The Transition from AIS to AIM

Contents

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1
Introduction

Like other industries, the Air Traffic Management (ATM) business is being challenged to evolve in the face of increased globalisation and competition:

- States are applying different business models to aviation in an attempt to meet their needs. Some States maintain a State controlled ATM system, others have evolved to a semi-privatised model and still others have fully outsourced components of ATM to other service providers
- Resource constraints and the economic challenges of aviation are putting increased pressure on ATM to deliver capacity and efficiency improvements without sacrificing ATM's high levels of safety
- Citizens are demanding increased environmental responsibility and ATM must deliver reductions in noise, pollutants and global warming impacts

ATM has responded to these pressures by increasing the use of technology to deliver more services to its customers at high levels of safety and in an environmentally responsible manner. ATM is increasingly relying on information to derive ATM benefits. The increased use of information is leading to a paradigm shift in the way ATM views the role of aeronautical information. ATM needs a real-time common operating picture of aeronautical information that can be exchanged and shared to ensure efficient use of the aviation system.

In recognition of the increasing importance of aeronautical information to ATM, the Aeronautical Information Services (AIS) community has developed a concept of Aeronautical Information Management (AIM). The transformation from AIS to AIM is the transition of aeronautical information from traditional charts and paper publications towards real-time standards-based digital aeronautical information.

With the increased importance of AIM to ATM comes a growing responsibility of AIM to deliver the information services demanded by ATM. The challenge for AIM is to consider information, processes and services needed by ATM today and in the future.

2
AIS Today

Today, Aeronautical Information Services (AIS) supports flight operations by providing static information publications such as the Aeronautical Information Publication (AIP), Notices to Airmen (NOTAM, SNOWTAM, ASHTAM and BIRDTAM) and Pre-flight Information Briefings (PIB). These products are based on ICAO Annex 15 specifications.

These traditional AIS products were designed to be produced manually and consumed by humans. As a result the information is textual. Over time it has been a challenge to communicate increasingly complex aeronautical information using these legacy publications.

For example, the number of NOTAMS issued from 2000 to 2006 increased approximately 65% worldwide. The NOTAM is being used to communicate about an increasing number of aeronautical changes and this puts a significant burden on pilots, controllers and other ATM customers to review and synthesise hundreds of NOTAMs. A NOTAM briefing to pilots may contain hundreds of NOTAMs: it is unrealistic to expect a pilot to be able to maintain situational awareness on all of this NOTAM information. Furthermore, analysis suggests that most NOTAMs provided to a pilot are not relevant to their specific flight. Traditional AIS products are failing pilots because the traditional NOTAM products do not allow good filtering and sorting for the route of flight.

In addition, a patchwork of supplemental product specifications such as ARINC 424 for terminal procedure encoding and AMDB for Airport Mapping Databases have attempted to address the deficiencies of the current AIS products

to meet the needs of today's aviation system. While these supplemental products fulfill their roles, they also increase the complexity of the aeronautical information data chain. Many of these supplemental products cannot be directly derived from the official AIS products – potentially affecting information integrity and consistency.

Finally, some aeronautical information simply cannot be portrayed using traditional AIS products. For example, Global Navigation Satellite Systems (GNSS) can have low reliability regions that are described by complex three-dimensional shapes that vary in time. While some States have developed ways to communicate this information to pilots, additional work is needed to ensure a consistent international approach to communicating GNSS outages.

When addressing the future needs of ATM, AIS needs to look beyond the traditional AIS products defined in ICAO Annex 15. The future of AIS needs to consider:

- Timeliness, accuracy and quality necessary to support operations in a computer automated environment
- Support for electronic cock-pit displays, computerised dispatch systems and automated air traffic management
- Information to support collaborative decision making among airspace users
- Customisation to provide products and services to support a diverse set of end users

3
Expanding the Scope of AIM

In recognition that aeronautical information is an integral part of future ATM, ICAO has taken steps to define the role of AIM in the future. ICAO Global Air Traffic Management Operational Concept (Doc 9854) defines the role of AIM as providing accredited, timely, quality-assured information necessary to support flight operations. However the ICAO document does not explicitly identify future information requirements nor does it provide for the transformation of AIS to meet the future information demands.

Since 2006 the AIM community has been meeting yearly to address the challenges of transitioning from AIS to AIM. Annual Global AIM Congresses organised by EUROCONTROL in coordination with a consortium of AIM organisations have highlighted issues of AIM architecture, transition, quality and scope.

The consensus from these Congresses is that AIM expands and modernises the role of traditional AIS to cover:

- Information lifecycle management including digital data collection, higher levels of data integrity and higher levels of quality
- Improved data accuracy and precision to support safety critical operations
- Increased scope of aeronautical information to support efficiency, capacity and environmental performance requirements as identified in future ATM concepts of operation
- Aeronautical information exchange through international standards

4
Information Lifecycle Management

The management of information involves three steps:

- Collection of aeronautical information from one or more sources
- Management of information sources to develop a consistent view of aeronautical information (also know as a common operating picture)
- Distribution of aeronautical information and services to one or more customers

To ensure consistent, high quality and timely information, ATM relies on AIM to be the authoritative source of aeronautical information. As the authoritative source AIM must manage, monitor and control the information chain. AIM responsibilities include:

- Reconciling information collected from multiple sources
- Verifying the information fitness for purpose to ensure the data collected can be used safely to support different ATM services
- Working with data suppliers to improve information quality and resolve inconsistencies
- Standardising and harmonising the information
- Assembling aeronautical data sets and services
- Transforming aeronautical information into products and services to meet diverse customers needs
- Assessing the impacts of data changes and communicating impacts to data suppliers and information consumers
- Working with regulators to define performance requirements for aeronautical information

The net result of these activities is that AIM will be able to produce a common operating picture of aeronautical information that ATM can use to safely and efficiently conduct flight operations.

Although AIM is responsible for the overall information data chain, the creators, producers and owners of the information are often outside of AIM. AIM relies on accountable sources to supply raw aeronautical data. The accountable source is ultimately responsible for delivering data at specified performance levels – any errors must be addressed at the source.

Creating a common operating picture of aeronautical information may require AIM to manage information from multiple accountable sources. To manage the quality of the information, AIM must maintain the lineage of aeronautical information so discrepancies can be addressed with the originating accountable source.

5
Improved Accuracy and Precision

The second challenge facing AIM is to develop the means to improve the accuracy and precision of aeronautical information. Increased reliance on computer decision support systems, area navigation, precision approach and departure procedures and high density flight operations requires a corresponding increase in aeronautical information accuracy and precision.

For example, the ICAO standard for an electronic terrain and obstacle database includes stringent requirements for obstruction data in the en route and terminal environments. To deliver this information to ATM, AIM must develop new processes to manage terrain and obstacle data. This includes identifying data suppliers (accountable sources) and developing the infrastructure to collect, manage and distribute the information.

6
Increased Scope of AIM

At its foundation, the purpose of AIM is to provide the information necessary to support international air navigation (ICAO ANNEX 15). Currently AIS provides basic information about flight rules, airspace, routes, fixes, navaids, airports and procedures in the AIP. Additionally AIS provides the NOTAM to alert customers of temporary changes to the information contained in the AIP.

Is this basic aeronautical information sufficient to support current and future ATM? What are ATM future data requirements and how is AIM developing the suppliers, processes, tools and distribution services to support these future needs?

To answer these questions we used the tools of enterprise architecture to analyse ATM and determine ATM's information requirements. Enterprise architecture includes tools and techniques to identify systematically the current and future business environment for AIM. Because enterprise architecture identifies the current business situation and the desired end state, enterprise architecture is an effective tool for executive decision making and business process improvement. Using enterprise architecture we can improve the effectiveness and efficiency of AIM.

According to the ICAO Global Air Traffic Management Operational Concept the goal of ATM is to provide "a holistic, cooperative and collaborative decision-making environment where the diverging expectations and interest of the ATM community are balanced to achieve equity and access." The ATM Concept of Operations identifies seven concept components or services areas:

1. Airspace organisation and management
2. Demand and capacity balancing
3. Aerodrome operations
4. Traffic synchronisation
5. Conflict management
6. Airspace user operations
7. ATM service delivery management

In addition, the ICAO concept of operations identifies an eighth component, information management that supports these seven service areas. The mission of AIM is to provide interactive, on-demand aeronautical information interchange between the global aviation community to support safe, efficient and environmentally sound flight operations that maximises system capacity.

In this concept, AIM delivers a common operating picture of aeronautical information for customers and stakeholders. ATM, industry and other customers identify the information services to be provided by AIM. ICAO and State regulators set the information provision requirements and performance levels that AIM must meet. Based on this concept of operations for AIM, it might be more appropriate that AIM be renamed ATM Information Management.

Figure 1 — Operational Concept for AIM

Interactive, on-demand aeronautical information interchange between the global aviation community to support safe, efficient and environmentally sound flight operations that maximizes system capacity.

Given this concept of operations for AIM, consider the following questions regarding the scope of information and services to be provided by AIM:

- What business services should AIM provide?
- What performance requirements should AIM achieve to ensure the information achieves its intended purpose for use by ATM?
- What additional information does ATM need?

Answering these questions requires that AIM:

- Identify new information requirements to support the seven concept components of future ATM
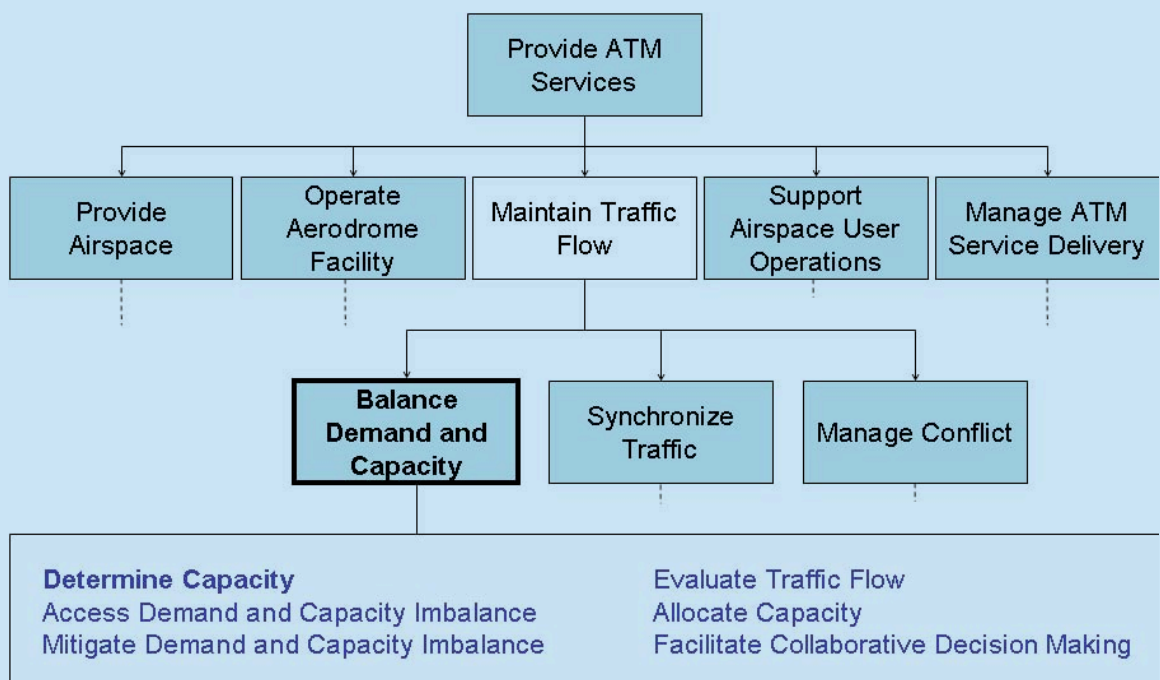- Map ATM performance requirements to the underlying quality, accuracy, precision and timeliness requirements for the aeronautical information
- Identify the gap between current AIS services and the future ATM information requirements. The gaps identify changes that need to be made in AIM.
- Work with regulators, accountable sources and ATM customers to develop a plan to integrate these new information requirements into the AIM common operating picture.

7
Identifying the New Information Requirements

Each of the seven ATM capability components can be decomposed into lower level business activities. Figure 3 shows a partial decomposition for the "Balance Demand and Capacity" capability component.

Figure 2 — Decomposition of ATM business services into sub-activities

Provide ATM Services

Provide Airspace | Operate Aerodrome Facility | Maintain Traffic Flow | Support Airspace User Operations | Manage ATM Service Delivery

Balance Demand and Capacity | Synchronize Traffic | Manage Conflict

Determine Capacity
Access Demand and Capacity Imbalance
Mitigate Demand and Capacity Imbalance

Evaluate Traffic Flow
Allocate Capacity
Facilitate Collaborative Decision Making

Balancing Demand and Capacity consists of 6 sub-activities:

– Determine Capacity – calculate capacity levels based on theoretical capacities, environmental conditions (e.g., weather, visual conditions) and aeronautical information common operating picture (e.g., AIP, NOTAMs and other status information);
– Evaluate Traffic Flow – evaluate expected traffic flows based on historical information, schedules and flight planning;
– Assess Demand and Capacity Imbalance – Determine if there is excess demand because there is more traffic than available airspace and/or airport capacity;
– Mitigate Demand and Capacity Imbalance – Propose restrictions, flight changes and other initiatives to balance demand and capacity;
– Facilitate Collaborative Decision Making – Incorporate stakeholder involvement to solve demand and capacity imbalance;
– Allocate Capacity – Execute capacity utilisation strategy.

Each of these sub-activities can then be analysed for information requirements. The analysis for "Determine Capacity" is shown in the figure below.

On the right are Inputs needed to support the activity. Once the activity occurs, the inputs are transformed into the activity output. For "Determine Capacity" the primary input is the engineered or theoretical capacity of the airport, runway, airspace or other aviation resource. This is the maximum capacity given perfect aviation conditions.

Figure 3 — Analysis of the "Determine Capacity" sub-activity to identify information flows

At the top of the diagram are Controls. Controls restrict and influence the "Determine Capacity" activity. In this case there are three main controls: 1) Capacity rules which describe the heuristics used to estimate actual capacity levels based on environmental and aeronautical factors 2) environmental factors such as noise restrictions, ATC staffing levels, weather and other external factors that might affect the resource capacity and 3) aeronautical common operating picture providing the current status of the aviation system resources.

At the bottom of the diagram are Mechanisms – the tools and organisations that support the activity. Determining capacity is normally completed by the traffic management unit organisation with assistance from AIM.

Finally the right side of the diagram shows the activity Outputs – the capacity level.

The analysis of "Determine Capacity" has identified several aeronautical information requirements that go beyond the scope of traditional AIS:

- Engineering capacity
- Capacity level
- Capacity rules

To support ATM requirements for capacity and demand balancing, AIM needs to create capabilities to collect, manage and distribute digital capacity information about aviation resources such as airspace, runways, taxiways and routes.

In addition, AIM may need to provide additional services to ensure the provision of accurate capacity information to ATM system users:

- Digitising capacity rules
- Capacity rule validation
- Providing the aeronautical information common operating picture

To fully define the added scope of AIM we need to consider performance requirements for the delivery of capacity information to ATM. Levels of accuracy, timeliness, quality and precision should be directly linked to the performance needs of the overlying ATM activity – Determine Capacity.

Figure 4 (see page 10) summarises the performance, business service and information requirements associated with the "Determine Capacity" sub-activity of the seven ATM capability components. By systematically considering the information requirements of the Global ATM future concept of operations, it is possible to determine the scope of AIM.

8
Integrating New Information Requirements into AIM

The final step is to integrate these future information requirements into AIM. Information management considerations include:

– Digital capture – Specifying digital formats for capturing and processing the information to ensure products and services are equally available to humans and computer systems

– Quality management – monitoring and controlling the quality of the information

– Information sharing – publishing the information via internationally accepted data standards to promote information exchange

– Integrated planned, operational and historical information – ensuring the information is integrated into a fully temporal common operating picture

showing historical information, planned information as well as current operational data

– Decision information support – Deliver value-added services on top of the raw data to assist with filtering, querying, sorting and notification

9
Summary

Only recently has aviation realised that, the movement of information is as important as the movement of people or goods. Today many AIS's remain focused on providing narrowly defined legacy aeronautical products as specified in ICAO Annex 15. Yet, there is an awareness among aeronautical providers that they must

Figure 4 — AIM performance, business service and information requirements to support ATM capacity business activities
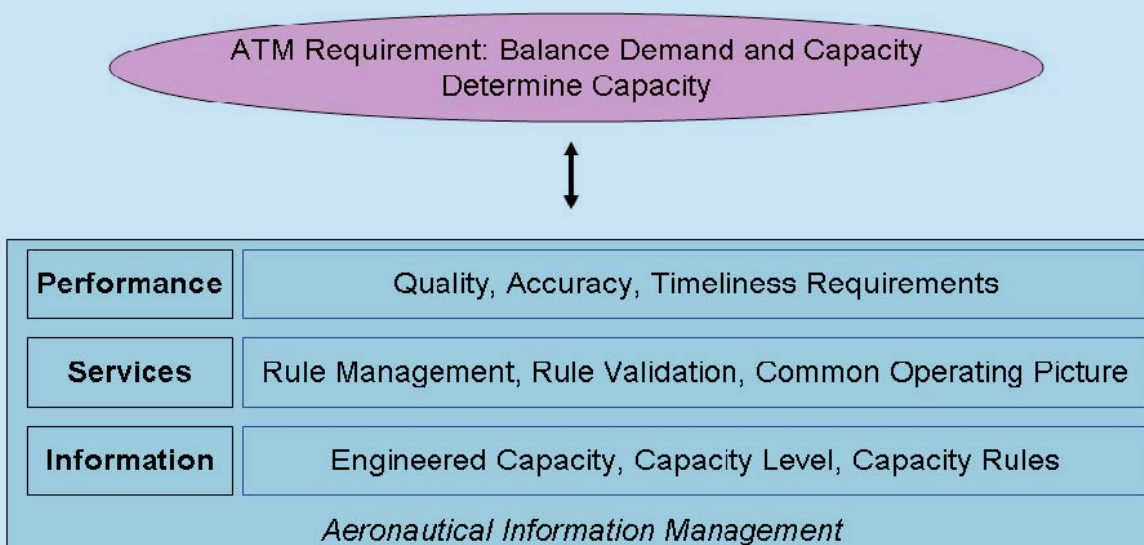
transform from AIS to AIM to meet the growing demands of the ATM business. The transformation includes changing from a manual, paper product environment to a digital, standards-based environment. The transformation means the establishment of an AIM focused clearly on the current and future requirements of ATM.

As a result of a focus on ATM needs, AIM will need to provide new aeronautical services that expand upon the traditional AIS safety information. These new AIM services include information services that support aviation system efficiency, capacity, and environment performance requirements. While it is known that AIM must provide timely, high quality and digital information, the fundamental business services included in AIM have not yet been completely defined. A full definition of AIM can only be determined by identifying all the information management services that support the ATM capabilities.

The enterprise architecture approach has identified future AIM performance requirements, business services and information management needs. It is important that AIM identify quality, information management, information sharing and decision support services that will be required to meet ATM information requirements.

The ongoing challenge for the aviation business is to continue making investments in information management to facilitate the ability to plan and operate flights with maximum flexibility, flight efficiency and cost-effectiveness, with minimum constraints and with no degradation in safety.

These changes in the aviation system are placing new importance on AIM. It is the challenge of AIM to expand, to modernisation and to standardise in order to meet the increasing demand for information in ATM.

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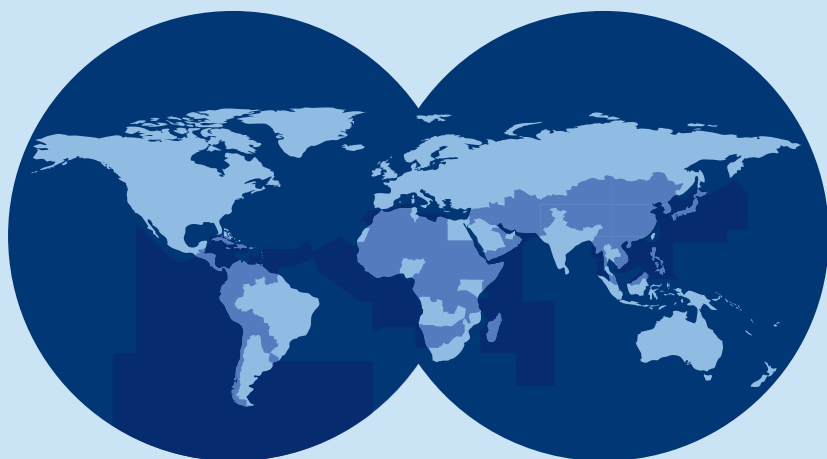
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