



Strategy Document

Aeronautical Information Exchange Model (AIXM) Strategy

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1. Glossary of Terms

Aeronautical data. A representation of aeronautical facts, concepts or instructions in a formalised manner suitable for communication, interpretation or processing.

Aeronautical Information Management (AIM). The dynamic, integrated management of aeronautical information through the provision and exchange of quality-assured digital aeronautical data in collaboration with all parties.

Aeronautical Information Product. Aeronautical data and aeronautical information provided either as digital data sets or as a standardised presentation in paper or electronic media. Aeronautical Information Products include:

- Aeronautical Information Publication (AIP), including Amendments and Supplements;
- Aeronautical Information Circulars (AIC);
- Aeronautical charts;
- NOTAM;
- Digital data sets.

Note.—Aeronautical information products are intended primarily to satisfy international requirements for the exchange of aeronautical information.

Aeronautical Information Regulation and Control (AIRAC). A system aimed at advance notification, based on common effective dates, of circumstances that necessitate significant changes in operating practices.

Air Traffic Management (ATM). The dynamic, integrated management of air traffic and airspace (including air traffic services, airspace management and air traffic flow management) — safely, economically and efficiently — through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions.

Data. A representation of fact, concept, or instruction represented in a formalised form suitable for communication, interpretation or processing either by human and/or by automated systems.

Note. — This is the lowest level of abstraction, compared to information and knowledge.

Database. A collection of data stored in structured digital format so that appropriate applications may retrieve and update it.

Note. — This primarily refers to digital data (accessed by computers) rather than files of physical records.

Data accuracy. A degree of conformance between the estimated or measured value and the true value.

Data completeness. The degree of confidence that all of the data needed to support the intended use is provided.

Data Dictionary. or metadata repository, is a "centralised repository of information describing the contents, format, and structure of a database and the relationship between its elements, used to control access to and manipulation of the database.

Data format. A structure of data elements, records and files arranged to meet standards, specifications or data quality requirements.

Data integrity (assurance level). A degree of assurance that an aeronautical data and its value has not been lost or altered since the origination or authorised amendment.

Data Management. The management of resources and processes for the development and execution of the architectures, policies, practices and procedures that properly manage the full data lifecycle throughout the collection, validation, integration, storage, protection, exchange and delivery of accredited, quality-assured and timely data.

Data product. Data set or data set series that conforms to a data product specification (ISO 19131*).

Data product specification. Detailed description of a data set or data set series together with additional information that will enable it to be created, supplied to and used by another party (ISO 19131*).

Data quality. A degree or level of confidence that the data provided meet the requirements of the data user in terms of accuracy, resolution, integrity (or equivalent assurance level), traceability, timeliness, completeness and format.

Data resolution. A number of units or digits to which a measured or calculated value is expressed and used.

Data timeliness. The degree of confidence that the data is applicable to the period of its intended use.

Data traceability. The degree that a system or a data product can provide a record of the changes made to that product and thereby enable an audit trail to be followed from the end-user to the originator.

Data set. Identifiable collection of data (ISO 19101*).

Data set series. Collection of data sets sharing the same product specification (ISO 19115*).

Extensible Mark-up Language (XML). A step in the evolution of web data formats (beyond HTML).

Information. Data that:

- (1) has been verified to be accurate and timely,
- (2) is specific and organised for a purpose,
- (3) is presented within a context that gives it meaning and relevance, and which
- (4) leads to increase in understanding and decrease in uncertainty. The value of information lies solely in its ability to affect a behaviour, decision, or outcome.

Information Consumer. The person, application or system consuming an information service. Also called consumer.

Infrastructure. The logical and physical (i.e., hardware and software) elements that together provide (SWIM) functionality.

Internet. A system of computer networks that interconnect worldwide and use the Transmission Control Protocol/Internet Protocol (TCP/IP) for transmission and recovery of information.

Internet protocol (IP). A protocol used to route data packets from source to destination in an Internet (interconnected networks) environment.

Metadata. Data about data (ISO 19115*)

Note. — A structured description of the content, quality, condition or other characteristics of data.

Origination (aeronautical data or aeronautical information). The creation of the value associated with new data or information or the modification of the value of an existing data or information.

Originator (aeronautical data or aeronautical information). An entity that is accountable for data or information origination and from which the AIS organisation receives aeronautical data and information.

Quality. Degree to which a set of inherent characteristics fulfils requirements (ISO 9000*).

Traceability. Ability to trace the history, application or location of that which is under consideration (ISO 9000*).

Validation. Confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled (ISO 9000*).

Verification. Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled (ISO 9000*).

Service (application function). An implementation-independent reusable operational function that may be discovered as self-describing interfaces, and invoked using open standard protocols across networks. Services can be combined and orchestrated to produce composite services and operations processes, in accordance with predefined policies, security and service level agreements.

Service Provider. An organisation or entity providing a service. Refers (in this document) to ATM Service Providers (ASPs) or vendors that provide network or other value-added services; distinct from an information provider.

2. Abbreviations and Acronyms

Abbreviation	Description
AIC	Aeronautical Information Circular
AICM	Aeronautical Information Conceptual Model
AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation and Control
AIXM	Aeronautical Information Exchange Model
ATM	Air Traffic Management
ICAO	International Civil Aviation Organisation
GANP	Global Air Navigation Plan
GATMOC	Global Air Traffic Management Operational Concept
GML	Geography Mark-Up Language
IM	Information Management
ISO	International Standards Organisation
NOTAM	Notice to Airmen
XML	Extensible Mark-up Language

3. Executive Summary

3.1 Document Purpose

The purpose of this document is to define the AIXM Strategy for **[State or Service Provider Name]** to ensure alignment with ICAO Global Air Navigation Plan (GANP Doc 9750) and ICAO SARP's as defined in ICAO Annex 15 and Procedures for Air Navigation Services – Aeronautical Information Management (PANS AIM Doc 10066).

3.2 Background

Aeronautical Information has been defined as a key enabler of the future Air Traffic Management (ATM) System in accordance with the Global ATM Operational Concept (GATMOC - ICAO Doc 9854). For Aeronautical Information to support the data centric and interconnected ATM system, Aeronautical Information Services is required to transition from a paper-based system to an electronic based system, where data is shared between the various ATM systems and components in a structured and standardised format.

The transition brought about the development of the Aeronautical Information Conceptual Model (AICM) and the Aeronautical Information Exchange Model (AIXM) to enable the change from a paper environment to a digital environment. AICM provides a formal description of the aeronautical items, using standardised data modelling language. This standardised data model enables the automated processing of aeronautical information by the users, ensuring better quality, integrity and accuracy of information whilst limiting the occurrence of human induced errors. AICM forms the basis of AIXM.

AIXM is a specification designed to enable the encoding and distribution of aeronautical information in digital format. The AIXM format is based on Extensible Markup Language (XML), and it is used for the storing, transmitting, and reconstructing data, ensuring standardised interfaces between computers. This

includes information such as airport area data, airspace structures, organisations and units, points and nav aids, procedures, routes and flying restrictions.

AIXM supports the collection, verification, dissemination and transformation of digital aeronautical data throughout the data chain, in particular in the segment that connects AIS with the next intended user.

3.3 Implications

Not transitioning from a paper-based AIS environment to a digital data centric Aeronautical Information environment poses a serious risk to the availability, quality and integrity of Aeronautical Information within the operations of the ATM system. This is important to consider, taking into account the evolution of the ATM system as well as AIM developments to ensure **[State or Service Provider Name]** is able to keep up with the global progression of aeronautical data.

3.4 Recommendation

As the implementation of AIXM is a key component of the ATM system operations, **[State or Service Provider Name]** is required to implement AIXM, not only to ensure interconnectivity with the ATM system at National and Regional level, but also at Global level.

4. Introduction

The AIXM Strategy serves as a guide for the implementation of AIXM for **[State and/or Service provider Name]**. The intention of this strategy is to ensure all applicable aspects are considered for the effective implementation of AIXM within **[State Name]**.

4.1 Background

The 16th Edition of Annex 15 — Aeronautical Information Services and the new Procedure for Air Navigation Services — Aeronautical Information Management (Doc 10066, PANS-AIM) introduced significant changes to the scope of traditional AIS. The amendments to the ICAO SARPs have introduced new aspects for AIS products and services through the definition of various data sets (AIP, terrain, obstacle, aerodrome mapping and Instrument Flight Procedure data sets) as well as the introduction of aeronautical data catalogue requirements. These aeronautical datasets shall be exchanged through globally standardized exchange modules such as the Aeronautical Information Exchange Model (AIXM).

All contracting states are required to implement ICAO strategies and SARP's to ensure Global alignment and seamless operations for aviation.

The 12th ICAO Air Navigation Conference (AN-Conf/12) Recommendation 3/8(c) called for the intraregional and interregional cooperation to ensure an expeditious transition from aeronautical information service (AIS) to aeronautical information management (AIM) in a harmonised manner and the use of digital data exchange and regional or subregional AIS databases as an enabler for the transition from AIS to AIM.

4.2 Document Purpose

The purpose of the AIXM Strategy is to:

- a) Define the aspects to be considered to implement AIXM successfully for **[State and/or Service provider Name]**.

- b) Assess and describe any potential risk and/or gaps, issues or limitations that will affect the implementation of AIXM within the State.
- c) Provide an articulation of objectives and proposed timelines that will ease AIXM implementation within the State.

4.3 Reference documents

- a) ICAO Doc 9854 - Global Air Traffic Management Operational Concept
- b) ICAO Doc 9750 - Global Air Navigation Plan
- c) ICAO Annex 15 – Aeronautical Information Services
- d) ICAO Doc 10066 – Procedure for Air Navigation Services – Aeronautical Information Management
- e) ICAO AIS to AIM Roadmap

5. Strategic objectives

The Strategic objectives of the AIXM Strategy can be described as follows:

- a) To comply with ICAO SARPs as defined in ICAO Annex 15 and PANS-AIM Doc 10066 with associated amendments in relation to digital datasets.
- b) To enable the digital capturing of aeronautical data whilst ensuring the integrity of aeronautical information is maintained through-out the aeronautical data processing chain.
- c) To provide supporting regulations to enable the operations and use of AIXM within the State.
- d) To ensure Aeronautical Information is digitally represented, stored in a digital database, from which it can be retrieved in order to be sorted, filtered, graphically displayed, or otherwise manipulated and digitally disseminated.
- e) To ensure that aeronautical information is globally harmonised via common data definitions, data models, data exchange formats, measured using agreed upon units of measurement and common frames of reference.
- f) To enable the temporality of aeronautical information in support of operational decision making through all phases of flight, including planning, pre-flight, inflight and post-flight.
- g) To develop supporting Quality Management System processes and procedures including Service Level Agreements to improve data quality, integrity and accuracy.
- h) To outline the training requirements for AIXM implementation.

6. Current Situational Analysis

6.1 Organisation Structure

[The State and/or Service provider is required to define its structure including roles and associated responsibilities in this section. This will influence how the regulations including associated processes and procedures are developed and tailored to the specific States needs]

6.2 Key Considerations

Key considerations for [State and/or Service provider Name] to indicate the number of activities that needs to be undertaken to successfully implement AIXM include:

- a) Does the state want to implement AIXM between the internal systems (ATC, AIM, etc) or establish an AIXM database.
- b) In what AIXM version will information be exchanged? (Latest versions is AIXM 5.1)
- c) Is all the information in the AIP complete, accurate and quality assured and published in accordance with the aeronautical data quality requirements and publication resolution as contained in ICAO Annex 14/15.
- d) Does the state have the infrastructure (network and database) capable of hosting/managing Aeronautical Information Product data in AIXM format.
- e) Does the state have regulations to support the collection and management of AIP data. (Aeronautical Data Quality - ADQ, certification of Air navigation Service Providers - ANSP by Civil Aviation Authority - CAA to provide AIM services, Airport survey data, requirement for annual/maintenance surveys to airports, collection of geometrical data of airport layouts for Aerodrome Mapping Database (AMDB) and charting, WGS-84 survey standards for surveyors to comply with when conducting airport surveys, etc)
- f) Does the state have Service Level Agreements in place with data originators defining the data quality and integrity standards and submission timelines/process of data.
- g) Is the data obtained through surveying (WGS-84) or through other means (photographic/stereo graphic/lidar/autocad engineering drawing

information processing) – Is there regulations/standards to govern the different formats.

- h) Does the state have resources to manage/maintain the AIXM database.
- i) If the state does not have the resources or infrastructure to maintain an AIXM database, can this function be outsourced to another state/service provider? (Is this other state ISO certified and capable of managing the AIXM database)
- j) Are the resources of the state adequately trained in managing an AIXM database.
- k) Is data processed and published in accordance with AIRAC.
- l) Does the state have a Quality Management System (QMS) - ISO Certified, (encompassing all functions of the AIS provider) with associated processes and procedures to ensure the quality process of the data from originator to publication (Controlled Harmonised Aeronautical Information Network – CHAIN) in the Aeronautical Information Product.

6.3 SWOT Analysis

Table 1: AIXM SWOT Analysis

[The State and/or Service provider is required to conduct an internal SWOT analysis to identify specific areas of interest which should form part of the AIXM implementation plan]

	<i>STRENGTHS</i>	<i>WEAKNESSES</i>
INTERNAL FACTORS	a.	a.
	<i>OPPORTUNITIES</i>	<i>THREATS</i>
EXTERNAL FACTORS	a.	a)

7. Strategic Actions

7.1 Timescales

- 7.1.1 Each step of the AIXM Strategy indicate the necessary steps to transition from the current AIS environment of **[State or Service provider name]** to an AIM environment.
- 7.1.2 Inevitably, the accuracy of the AIXM Strategy in the short-term is higher than that of the longer terms. Therefore, although the AIXM Strategy up to 2025 is considered ‘mature’, it needs to be updated regularly. The AIXM Strategy is therefore defined into the follow 3 timeframes, namely:
- The AIXM Strategy from Short-Term (1 – 2 years);
 - The AIXM Strategy from Medium-Term (3 – 5 years);
 - The AIXM Strategy from Long-Term (5 Years and beyond).

7.2 Summary of Strategic Actions

- 7.2.1 The summary of the short-term strategic actions and timelines of the AIXM Strategy for the next two (2) years is illustrated in the table 2 below:

Table 2: Short Term Activities

ACTI ON NUM BER	PRI O RITY ACTI ON	ACTIVITY	DESCRIPTION	PARTICIP ANTS/ CONTRIB UTORS	START DATE
A1		Example: Development of AIXM Implementati on Plan			

7.2.2 The summary of the short-term strategic actions and timelines of the AIXM Strategy for the next three to five (3-5) years is illustrated in the table 3 below:

Table 3: Medium-Term Activities

ACTI ON NUM BER	PRIO RITY ACTI ON	ACTIV ITY	DESCRIPTION	PARTICIP ANTS/ CONTRIB UTORS	START DATE

7.2.3 The summary of the short-term strategic actions and timelines of the AIXM Strategy beyond five (5) years is illustrated in the table 4 below:

Table 4: Long-term Activities

ACTI ON NUM BER	PRIO RITY ACTI ON	ACTIV ITY	DESCRIPTION	PARTICIP ANTS/ CONTRIB UTORS	START DATE

7.3 AIXM targets for each area of interest.

In order to ensure that each element of the AIXM strategy is addressed holistically, the following list of defined targets and descriptions covers the strategy activities for each area of interest:

7.3.1 Systems

An AIXM compliant database is one of the key aspects that needs to be implemented. This would require the development of user requirements specifications for the State to procure a system that meets the requirements of ICAO SARPs.

In accordance with the ICAO AIS to AIM Roadmap, P-06 – Integrated aeronautical information database, a State is required to establish and maintain a database where digital aeronautical data from the State are integrated and used to produce current and future AIM products and services. This is a main step in Phase 2 of the ICAO AIS to AIM Roadmap in order for a State to transition to AIM.

An Integrated Aeronautical database is a single centralised repository of aeronautical information where digital aeronautical data from a State are integrated and used to produce current and future AIM products and services. The database must be able to exchange information in AIXM format with other aeronautical databases (Nationally, Regionally and Globally)

In accordance with the ICAO AIS to AIM Roadmap, P-10 – Communication Networks, States are required to transition towards networks based on Internet Protocol (IP) capable of exchanging more data with higher bandwidth and integrity. For the transition to AIM to be effective, the needs of future AIM will have to be declared in terms useable for network specification: Which data network will be used to distribute the new data products and services? what information can be exchanged via the Internet? and what information requires a secured network reserved for aviation? These are open questions that will need to be answered for the transition to be effective.

Networks utilising Internet protocol for the transmission and dissemination of aeronautical data and information should be implemented. This would also ensure the

safety and security of information through the establishment of network security mechanisms and firewalls.

7.3.2 Operations

There are many factors to consider in the operation of AIM within an AIXM environment. These necessitate clearly defined roles and responsibilities in terms of who captures, quality assures and/or manages the database. Procuring a system is only one element of AIXM implementation as it needs both supporting regulations as well as QMS processes and procedures.

In accordance with the ICAO AIS to AIM Roadmap, P-17 – Quality, a State is required to re-enforce quality management measures to ensure the required level of quality of aeronautical information is maintained through-out the data processing chain. A State is therefore required to implement an effective quality management system based on the ISO 9001 standard. States must implement national regulation on the requirement for all organisations involved in aeronautical data processing and publication, to have a Quality Management System in place, which shall manage the safety of all their services.

In accordance with the ICAO AIS to AIM Roadmap, P-18 – Agreements with data originators, Data of high quality can only be maintained if the source material is of good quality. States will be required to better control relationships along the whole data chain from the originator to the distributor. This may take the form of template service level agreements with data originators, neighbouring States, information service providers or others.

A Service Level Agreement or SLA is a formal document that defines a working relationship between parties for a service contract. It is generally more applicable to businesses than to consumers and involves one or more end user parties and a service provider. It is key for SLA's to be defined between all actors within the data processing chain, which will ensure higher quality, integrity and accuracy of data based on specific standards.

SLAs provide a remedial mechanism and compensation regime where performance standards are not achieved, whilst incentivizing the service provider to maintain a high level of performance. It will provide a mechanism for review and change to the service levels over the course of the contract. The SLA requirement must also be included into the national regulations to ensure compliance.

7.3.3 Regulations

To effectively manage aeronautical information requires adequate regulations, not only on the services provider side for the regulator to provide oversight but also for data originators. One of the key contributors to the Aeronautical Information Product of a State is aerodromes. The regulations therefore need to ensure that all related information provided for aerodromes published in the Aeronautical Information Product of a States meets the minimum requirements of data as defined in ICAO Annex 14, including the aeronautical data catalogue published through the PANS-AIM Doc 10066.

When transitioning from a paper-based environment to a digital dataset, aeronautical information can usually be categorised under the following three areas:

- Information which can be captured in an AIXM database and meets the aeronautical data catalogue requirements as defined in PANS-AIM Doc 10066,
- Information which contains discrepancies and need to be validated and corrected before it can be captured in the AIXM database,
- Information which is missing and which needs to be obtained to ensure the completeness of the data being captured in the AIXM database.

(The regulations therefore need to ensure that the collection, management and provision of aeronautical data and aeronautical information as well as aeronautical information products and services specifications)

7.3.4 Training

In accordance with the ICAO AIS to AIM Roadmap, P-16 – Training, and based on the evolution of AIM, States would need to ensure that the training of personnel be adapted to address the new requirements based on skills and competencies introduced by the transition to AIM. Training requirements for AIS staff must be expanded to include the new requirements of databases, AIXM, XML, HTML, etc

8. Funding model

[The State and/or Service provider needs to define the funding model here if applicable]

9. Strategic Risk and Mitigation Plans

9.1 The impact of key decisions on the ultimate success of the AIXM Strategy implementation will need to consider the risks on an ongoing basis. These risks could be associated with any of the strategic actions as detailed in tables 2, 3 and 4 above.

The risk matrix as shown in Table 5 below can be used to combine LIKELIHOOD and IMPACT to obtain a risk score.

Table 5: Risk rating Matrix

L I K E L I H O O D	5	Almost Certain 90%	Low	Moderate	High	Extreme	Extreme
	4	Likely 65%	Insignificant	Low	Moderate	High	Extreme
	3	Possible 40%	Insignificant	Low	Moderate	Moderate	High
	2	Unlikely 20%	Insignificant	Insignificant	Low	Low	Moderate
	1	Rare 10%	Insignificant	Insignificant	Insignificant	Insignificant	Low
			Minor 10%	Significant 30%	Serious 50%	Critical 70%	Catastrophic 100%
			1	2	3	4	5
			IMPACT/CONSEQUENCE				

9.2 Potential risk to consider within the State could include:

- Inadequate Regulatory Framework (National)
- Misinterpretation of ICAO SARP's (Annex 14 & Annex 15, etc)
- Reluctance to change (Regulator and Aviation Community)

- Legacy Data Issues (Obstacles, WGS-84, e-TOD, etc)
- Staff competency and training
- Interoperability between systems (Oracle, SQL, 3rd Party Software)
- Standardised exchange formats (Raster, Vector, Grid formats, .ort, .bil, etc)

9.3 A set of risks for AIXM Strategy implementation has been listed in the table below:

Table 6: Identified risk with appropriate risk rating

No	Risk Definition	Mitigation Plans	Potential Impact	Likelihood	Rating
1.					
2.					
3.					
4.					
5.					
6.					
7.					

10. Conclusion

- 10.1 AIM plays a pivotal role within the sharing and integration of all ATM information as contained in the GATMOC (ICAO Doc 9854) and GANP (ICAO Doc 9750). This is due to data and information, and their management becoming more critical for the safety and efficiency of air navigation.
- 10.2 This AIXM Strategy will ensure that the outlined strategic actions and plans will yield the desired result within the short, medium and long terms.
- 10.3 The AIXM Strategy will ultimately contribute towards meeting National, Regional as well as Global Requirements for the implementation of AIXM within **[State and/or Service provider Name]**