a State's economic development;
b) how PIRGs can improve contribution to regional development;
c) facilitating implementation of BBBs services and ASBUs elements; and
d) improving implementation of SAR processes and procedures.

Agenda Item 5: Emerging issues

5.1: Operations above Flight Level 600
5.2: Operations below 1000 feet
5.3: Remotely piloted aircraft system (RPAS)
5.4: Cyber resilience
5.5: Other emerging issues impacting the global air navigation system including unmanned aircraft systems (drones), and supersonic and commercial space operations

The Conference will be invited to put forward recommendations on:

a) the process and procedures to improve the management of operations above FL600 and below 1000ft;
b) the regulatory framework to enable the integration of RPAS in non-segregated airspace;
c) cyber strategies to reduce system vulnerabilities; and
d) any other emerging issues that may impact safety and regularity of the air navigation system.

COMMITTEE B

Agenda Item 6: Organizational safety issues

6.1 Strategic plan

6.1.1: Vision and overview of the Global Aviation Safety Plan (GASP), 2020-2022 edition
6.1.2: Enabling safety performance monitoring; goals, targets and indicators in the 2020-2022 edition of the GASP
6.1.3: Global Aviation Safety Oversight System (GASOS)

6.2 Implementation of safety management

6.2.1: State safety programmes (SSPs)
6.2.2: Safety management systems
6.2.3: Developing safety intelligence

6.3 Monitoring and Oversight

6.3.1: The evolution of the Universal Safety Oversight Audit Programme (USOAP) continuous monitoring approach (CMA)
6.3.2: Support and the USOAP CMA Online Framework (OLF)

The Conference will be invited to put forward recommendations on:

a) the 2020-2022 edition of the GASP;
b) plans for the evolution of the USOAP CMA;
c) strategies to support the development of safety intelligence; and
d) the proposed GASOS.

Agenda Item 7: Operational safety risks

7.1: Facilitation of data-driven decision-making in support of safety intelligence to support safety risk management
7.2: Operational safety risks at the global, regional and national levels, and the role of RSOOs and RASGs in achieving the GASP goals
7.3: Other implementation issues

The Conference will be invited to put forward recommendations on:

a) the sharing of data sources for developing safety intelligence in support of safety risk management;

b) global, regional and national initiatives to address high risk categories (HRCs) of accidents; and

c) other recognized operational safety issues.

Agenda Item 8: Emerging safety issues

8.1: Measures to proactively address emerging issues;
8.2: Emerging safety issues

The Conference will be invited to put forward recommendations on:

a) initiatives to proactively address emerging safety issues;
b) global, regional and national initiatives to address emerging safety issues.

— END —

Description of the potential performance indicators presented in the GANP 2016

Note: these indicators, definitions and descriptions are used by different States and organizations that already have published performance information. They are provided for information and might differ from indicators and definitions contained in existing ICAO documentation.

Table 1 below provides an overview of each indicator. A description in greater level of details can be found in the following pages.

Table 1 Potential key performance indicators (KPIs) definition

Flight phase or event	ID	Name	Definition
Off-blocks (OUT)	**KPI01**	Departure punctuality	Percentage of flights departing from the gate on-time (compared to schedule) [avg. per traffic flow, per airport or per cluster of airports]
Taxi-out	**KPI02**	Taxi-out additional time	Actual taxi-out time compared to an unimpeded taxi-out time [avg. per airport or per cluster of airports]
Take-off (OFF)	**KPI03**	ATFM slot adherence	Percentage of flights taking off within their assigned ATFM slot (Calculated Take-Off Time Compliance) [avg. per airport or per cluster of airports]
En-route	**KPI04**	Filed flight plan en-route extension	Flight planned en-route distance compared to a reference ideal trajectory distance [avg. per traffic flow or airspace volume]
	KPI05	Actual en-route extension	Actual en-route distance flown compared to a reference ideal distance [avg. per traffic flow or airspace volume]
	KPI06	En-route airspace capacity	The maximum number of movements an airspace volume will accept under normal conditions in a given time period (also called declared capacity) [per airspace volume]
	KPI07	En-route ATFM delay	ATFM delay attributed to flow restrictions in a given en-route airspace volume [avg. per airspace volume]
Descent & terminal area arrival	**KPI08**	Additional time in terminal airspace	Actual terminal airspace transit time compared to an unimpeded time [avg. per airport or per cluster of airports]
Landing (ON)	**KPI09**	Airport peak arrival capacity	The highest number of landings an airport can accept in a one-hour time frame (also called declared arrival capacity, or airport acceptance rate) [per airport]
	KPI10	Airport peak arrival throughput	The 95th percentile of the hourly number of landings recorded at an airport, in the "rolling" hours sorted from the least busy to the busiest hour [per airport]
	KPI11	Airport arrival capacity utilization	Airport arrival throughput (accommodated demand) compared to arrival capacity or demand, whichever is lower [per airport]
	KPI12	Airport/Terminal ATFM delay	ATFM delay attributed to arrival flow restrictions at a given airport and/or associated terminal airspace volume [avg. per airport or per cluster of airports]
Taxi-in	**KPI13**	Taxi-in additional time	Actual taxi-in time compared to unimpeded taxi-in time [avg. per airport or per cluster of airports]
In-blocks (IN)	**KPI14**	Arrival punctuality	Percentage of flights arriving at the gate on-time (compared to schedule) [avg. per traffic flow, per airport or per cluster of airports]

Per flight phase or gate-to-gate	**KPI15**	Flight time variability	Distribution of the flight (phase) duration around the average value [avg. per airport or per traffic flow]
	KPI16	Additional fuel burn	Additional flight time/distance converted to estimated additional fuel burn attributable to ATM [avg. per flight, airport or per airspace volume]

Detailed descriptions of potential key performance indicators

KPI ID	**KPI01**
KPI Name	**Departure punctuality**
Definition	Percentage of flights departing from the gate on-time (compared to schedule)
Measurement Units	% of scheduled flights
Variants	Variant 1 – departure punctuality within 5 minutes of scheduled departure time Variant 2 – departure punctuality within 15 minutes of scheduled departure time
Operations measured	Departures of scheduled flights
Object(s) 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 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 departure time (STD) - 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 (June 2014)

KPI ID	KPI02
KPI Name	**Taxi-out additional time**
Definition	Actual taxi-out time compared to an unimpeded/reference taxi-out time
Measurement Units	Minutes/flight
Variants	Variant 1 – basic (computed without departure gate and runway data) Variant 2 – advanced (computed with departure gate and runway data)
Operations measured	The duration of the taxi-out phase of departing flights
Object(s) 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 (June 2014) PRC Performance Review Report (EUROCONTROL 2015) Single European Sky Performance Scheme CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI ID	KPI03
KPI Name	**ATFM slot adherence**
Definition	Percentage of flights taking off within their assigned ATFM slot (Calculated Take-Off Time Compliance)
Measurement Units	% of flights subject to flow restrictions
Variants	None
Operations measured	The take-off of IFR flights subject to flow restrictions
Object(s) 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: the period between 5 minutes before and 10 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 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	Single European Sky Performance Scheme CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI ID	**KPI04**
KPI Name	**Filed flight plan en-route extension**
Definition	Flight planned en-route distance compared to a reference ideal distance
Measurement Units	% excess distance
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
Operations measured	The planned en-route distance, as selected during the preparation of flight plans
Object(s) 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.

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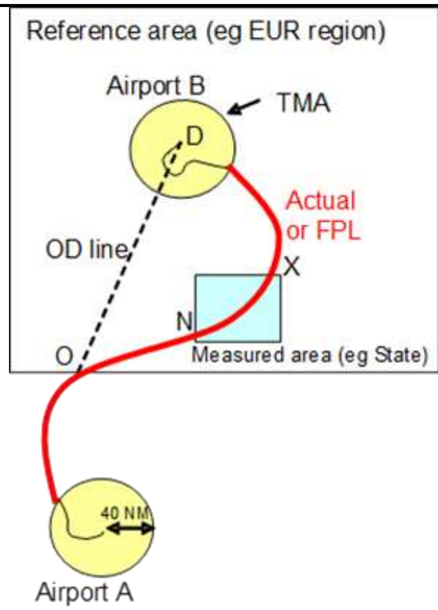
<tr>
<td>

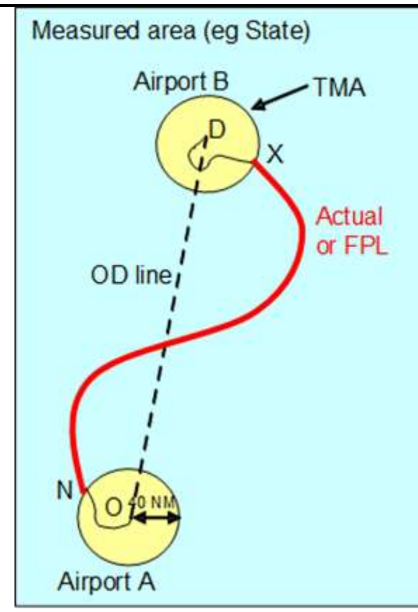
Figure 1 - Significant points and trajectory segments (example 1)</td>
<td>

Figure 2 - Significant points and trajectory segments (example 2)</td>
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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.
</td>
</tr>
<tr>
<td>References & examples of use</td>
<td>ICAO EUR Doc 030 EUR Region Performance Framework Document (July 2013)
Comparison of ATM-Related Operational Performance: U.S./Europe (June 2014)
PRC Performance Review Report (EUROCONTROL 2015)
Single European Sky Performance Scheme
CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)</td>
</tr>
</table>

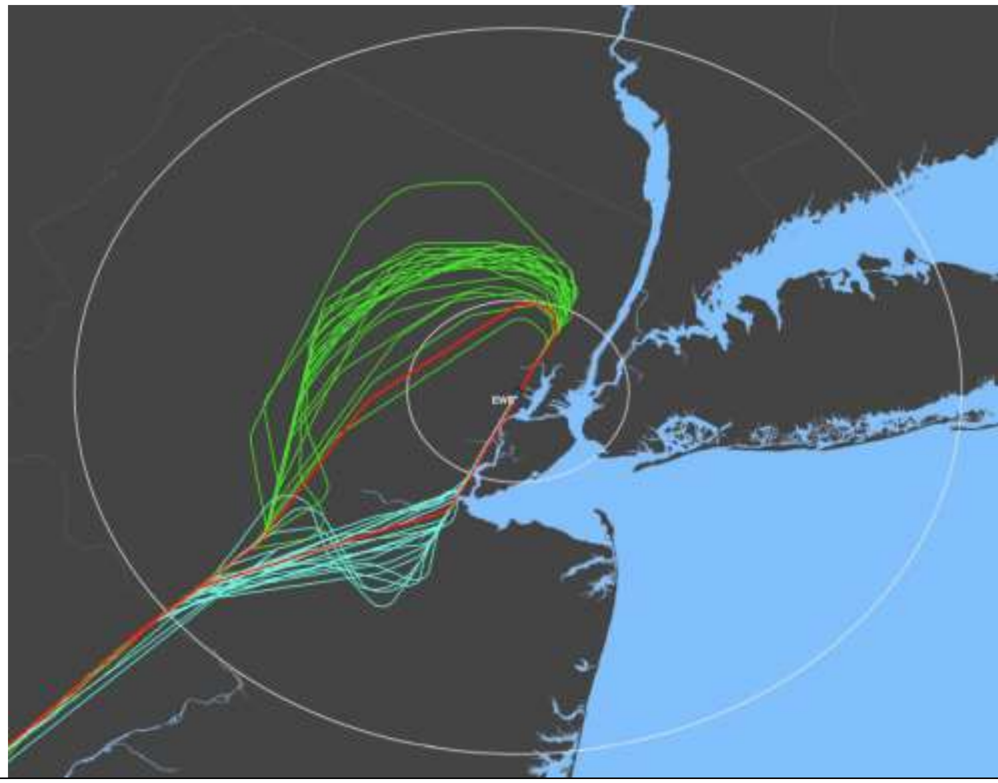
KPI ID	KPI05
KPI Name	**Actual en-route extension**
Definition	Actual en-route distance flown compared to a reference ideal distance
Measurement Units	% excess distance
Variants	Variant 1, using a 40 NM cylinder around the departure and destination airport as the start/end of en-route airspace Variant 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
Operations measured	The actual distance flown by flights in en-route airspace
Object(s) 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 (June 2014) PRC Performance Review Report (EUROCONTROL 2015) Single European Sky Performance Scheme CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI ID	KPI06
KPI Name	**En-route airspace capacity**
Definition	The maximum number of movements an airspace volume will accept under normal conditions in a given time period (also called declared capacity)
Measurement Units	Movements/hr
Variants	None
Operations measured	The nominal capability of an ANSP to deliver ATM services to IFR traffic in a given volume of en-route airspace.
Object(s) 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 of an en-route facility or sector. Declared capacities are used in real time 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 declared daily based on known/current operational factors. Declaring capacities 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.
Parameters	None
Data requirement	Declared capacities are determined by the ANSP, and are dependent on traffic pattern and sector configuration. Some ANSPs determine the capacity at facility level using a simulation tool: a given traffic pattern is iteratively grown, until the annual ATFM delay per flight reaches a predetermined maximum acceptable value. The throughput at which this occurs is the airspace capacity.
Data feed providers	ANSPs
Formula / algorithm	At the level of an individual en-route facility: 1. Select highest value from the set of declared capacities (the maximum configuration capacity) 2. Compute the KPI: convert the value to an hourly movement rate, if the declaration is at smaller time intervals
References & examples of use	CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI ID	**KPI07**
KPI Name	**En-route ATFM delay**
Definition	ATFM delay attributed to flow restrictions in a given en-route airspace volume
Measurement Units	Minutes/flight
Variants	None
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
Object(s) 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 (June 2014) PRC Performance Review Report (EUROCONTROL 2015) Single European Sky Performance Scheme CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

<table>
<tr><th>KPI ID</th><th>KPI08</th></tr>
<tr><th>KPI Name</th><th>Additional time in terminal airspace</th></tr>
<tr><td>Definition</td><td>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.

</td></tr>
<tr><td>Measurement Units</td><td>Minutes/flight</td></tr>
<tr><td>Variants</td><td>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.
<table>
<tr><td></td><td>40 NM cylinder</td><td>100 NM cylinder</td></tr>
<tr><td>Advanced data feed</td><td>Variant A40</td><td>Variant A100</td></tr>
<tr><td>Basic data feed</td><td>Variant B40</td><td>Variant B100</td></tr>
</table></td></tr>
<tr><td>Operations measured</td><td>The terminal airspace transit time during the arrival flight phase</td></tr>
<tr><td>Object(s) characterized</td><td>The KPI is typically computed for individual airports, or clusters of airports (selection/grouping based on size and/or geography)</td></tr>
<tr><td>Utility of the KPI</td><td>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</td></tr>
</table>

	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 (June 2014) PRC Performance Review Report (EUROCONTROL 2015) Single European Sky Performance Scheme CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI ID	KPI09
KPI Name	**Airport peak arrival capacity**
Definition	The highest number of landings an airport can accept in a one-hour time frame (also called declared arrival capacity, or airport acceptance rate)
Measurement Units	Number of landings / hour
Variants	None
Operations measured	The capacity declaration of an airport
Object(s) characterized	The KPI is computed for individual airports
Utility of the KPI	This KPI indicates the highest landing rate 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)
Data feed providers	Airports
Formula / algorithm	At the level of an individual airport: 1. Select highest value from the set of declared arrival capacities 2. Compute the KPI: convert the value to an hourly landing rate, if the declaration is at smaller time intervals
References & examples of use	Comparison of ATM-Related Operational Performance: U.S./Europe (June 2014) CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI ID	KPI10
KPI Name	**Airport peak arrival throughput**
Definition	The 95th percentile of the hourly number of landings recorded at an airport, in the "rolling" hours sorted from the least busy to the busiest hour
Measurement Units	Number of landings / hour
Variants	Variant 1: IFR arrivals only Variant 2: IFR + VFR arrivals (relevant for airports with a high percentage of VFR traffic)
Operations measured	The actual number of landings at an airport
Object(s) characterized	The KPI is computed for individual airports
Utility of the KPI	This KPI gives an indication of "busy-hour" landing 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 arriving flight: - Actual landing time (ALDT)
Data feed providers	Airports
Formula / algorithm	At the level of individual flights: 1. Select arrivals, exclude helicopters At the level of individual "rolling" hours: 2. Convert the set of landings to hourly landing rates by "rolling" hour 3. Sort the "rolling" hours from the least busy to the busiest hour 4. Compute the KPI: it equals the landing rate value of the 95th percentile of the "rolling" hours
References & examples of use	Comparison of ATM-Related Operational Performance: U.S./Europe (June 2014)

KPI ID	KPI11
KPI Name	**Airport arrival capacity utilization**
Definition	Airport arrival throughput (accommodated demand) compared to arrival capacity or demand, whichever is lower
Measurement Units	%
Variants	Variant 1: IFR arrivals only
Operations measured	The number of unaccommodated landings at an airport
Object(s) characterized	The KPI is computed for individual airports
Utility of the KPI	This KPI assesses how effectively arrival 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" arrival 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 flight: - Actual landing time (ALDT) - Estimated landing time (ELDT) (from flight plan) For each time interval: - Declared landing capacity of the airport
Data feed providers	Airports
Formula / algorithm	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: utilization = throughput / capacity 3b. if demand < capacity: utilization = throughput / demand At aggregated level (longer time periods): 4. Compute the KPI: sum(utilization*demand) / sum(demand)
References & examples of use	CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI ID	KPI12
KPI Name	**Airport/Terminal ATFM delay**
Definition	ATFM delay attributed to arrival flow restrictions at a given airport and/or associated terminal airspace volume
Measurement Units	Minutes/flight
Variants	None
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
Object(s) 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 2015) Single European Sky Performance Scheme CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI ID	**KPI13**
KPI Name	**Taxi-in additional time**
Definition	Actual taxi-in time compared to an unimpeded/reference taxi-in time
Measurement Units	Minutes/flight
Variants	Variant 1 – basic (computed without landing runway and arrival gate data) Variant 2 – advanced (computed with landing runway and arrival gate data)
Operations measured	The duration of the taxi-in phase of arriving flights
Object(s) 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: ALDT minus AIBT 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 (June 2014) PRC Performance Review Report (EUROCONTROL 2015) CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI ID	KPI14
KPI Name	**Arrival punctuality**
Definition	Percentage of flights arriving at the gate on-time (compared to schedule)
Measurement Units	% of scheduled flights
Variants	Variant 1 – arrival punctuality within 5 minutes of scheduled arrival time Variant 2 – arrival punctuality within 15 minutes of scheduled departure time
Operations measured	IFR arrivals of scheduled airlines
Object(s) 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 departure time (STA) - 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 (June 2014)

KPI ID	KPI15
KPI Name	**Flight time variability**
Definition	Distribution of the flight (phase) duration around the average value
Measurement Units	Minutes/flight
Variants	Different parameter values possible (see 'Parameters')
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)
Object(s) 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 15^{th} percentile (percentile 1) is used to determine the shortest duration, the 85^{th} 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 20^{th} percentile (percentile 1) is used to determine the shortest duration, the 80^{th} 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 (June 2014) PRC Performance Review Report (EUROCONTROL 2015) CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI ID	**KPI16**
KPI Name	**Additional fuel burn**
Definition	Additional flight time/distance converted to estimated additional fuel burn attributable to ATM
Measurement Units	kg fuel/flight
Variants	None
Operations measured	Actual IFR flights
Object(s) characterized	This KPI is a conversion of the additional flight time/distance KPIs to a corresponding (estimated) additional fuel consumption; hence it describes a performance characteristic of the same objects as the additional flight time/distance 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 CO_2 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. Two remarks need to be made here: 1. In practice the actionable "benefit pool" is smaller: real optimum performance is achieved at a residual non-zero value of the KPI. 2. Certain ATM-related inefficiencies are not covered by this KPI. For example ATM can deliver additional fuel burn benefits by removing vertical flight efficiency constraints.
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
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)
Data feed providers	Performance analysts
Formula / algorithm	At aggregated level: Compute the KPI: (Taxi-Out Additional Time x Average fuel flow during taxi) + (Taxi-In Additional Time x Average fuel flow during taxi) + (Actual en-Route Extension (%) x average en-route distance flown x Average fuel flow in en-route airspace) + (Additional time in terminal airspace x Average fuel flow during arrival in terminal airspace)
References & examples of use	Comparison of ATM-Related Operational Performance: U.S./Europe (June 2014)