Final Project Report

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Abstract

Project 08.01.03 developed the ATM Information Reference Model (AIRM) including the AIRM Foundation Rulebook.

The AIRM was developed to promote semantic interoperability within the modernised European ATM Network. In other words, the AIRM was designed to be a common reference for the development of different information and data models throughout ATM.

In addition to the work in SESAR, the need for development of an AIRM is identified in the European Commission's Regulation on the Pilot Common Project. Moreover, the need for an AIRM is recognised in the ICAO Global Air Navigation Plan (GANP). Therefore, P08.01.03 promoted the SESAR AIRM as a significant input to European and global interoperability initiatives.

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Rational for rejection
None.

Document History

Edition	Date	Status	Author	Justification
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00.00.02	05/04/2016	Draft		Incorporation of first round of comments.
00.00.03	02/05/2016	Draft		Resolution of comments from partners
00.00.04	09/05/2016	Draft		Additional resolution of comments from partners
01.00.00	24/05/2016	Final		Prepared for hand-over to the SJU.

Intellectual Property Rights (foreground)

This deliverable consists of SJU foreground.

Acronyms

Acronym	Definition
ACI	Airport Council International
AIRM	ATM Information Reference Model
AIXM	Aeronautical Information Exchange Model
ATM	Air Traffic Management
BEST	Achieving the BEnefits of SWIM by making smart use of Semantic Technologies
CP	Coordination Plan
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration
FIXM	Flight Information Exchange Model
GANP	ICAO Global Air Navigation Plan
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
INEA	Innovation and Networks Executive Agency
ISRM	Information Service Reference Model
IWXXM	ICAO Weather Information Exchange Model
NEXTGEN	Next Generation Air Transportation System
OFA	Operational Focus Area
OI	Operational Improvement
SES	Single European Sky
SESAR	Single European Sky Air Traffic Management Research
SWIM	System Wide Information Management
SWP	Sub-Work Package
UML	Unified Modelling Language
WXXM	Weather Information Exchange Model

1 Project Overview

Project 08.01.03 developed the ATM Information Reference Model (AIRM) including the AIRM Foundation Rulebook to promote semantic interoperability within the modernised European ATM Network. In other words, the AIRM was designed to be a common reference for the development of different information and data models throughout ATM.

1.1 Project progress and contribution to the Master Plan

P08.01.03 used an iterative approach to build the AIRM. The first version of the AIRM, the "Initial Load" was populated from the "bottom-up". That means it imported existing models (e.g. AIXM, WXXM and others) identified by the contributing projects. This approach gave a quick starting point for developing the AIRM. The "Initial Load" was followed by a series of regular releases, each of which sought to improve upon the previous release by developing content in support of the SESAR Programme. This approach culminated in the final version of the AIRM to be delivered under SESAR, the AIRM v4.1.0.

P08.01.03 established a set of working arrangements to ensure that its objectives were achieved.

The AIRM Governance mechanisms were established very early in the project. This allowed two things:

- Changes to the AIRM to be processed and managed in an open and transparent manner; and
- A community of key SESAR stakeholders to be formed around the AIRM. It is worth noting that, over time, the list of stakeholders was expanded to cover Airspace Users and non-SESAR members such as the Federal Aviation Administration and Airservices Australia.

The governance mechanisms were about making the decisions which affected the AIRM. They were complemented by two teams to perform the work of developing and ensuring the use of the AIRM. These were:

- The Information Modelling Team, which was a collection of information architects, organised around specific "themes" tasked with developing the AIRM UML models. This team was also tasked with providing support to operational projects for identifying and describing new Information Elements required for SESAR Operational Improvements.
- The Service and System Support Team, which was tasked with supporting other SESAR projects when they used the AIRM e.g. supporting the development of message models for services within the ISRM (P08.03.10) and the use of the AIRM (via the compliance framework) within the SESAR Validation and Verification Exercises for Release 4 and Release 5.

In addition to the internal SESAR working arrangements, the NextGen-SESAR Data Model Coordination Group was set up under CP2.1. This allowed a degree of harmonisation to be achieved between the SESAR AIRM and NextGen's equivalent model. This effort resulted in many benefits e.g. an agreed set of subject fields to be used to structure both models and a harmonised set of units of measure.

Finally, the 08.01.03 members established coordination with other bodies e.g. IATA, ACI, EUROCAE and the owners of information exchange models (AIXM, WXXM and FIXM).

P08.01.03 made a significant impact to the OI steps of SESAR Programme. This involved e.g.

- Contributing to the information aspects of the SWIM Foundation;
- Ensuring the import of the AIRM entities as "information elements" and "data elements" into the European ATM Architecture;
- Submitting new definitions to the SESAR Lexicon to account for the evolution of OI steps;
- Participating in the work of OFAs through a team of information architects; and
- Using the AIRM in the ISRM and Validation and Verification Exercises.

The main enablers (extracted from [10]) that P08.01.03 contributed to are detailed in the table below.

Code	Name	Project contribution	Maturity at project start	Maturity at project end

SWIM-STD-01	AIRM	Development of the AIRM within SESAR and promoting it at ICAO level.	V0 (TRL 1)	V3 (TRL 6)
SWIM-STD-08	AIRM Rulebook	Development of the AIRM Foundation Rulebook.	V0 (TRL 1)	V3 (TRL 6)

In addition, the AIRM will form part of the following "SESAR Solution" which is to be made available at the end of the SESAR 1 Programme:

- SESAR Solution #46: SWIM Technological Solution

The AIRM Foundation Rulebook will be part of:

- SESAR Solution - SWIM Framework

1.2 Project achievements

The 08.01.03 Project Initiation Report [4] set out the following objectives:

- The main objective is to ensure semantic interoperability within ATM across SWP8.1 and the SESAR Programme.
- The project will provide an ATM Information Reference Model (AIRM) representing all the possible ATM information constructs that are part of the SESAR Concept.
- The project will encourage the standardisation of ATM information constructs worldwide.

In summary, these can be seen as satisfied:

- The AIRM and AIRM Compliance Framework were developed in order to satisfy the need for semantic interoperability. These were used in designed information services in a number of Validation and Verification Exercises.
- The AIRM was developed through coordination with other SESAR projects covering the research and development work, inputs from SESAR Concept of Operations [6] and other input documents.
- P08.01.03 has provided inputs to the ongoing development of the ICAO AIRM and the SESAR AIRM will form the start point for development of the AIRM standard within the Pilot Common Project.

1.3 Project Deliverables

The following table presents the relevant deliverables that have been produced by the project. These were repetitive deliverable so the table details only the last version of each deliverable. It details only deliverables which are of relevance post-SESAR so does not include the various reports and inventories which were produced during the project's lifetime.

Reference	Title	Description

Reference	Title	Description

D47	AIRM v4.1.0	The SESAR AIRM acts as a common reference for the other models developed as part of SWIM research and development, and deployment. As a reference model, it is independent of specific implementation standards, technologies, implementations, or other concrete details.
		
		The AIRM itself has several components:
		
		- AIRM UML Models
		  - Consolidated Logical Data Model
		  - Information Model
		  - Constraints Model
		  - AIRM Foundation Library
		- AIRM Primer
		  - Including supporting documents in annex:
		    - AIRM Strategy
		    - AIRM Compliance Framework and
		    - AIRM Compliance Handbook
		    - AIRM Governance Handbook
		    - AIRM Quality Assurance Handbook
		    - AIRM Constraints Handbook
		- AIRM Glossary

D48	AIRM Foundation Rulebook v4.1.0	The AIRM Rulebook provides principles, rules and recommendation in order to facilitate the development and maintenance of the AIRM. The principles, rules and recommendations are intended to be used for modelling, consolidation, validation and verification, compliance, and quality check purposes.

All of the deliverables and supporting documents are available on the 08.01.03 extranet site [5].

1.4 Contribution to Standardisation

During the lifetime of P08.01.03, its members contributed to:
- The AIXM 5.1 compliance mapping towards the AIRM [8];
- The IWXXM 1.1 compliance mapping towards the AIRM [9];
- The FIXM developments;
- The EUROCAE ED-133 Flight Object data model compliance mapping towards the AIRM; and
- The introduction of SWIM and related AMXM into the EUROCAE (and RTCA) ED99 and ED119 standards for Aerodrome Mapping used in cockpit displays for situational awareness.

1.5 Project Conclusion and Recommendations

P08.01.03 has progressed in line with the objectives set out in the Project Initiation Report. It has developed the AIRM deliverable in support of semantic interoperability in the modernised ATM network. It did this by establishing working arrangements to ensure the AIRM was developed by a community of interested stakeholders in a fair and open manner, and at the same time, to ensure that the AIRM improved over time to reach a good-quality, mature final state.

Furthermore, it ensured that the concepts which underlie the AIRM were validated, by talking to international partners such as the FAA, IATA and ACI.

It is recommended that the AIRM and AIRM Rulebook be:
- Handed over to SES deployment,
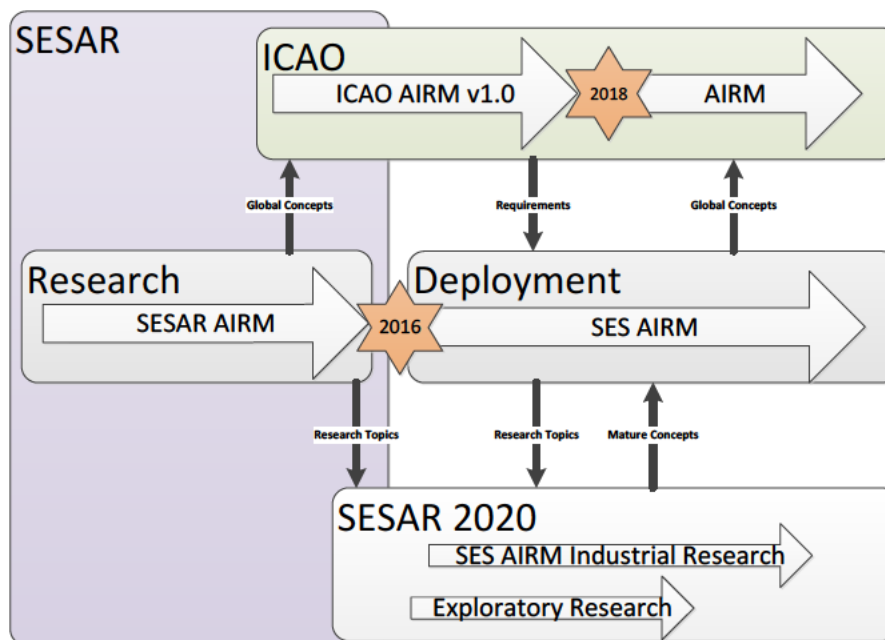- Treated as input to SESAR 2020 and

- Treated as input to the development of the ICAO AIRM.

This will allow it to play a significant role in the three "threads" as illustrated in the figure below. Indeed, it is already playing a part in the threads.

The SESAR AIRM will be handed-over to "Deployment". As mentioned in the Pilot Common Project, the **SES** AIRM and AIRM Rulebook will become "standards". The standards will be developed by EUROCONTROL in close cooperation with the stakeholders. The SES AIRM can therefore be seen as the continuation of the SESAR AIRM.

The SESAR AIRM is already being used in the development of the ICAO AIRM. For example, the SESAR AIRM was used in order to develop the "Sneak Peek" of the ICAO AIRM (a demonstrator of the capabilities of an ICAO AIRM to enable the experts to make informed decisions). This included:
- Using the terms and definitions from the Foundation Library;
- Using the set of subject fields currently used to structure the SESAR AIRM;
- Using some example relationships from the SESAR AIRM Information Model; and
- Using some example codelists from the SESAR AIRM Consolidated Logical Data Model.

Although there is no dedicated AIRM activity foreseen in SESAR 2020 "Industrial Research", the Multi-annual Work Programme foresees an interaction with the AIRM e.g. in "PJ19 - Content Integration" there is an activity to "Research, develop and validate topics and new content for inclusion in the … AIRM".

There is a project within SESAR 2020 "Exploratory Research" which will use the SESAR AIRM as input. This is the "Achieving the BEnefits of SWIM by making smart use of Semantic Technologies (BEST)" project which will explore the use of semantic technologies within ATM.

This recommendation is possible due to the gradual and iterative development of the AIRM, including partner buy-in through open and transparent collaborative governance, and customer buy-in through the development of European ATM Information Services, European ATM Architecture, collaborative relations with international data exchange standardisation efforts, and initial buy-in at the Global ATM network level through the proceedings of the ICAO Information Management Panel in alignment with the ICAO SWIM Concept Manual Doc 10039 [7].

2 References

[1] SESAR Programme Management Plan, Edition 03.00.01

[2] European ATM Master Plan, https://www.atmmasterplan.eu/

[3] Multilateral Framework Agreement ("MFA") signed between the SJU, EUROCONTROL and its 15 selected members on August 11, 2009, amended on 14 June 2010, 19 October 2010 and 2 July 2012

[4] P08.01.03, Project Initiation Report, 08.01.03-PIR-Part 1.doc, Edition 00.02.00, 22 February 2010

[5] P08.01.03, Extranet site

[6] SESAR Concept Of Operations Step 2, 01.00.00

[7] ICAO SWIM Concept Manual Doc 10039

[8] AIXM Compliance Report

[9] IWXXM Compliance Report

[10] Integrated Roadmap Data Set 15 (DS15), 2016-02-16

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