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INFORMATION PAPER

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Virtual, 11 to 14 July 2022

Agenda Item 11: Any other business

What is aeronautical information service?

(Presented by Secretary)

SUMMARY

This information paper is an attempt to summarize, in simple terms, the essence of what is aeronautical information service (AIS). The intent is that with this common understanding, WG-A will be in a better position to assess the progress towards the digital transformation from AIS to AIM, and identify possible future areas to focus on. In particular, this information paper may help to put the work of FG-NRS on the NOTAM replacement system, and FG-AC on aeronautical charts within the proper context and thereby overcome some of the challenges.

1. INTRODUCTION

1.1 During recent work of the Secretariat on developing an AIS training course and conducting several AIS workshops, it became apparent that it is not obvious to explain, in simple terms, what AIS is. The following write-up is therefore an attempt to capture, in somewhat informal but hopefully easy-to-understand language, the essence of what AIS is and to outline where AIS is heading as part of the digital transformation from AIS to AIM.

1.2 The intent of this information paper is that with a common understanding, and based on established terminology of Annex 15 – Aeronautical Information Services, Procedures for Air Navigation Services – Aeronautical Information Management (PANS-AIM, Doc 10066), and the Aeronautical Information Services Manual (Doc 8126), WG-A will be in a better position to assess the progress towards the

digital transformation from AIS to AIM, and to identify possible future areas to focus on. In particular, this information paper may help place the work of FG-NRS on the NOTAM replacement system, and FG-AC on aeronautical charts within the proper context and thereby overcome some of the challenges.

2. DISCUSSION

2.1 What is information?

2.1.1 AIS practitioners are oftentimes asked, "What do you actually do?" Their managers often do not quite understand what the AIS department does, and why it is important. They therefore struggle to prioritize AIS such as to approve investments in new equipment or ongoing staff training. Unlike, for example, investments in CNS infrastructure, when managers get to see physical pieces of technology with its associated tangible benefits, they do not understand why to invest in AIS modernization projects and training.

2.1.2 To the above question of what they do, AIS practitioners may be answering, "We are managing aeronautical information". This is, of course, correct; but what is information, and why is information important?

2.1.3 One problem when trying to explain what information is, is that information is a little bit like air. Air is invisible, one cannot touch it or see it, but without air, one cannot live, or, as in the case of information, one cannot make decisions. Decision-making involves collecting information, analyzing it, and putting the information into context in order to be able to make decisions. Flight operations involves a constant sequence of well-informed decisions. Very often, these decisions and the actions that stem from them are safety critical.

2.1.4 In short, without information, we cannot make decisions. As a consequence, bad information lead to bad decisions, and bad decisions always compromise aviation safety!

2.2 Aeronautical information in the operational context

2.2.1 To better understand what information is, it is helpful to reflect upon the role information plays in aviation. Towards that objective, let us take a look at what may be referred to as the ATM operational triangle, as depicted in Figure 1:

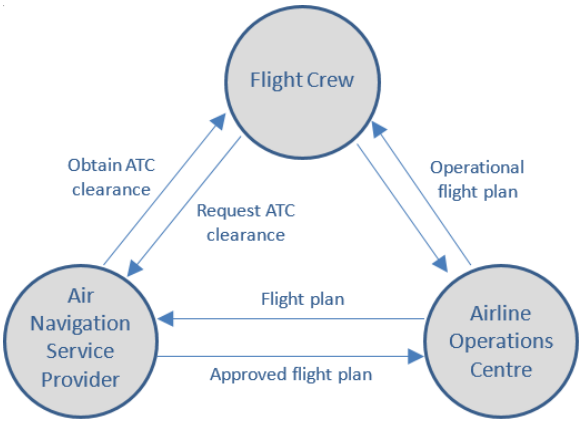

Figure 1 ATM operational triangle

2.2.2 In Figure 1, the airline operations centre (AOC) of an aircraft operator submits a flight plan to the flight plan processing unit of an air navigation service provider (ANSP). The flight plan is a collection of information; it states the aircraft that is being used, its registration, departure and destination aerodromes, the planned route of flight, as well as a range of additional information. Upon receipt, the flight plan processing unit validates (and corrects, if necessary) the submitted flight plan and returns the approved flight plan to the AOC, as well as distributing it to the relevant air traffic control (ATC) units.

2.2.3 The AOC transmits the operational flight plan (i.e. including fuel calculations, weight and balance sheets, etc) to the aircraft where the flight crew enters the information into the on-board flight management system (FMS). The FMS contains a database of digital information, coded in a format known as ARINC 424, which comprises aerodromes, runway dimensions, instrument flight procedures, waypoints, airways, airspace, etc. When entering the planned route of flight into the FMS, the FMS ensures that the entered information corresponds to the information stored in its navigation database.

2.2.4 Once ready for departure, the flight crew contacts ATC to request their clearance. After obtaining ATC clearance, the aircraft is ready for start-up and taxi, and the actual flight operation begins. When taxiing to the runway, the flight crew may use the airport moving map display on their electronic flight bag (EFB) to monitor progress on the taxiways. The EFB is one of several on-board systems that relies on the information stored in its navigation database.

2.2.5 Throughout the flight, and until landing, taxi-in and engine shut-down, the flight crew is in continuous contact with ATC as well as the AOC to ensure the safe conduct of their flight.

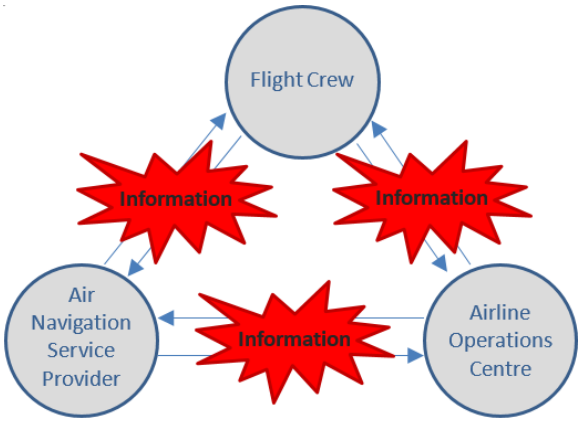

Figure 2 The ATM stakeholders exchange information

2.2.6 As shown in Figure 2, the one thing that all stakeholders in the ATM operational triangle have in common is the need to consume and exchange information, information they can rely upon for critical operational decision-making. AIS provides that information[1].

[1] Note that even though AIS is the only entity providing aeronautical information, there are, however, other information providers like, for example, meteorological and flight and flow information providers.

2.3 **Aeronautical information changes all the time – how to keep it up-to-date?**

2.3.1 So, when we say that "We are managing aeronautical information", we are in fact saying that AIS manages and continually updates the information, which is needed for making operationally important decisions. For example, AIS publishes the information describing a runway's dimensions. This is critical information for calculating take-off and landing performance. Without that information, one cannot decide if the runway has adequate take-off distance available for the planned take-off weight of the airplane.

2.3.2 In fact, AIS collects all aeronautical information and publishes it in the aeronautical information publication, also known as AIP. However, the information in the AIP constantly undergoes change, for a variety of reasons. Therefore, the AIS employs different update mechanisms to keep the information current. We distinguish four different update mechanisms, as explained below, based on the likelihood this information is going to change in the future, namely:

a) AIP amendment;
b) AIP supplement;
c) NOTAM; and
d) aeronautical information circular.

2.3.3 For changes to aeronautical information of a more permanent nature, the AIS publishes an **AIP amendment**. For example, a newly constructed taxiway is considered permanent aeronautical information since it is unlikely to change again anytime soon. AIP amendments become an integral part of the AIP.

2.3.4 An **AIP supplement** is a publication mechanism for aeronautical information considered temporary in nature, but of long duration. In this context, long duration is defined to be in excess of three months. An example of temporary information of long duration is a taxiway that, due to construction at the aerodrome, may be closed for six months. This means that even though the taxiway has been published as permanent information in the AIP, its 6-months closure is considered temporary information of long duration and hence is published via an AIP supplement. After the construction has been completed, the taxiway is reopened, the AIP supplement is not valid anymore, and everything is back to normal.

2.3.5 Temporary information of short duration, i.e. shorter than three months duration, are published via **NOTAM**. By definition, a NOTAM should only contain information considered to be operationally significant, otherwise it does not warrant to be published. A temporary but unplanned runway closure is an example of a NOTAM that clearly is of operational significance.

2.3.6 Lastly, there is an update mechanism referred to as **aeronautical information circular** (AIC); the AIC is used for information updates of a more administrative nature. For example, many of the COVID-related announcements could have been published via AIC.

2.4 **Aeronautical information - is it operationally significant?**

2.4.1 Since information is being used for decision making, it is also important to distinguish whether the information is considered operationally significant, or not. If the information is considered operationally significant, the AIS has to publish the information on fixed dates, known as aeronautical information regulation and control (AIRAC). AIRAC dates are based on a fixed time interval of 28 days, the exact dates of which have been established and are known throughout the aviation system.

2.4.2 The purpose of the AIRAC system is for all stakeholders to be in sync, and to allow sufficient time for them to process the information and to update the onboard navigation databases. The AIRAC system also permits flight crews and air traffic controllers to prepare and, if needed, train for the new situation described by the information; after all, the information is operationally significant. An example of operationally significant information is the availability of a new instrument flight procedure to permit precision approaches in reduced visibility.

2.4.3 In summary, all aeronautical information that are needed for operational decision-making are published in the AIP. Permanent changes to aeronautical information are published at regular intervals via AIP amendments, and if that information is operationally significant, it is published as an AIRAC amendment. Temporary changes of long duration are published via AIP supplements, and if that information is operationally significant, it is published as an AIRAC supplement. Temporary changes of short duration, which are operationally significant, are published via NOTAM.

2.5 **The AIP and digital transformation**

2.5.1 In this context it is interesting to note that the information in the AIP falls into one of the following three categories, namely text, numbers or charts.

2.5.2 Text is oftentimes administrative, or descriptive in nature and meant for human consumption. The GEN section of the AIP contains primarily text. The ENR section of the AIP contains primarily numbers; numbers related to, for example, airspace and airways, etc. The numbers are oftentimes those that are coded in a navigation database and subsequently used by automation systems.

2.5.3 Finally, the AD section of the AIP contains primarily charts. The aeronautical charts deserve special mention here, in the sense that they are a means to visualize information, according to the common saying, “A picture is worth a thousand words”. Given the effort required to create and update charts, it is not surprising to realize that charts oftentimes contain information of a more permanent nature and are meant for human consumption. It is humans who are capable of properly interpreting charts.

2.5.4 Aeronautical information publications have existed as paper products for well over half a century. These products are now gradually and increasingly provided digitally. Over the course of the last few years, international standards have been developed to provide parts of the AIP as digital data sets. The focus there has been on extracting the numbers from the AIP and to provide them as digital data sets. The first five digital data sets that have been defined are the AIP data set, the instrument flight procedure data set, the terrain and obstacle data set (which are oftentimes mentioned together but are fundamentally different data sets), and the airport mapping data set. Digital transformation thereby implies a shift in focus away from the AIP and towards digital data sets.

2.6 **How to distinguish between aeronautical information publication, digital data sets, data catalogue, and information exchange models**

2.6.1 With the new provisions regarding digital data sets, some confusion has entered the debate how to distinguish between the information of the AIP, digital data sets, the data catalogue and its data product specification, and an information exchange model. Since they are all dealing with information, in one form or another, even practitioners sometimes struggle to explain what is the difference?

2.6.2 We have already learned that the **aeronautical information publication** (or AIP) is a collection of and a means to publish aeronautical information. The AIP is sub-divided into three sections; the general (GEN) section, the en-route (ENR) section, and the aerodrome (AD) section. The GEN section contains primarily text, the ENR section primarily numbers, and the AD section contains primarily charts. The AIP can be published as a traditional paper product, or electronically (in html or pdf), in which case it is referred to as an eAIP. Fundamentally, the AIP and eAIP are identical.

2.6.3 We have also learned that parts of the AIP can be extracted and distributed as **digital data sets**. The focus there has been on extracting the numbers from the AIP and to provide them as digital data sets. In order for the user to know what kind of data is provided, a digital data set is distributed together with a so-called **data product specification**. The data product specification, or DPS, is a description of the data content of the digital data set. It describes when, where and how the data was recorded, who is providing the data, and other information that is required for the user to determine whether or not the data is fit for its intended use.

2.6.4 The **data catalogue**, on the other hand, is a set of tables that collectively provides a comprehensive overview of all the aeronautical information that the AIS provides. The aeronautical information is organized in those tables according to categories. These categories are, namely, aerodrome data, airspace data, ATS and other routes data, instrument flight procedure data, radio navigation aids data, obstacle data, geographic data, and terrain data, and provides an additional table describing the different data types being used, and one table describing information about national and local regulation. Each table of the aeronautical data catalogue lists the information by subject (e.g. runway), together with its properties (e.g. RWY exit line), sub-properties (e.g. colour), data type (e.g. text), and a description, as well as the data quality requirements for each of its subject's properties and sub-properties (e.g. accuracy, integrity, and resolution).

2.6.5 The **aeronautical information exchange model** (AIXM) is used to distribute and exchange aeronautical information. It is based on the geography markup language (GML), a variant of the extensible markup language (XML) for geographical features. The exchange model has two components, the aeronautical information conceptual model, which describes all the features and their associated properties within the aeronautical domain, and the XML application schema. The AIXM application schema is a way to encode aeronautical information in XML and thereby enables the exchange of information between systems. Another way to encode and interchange data is by using the JavaScript Object Notation (JSON) which is gaining in popularity. The key challenge when addressing the exchange of information between systems is to ensure interoperability between different systems and variations in formats.

2.6.6 In summary, the aeronautical data catalogue is a comprehensive listing of all aeronautical information the AIS collects. Most, if not all that information is published in the aeronautical information publication. Parts of the AIP can be replaced and provided by digital data sets which, if encoded in an exchange format like XML or JSON, can be used to exchange the aeronautical information between systems. Digital data sets are meant for direct consumption by automation systems without necessitating further human manipulations.

2.7 **A word on quality**

2.7.1 The importance of providing quality information became even more pronounced as we progressed down the path of digital transformation from AIS to AIM. Of course, humans have always been a source of introducing errors throughout the aeronautical data chain, from collection to processing to distribution of aeronautical information. But humans also possess an uncanny ability to spot data errors, especially when visualizing the data.

2.7.2 The sources of and means of detection of errors, however, change as we automate the aeronautical data chain, and that is when the notion of a quality management system was introduced encompassing all processes and procedures of manipulating the aeronautical data and information. AIS has to increasingly rely on continuous quality assurance and quality control measures, as well as methods of validation and verification, to ensure that only quality-controlled information leaves the AIS.

2.7.3 The digital transformation of AIS cannot be successful without the assurance that the aeronautical information we provide is fit for its intended use. The challenge is for users to continue to place their trust in digital aeronautical information and to recognize AIS as the authoritative source of that information.

2.8 **Aspects of the digital transformation**

2.8.1 As previously discussed, several aspects of the digital transformation, or what we refer to as the path from AIS to AIM, have already been defined. What has not been defined yet, however, is how to update the digital data sets. We have seen, that the underlying aeronautical information changes all the time. When considering an adequate update mechanism for digital data sets, one of the questions that need to be addressed is whether it will still be necessary to distinguish between changes of permanent and temporary information, and to further distinguish temporary information of long or short duration. The answer to these questions will determine the update mechanism(s) needed for the digital transformation.

2.8.2 What is currently being developed is the mechanism for distributing the digital aeronautical information. It is envisioned to use information services over an IP-based infrastructure, a concept known as system-wide information management (SWIM). SWIM is supposed to not only distribute aeronautical information, but also meteorological information, flight and flow information, and any other information that is of relevance to the aviation system as a whole. It has yet to be seen whether SWIM can fulfill that promise. Again, the key challenge will be to establish a safe and secure global network of interoperable systems for exchanging information.

3. **CONCLUSION**

3.1 3.1 As stated in the introduction, the intent of this information paper is to provide a high-level overview of what AIS is and what still needs to be done as part of the digital transformation from AIS to AIM. By providing a common perspective, the objective of this information paper is for WG-A to now be in a better position to assess progress towards digital transformation, and to help identify possible future areas to focus on.

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