



WORKING PAPER

ASSEMBLY — 40TH SESSION

ECONOMIC COMMISSION

Agenda Item 34: Aviation Data — Monitoring and Analysis

ICAO STATISTICS PROGRAMME AND BIG DATA ANALYTICS

(Presented by the Council of ICAO)

EXECUTIVE SUMMARY

This working paper reports on the modernization of the ICAO Statistics Programme and its associated benefits, as well as activities related to big data, including details of the data sets and on-going analyses carried out in collaboration with other United Nations agencies, international organizations, academia, etc. Big data analytics for aviation is one of the aviation emerging issues identified in the ICAO Business Plan 2020–2022. ICAO applies the principles and practices of official statistics adopted by the United Nations Statistical Commission (UNSC) to its statistics activities, and follows the recommendations and guidelines of the UNSC on big data. This paper also presents ICAO's plan for future work related to the Statistics Programme and big data analytics (a part of aviation data and analysis work programme), which aims to support States and aviation stakeholders in using a data-driven decision- and policy-making approach to improving safety, operational and economic efficiency of air transport.

Action: The Assembly is invited to:

- a) review the work accomplished by ICAO as presented in paragraphs 2 and 3;
- b) endorse the Organization's work programme as presented in paragraph 4; and
- c) consider the information contained in this paper for the update of Assembly Resolution A39-15, Consolidated statement of continuing ICAO policies in the air transport field.

<i>Strategic Objective:</i>	This working paper relates to all the Strategic Objectives, especially <i>Economic Development of Air Transport</i> .
<i>Financial implications:</i>	The activities referred to in this paper will be undertaken subject to the resources available in the 2020–2022 Regular Programme Budget and/or from extra budgetary contributions, including the Voluntary Air Transport Fund (TRAF).
<i>References:</i>	Doc 10075, <i>Assembly Resolutions in Force</i> (as of 6 October 2016) Doc 10078, <i>Report of the Economic Commission of the 39th Session of the Assembly</i> A40-WP/20-EC/5, Report on the Updated Long-Term Traffic Forecasts A40-WP/22-EC/7, Consolidated statement of continuing ICAO policies in the air transport field ICAO Business Plan 2020–2022

1. BACKGROUND

1.1 Comprehensive and reliable aviation data, analysis and forecasts are the basis for States and the industry to make well-informed decisions, and align the regulatory and financing regimes with the projected growth of air traffic demand. These enable States to act proactively to avoid inefficiencies and impediments, reduce risks and uncertainty, monitor progress and performance, evaluate the return on investments, and promote financing for air transport development.

1.2 Article 55 of the *Convention on International Civil Aviation* (Chicago Convention) specifies the importance of conducting research and studies “into all aspects of air transport and air navigation which are of international importance, communicate the results of its research to the contracting States...”. The work of ICAO on big data and the dissemination of the analytical results is carried out, keeping in mind this requirement of the Chicago Convention.

2. MODERNIZATION OF ICAO STATISTICS PROGRAMME

2.1 The re-engineering process of the ICAO Statistics Programme was finalized in 2018 by utilizing new technologies and the Enterprise Data Management (EDM) architecture for the Integrated Statistical Database (ISDB). Different sources of data have been harmonized through the standardization of reference tables and taxonomies to create a holistic repository of cross functional data. Several benefits were generated associated with the modernized Statistics Programme such as, inter alia:

- a) **increased coverage and quality of data.** The quantity and quality of data available to States has been increased by combining, referencing and comparing data from different sources. The current ISDB contains over 5.5 million records of the historical data reported by States.
- b) **reduced time of processing and cost of storing data.** By fully automating manual and repetitive tasks, the processing time of ICAO Air Transport Statistical Reporting Forms has been reduced by 10 to 60 per cent, compared to the year 2016. The database for storing legacy and existing data has also been migrated to more cost-effective platforms to save storage cost.
- c) **greater interoperability.** With the implementation of harmonized methodologies, data from various statistical providers with different systems can now be assembled quickly and economically, leading to a reduction of administrative burdens and costs for both ICAO and Member States.
- d) **data integration for economic analyses.** Reported data from different sources can be integrated and transformed for economic analyses. For example, the process of conducting ICAO’s study on regional differences in international airline operating economics was simplified by integrating the application and the data used with the Statistics Programme. The result of the study is the basis to prorate passenger revenues from interline journeys used by the airline industry and to determine basic airmail conveyance rates by the Universal Postal Union (UPU).

2.2 Furthermore, the re-engineered Statistics Programme creates flexibility in the sharing of ICAO's data and analysis with States, United Nations (UN) agencies, international organizations, industry and other stakeholders. A series of applications and business analytical tools were developed through the ICAO Civil Aviation Data Solutions (iCADS) portal, which provides a single window platform to visualize and analyze statistical data (<https://www4.icao.int/icads/>).

3. BIG DATA ANALYTICS AND APPLICATIONS

3.1 Aviation data analytics is under transformation with velocity and quantity of data growing and new technologies evolving to analyze such “big data” (an umbrella term for the explosion in the quantity and diversity of high frequency digital data). In tandem with the pace of the industry development, States need to improve capabilities and capacity to manage the trove of information and use advanced analytics to reap the tremendous value through developing data-driven strategies.

3.2 Since 2016, ICAO has been gradually expanding activities related to big data, namely: a) Market Intelligence Data Transfer (MIDT); b) Automatic Dependent Surveillance-Broadcast (ADS-B); and c) Commodity and Trade (COMTRADE) and e-commerce transactional data (E-com)¹. These three data sets represent an all-encompassing coverage of traffic and operational data at a very high level of granularity and detail.

3.3 The MIDT contains passenger booking data of the global distribution systems (GDS) supplemented with the direct sales of air carriers, providing true origin-destination records of more than four billion passengers and 36 million departures annually. The Global Air Transport Optimizer (GATO) application enables the visualization of the data and the analysis of the movement patterns of direct and connecting passenger traffic. The MIDT data was used to update long-term traffic forecasts, as well as for the new electronic interface to customize traffic forecasts at different levels of granularity (A40-WP/20-EC/5 refers). It was also used to calculate an air connectivity index by applying the World Bank's methodology, for the *Aviation Benefits Beyond Borders* 2018 Report of the Air Transport Action Group (ATAG).

3.4 The ADS-B is “a means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link” (Annex 11 – Air Traffic Services refers). Approximately 600 million rows of data on aircraft positions (departure, en-route and arrival in intervals of one minute) are recorded monthly, covering a vast majority of scheduled passenger and freighter operations, as well as charter, business jets and other commercial operations. The algorithms developed by ICAO can monitor and track aircraft movement details (distance flown and time spent) in each Flight Information Region (FIR). The ADS-B data allows to, inter alia, understand the causes of divergence between actual and filed path, and assess operational improvements, including that of Aviation Systems Blocks Upgrades (ASBUs). The ADS-B data can also be used for the work of the Committee on Aviation Environmental Protection (CAEP), for example, the development of fleet forecasts and trend assessment.

3.5 The COMTRADE data contains billions of records of commodity movements, including origin and destination countries, cost, insurance, mode of transport, and the type of transaction while E-com records e-commerce parcel transactions by date, time, class, weight, number and origin-destination city-pair. As nearly 90 per cent of cross border business-to-consumer (B2C) e-commerce is currently

¹ ICAO has access and partnership arrangements with the providers of these three big data sets. The MIDT data access is available through the Official Airlines Guide (OAG) who also publishes the airline schedules (<http://analytics.oag.com/home/>). The ADS-B data access is provided by Flightaware (<https://flightaware.com/>). The COMTRADE and the e-commerce data access is provided by the United Nations and the Universal Postal Union (UPU).

moved by air transport, the fast and reliable air cargo services are essential to meet the expected growth of e-commerce. ICAO and the UPU embarked on a joint project using the COMTRADE and E-com data to identify and quantify logistical constraints on e-commerce activity.

3.6 These three data sets described above have been collected, processed and analyzed in close collaboration with other United Nations (UN) agencies and international organizations, for example, the International Transport Forum (ITF) at the Organization for Economic Co-operation and Development (OECD), the UPU, the UN Conference on Trade and Development (UNCTAD) and the World Customs Organization (WCO), as well as academia such as the Interdisciplinary Centre for Mathematical and Computational Modelling (ICM), University of Warsaw.

3.7 ICAO is a member of the inter-agency Global Working Group on Big Data established by UNSC. One of the objectives of this working group is to promote practical use of big data for official statistics and capacity building for monitoring the progress towards the UN Sustainable Development Goals (SDGs)². The recommendations by the working group have already been incorporated into ICAO's big data activities.

4. FUTURE WORK

4.1 One of the aviation emerging issues identified in the ICAO Business Plan 2020 – 2022 is big data analytics for aviation, i.e. leveraging and unlocking the potential value of big data to improve air transport connectivity, safety and operational efficiency of aviation; allowing States and the industry to make more informed decisions and policy-making; and strengthening the customer relationship and commitments. Algorithm-based technologies, including Artificial Intelligence, Machine Learning and Deep learning, have already been used for big data analysis to find trends, patterns and make predictions, and will become increasingly important as the quantity and complexity of the data collected grow.

4.2 Aspiring towards full transparency and availability of necessary information for data-driven decision- and policy-making, the ICAO Statistics Programme and big data analytics (a part of the aviation data and analysis work programme) aims to support States and aviation stakeholders in using a data-driven approach to improving safety, operational and economic efficiency of air transport. The focus and priority of future work in this area will, therefore, be placed on:

- a) continuing to collect, process and analyze aviation data, including big data, while ensuring the alignment of the ICAO Statistics Programme and big data applications with the current needs of Member States;
- b) continuing to build expertise on emerging technologies to leverage big data potential;
- c) disseminating and sharing aviation data that are of common interest in the air transport field with Member States, thus avoiding duplication of efforts and reducing their costs and administrative burden while fulfilling requests from States concerning the confidentiality of data; and
- d) conducting analysis on emerging issues of global importance jointly with UN agencies, international organizations and academia to benefit from each other's expertise.

— END —

² ICAO is the custodial agency responsible for collecting and sharing data for the global indicator (passenger and freight volumes by mode of transport) of the SDG target 9.1 – Develop quality, reliable, sustainable and resilient infrastructure with a focus on affordable and equitable access for all. <https://unstats-undesa.opendata.arcgis.com/>