



ORGANISATION DE L'AVIATION
CIVILE INTERNATIONALE

INTERNATIONAL CIVIL
AVIATION ORGANIZATION

Performance Audit Report on Data Management

IA/2022/3

Office of Internal Oversight

ACRONYMS

ADB	Bureau of Administration and Services
ANB	Air Navigation Bureau
APO	Align, Plan and Organize domain of COBIT 2019
ATB	Air Transport Bureau
AI	Administrative Instructions
CEB	UN System Chief Executives Board for Coordination
COBIT	Control Objectives for Information and Related Technologies
DAMA	Data Management Association International
DMBOK	Data Management Book of Knowledge
DMS	Document Management System
ERP	Enterprise Resource Planning
FIN	Finance Branch
ICAO	International Civil Aviation Organization
LEB	Legal Affairs and External Relations Bureau
OIO	Office of Internal Oversight
OSG	Office of the Secretary General
RMS	Record Management System
SARPs	Standards and Recommended Practices
TCB	Technical Cooperation Bureau

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EXECUTIVE SUMMARY

1. The Office of Internal Oversight (OIO), carried out a performance audit of data management included in its work plan for 2021 (C-WP/15114). The objectives of this audit were to assess the adequacy and effectiveness of governance, risk management and control mechanisms around data management; whether the policy and procedures are operating effectively and efficiently; evaluate if tools, and digital infrastructure are used economically to ensure integrity and assess the extent of availability of data for effective decision-making, and the availability and usefulness of data for decision making. The audit was conducted in conformance with the International Standards for the Professional Practice of Internal Auditing¹.
2. While ICAO collects huge volume of data from different sources, Bureaus/Offices do not always have clear knowledge about all available data. Available data are scattered in different databases, web pages on SharePoint portals, shared folders and in emails and physical records in an unstructured manner. *The major challenges that significantly limit access of staff to data required for decision making can be summarized as: inadequate knowledge about the existence of available data, technical skills and capacity to use existing IT systems/tools, slow-paced and partially integrated IT systems, data in silos and privacy and security restrictions.*
3. At present, ICAO does not have a data governance strategy nor an enterprise level data architecture that enable fully leveraging value from datasets and data-driven decision-making. This, coupled with a lack of data quality policy, results in weak data ownership and creates ambiguity on roles and responsibilities for timely resolution of data inaccuracies. An inventory of data assets has yet to be developed to facilitate timely oversight and protection of available data.
4. Current data management culture is not conducive to sharing available data/information due to "silo" approach across the Organization. While some Bureaus started using business intelligence (BI) tools as an effective way of gaining insights and making informed decisions, reluctance in data sharing amongst Bureaus/Offices persists.
5. Based on guidance from several globally recognised sources², OIO assessed the current maturity level of data management practices in ICAO to be at the initial/starting level. It is therefore critical that ICAO adopt an integrated approach in data management and ensure that digital data management aspect is effectively covered in digital transformation projects.
6. Based on the results of the audit, OIO has given an overall rating of 'Major Improvement Needed'. This report has made three high priority recommendations. These include constituting a data governance body, strengthening personal data protection and privacy, and risk assessment and project documentation for implementing digital transformation projects. All recommendations in the report have been accepted by the Management. Management comments and proposed actions to implement the recommendations are detailed in the Management Action Plan at Annex 4.
7. OIO wishes to thank management and staff for their assistance and cooperation during the audit.

¹ IIA Standard 1321

² Guidance from Data Management Association International, data management process of COBIT 2019 and guidance available in United Nations Data Strategy document.

RESULTS OF THE AUDIT

Introduction

8. Effective data management enables organizations to be more productive as it makes it easier for all users to access available information that they need for planning, implementation, monitoring and reporting on activities, projects and programs and effectively discharge their day to day jobs. It also helps validation of results or conclusions, structuring data to be easily shared with others, communicating and reporting internally and externally and storage retrieval of data for future reference in a secure and accessible manner.
9. The organizational benefits derived from a sound data management strategy and its implementation are illustrated in the following infographic:



Audit Objectives and Scope

10. The objectives of this high level audit were to assess:
 - (a) the adequacy and effectiveness of governance, risk management and control mechanisms around data management;
 - (b) whether the policy and procedures are operating effectively and efficiently;
 - (c) whether tools and digital infrastructure are used economically while ensuring integrity and availability of data for effective decision- making; and
 - (d) the extent of availability and usefulness of data for decision making.
11. OIO formulated the following two audit questions to assess the performance of ICAO in achieving the above objectives:
 - a) Audit question 1: Does ICAO have adequate and effective governance, risk management and control mechanisms around data management?
 - b) Audit question 2: Does ICAO bureaus /data management systems contribute to the availability of useful information for decision making?
12. The scope of the audit included assessing the compliance with relevant ICAO policies and procedures, considering UN good practice and other applicable standards such as COBIT 2019. It also included an analysis and review of available documentation and interviews with key staff were held to clarify and gain a better understanding of the data management practices.

13. ICAO has embarked on a digital transformation project. The results of this audit can be useful in developing and implementing data management related projects.

Audit Findings and Recommendations

Data Governance and enterprise data architecture

14. Best practices define data governance as exercising authority and control over the management of data assets. Data governance ensures that data and information³ are consistently defined and understood across the organization. A typical data governance and management framework includes establishing (a) data strategy and oversight; (b) data security, (c) data quality, and (d) reporting. At present, there is no data governance strategy adopted by ICAO.
15. Though ICAO has consistently identified 'Data Management' related issues as high risk areas⁴ in successive risk assessments reported to the Council, it has not taken steps to mitigate these risks by developing a data strategy within a defined data governance and management framework.
16. At present, ICAO does not have an Enterprise Data Architecture⁵ which aims at a better understanding the available data and enabling effective data management from initial capture in source systems to information consumption by business people. The missing Enterprise Data Architecture prevented ICAO from managing effectively the data and information stored in the 150 different ICT applications in use in the Organization. Data were not effectively modeled, named, and defined consistently as usually recommended by Enterprise Data Architecture standards. This absence of enterprise level view, coordination and management of all ICAO's conceptual, logical and physical data models constrained ICAO to rely more on specific staff members (data owners) than systems (where data is stored) increasing the risk of institutional data losses should these staff members leave the organization.
17. This was further exacerbated by an absence of an inventory of data asset, conducive to the proliferation of different tools for same purposes⁶ and the master data (single source of truth) of the Organization has not been identified. There are multiple sources of varying master data even for basic records such as names of countries and models of planes.
18. Finally, the organization does not have a well-defined Business Intelligence (BI) strategy and a developed mechanism to identify, collect, assess and translate data into accurate, meaningful and actionable information for efficient decision-making of stakeholders.
19. Absence of a solid data governance, strategy and enterprise data architecture led to an overall lack of data culture and weak data ownership and accountability. This coupled with lack of an inventory of data assets and documented data models impede timely identification, oversight and protection of data as an asset and further prevents ICAO to use available data effectively to make informed decision.

³ Data is a collection of facts, while information puts those facts into context. For the purpose of simplicity, all references to 'data' in this report will also include 'information'.

⁴ Insufficient centralized document management/storage process, No disaster recovery backup site, potential misuse of confidential information and ICAO's intellectual property

⁵ Enterprise data architecture is composed of models, policies, rules, or standards that dictate which data is collected and how it is stored, arranged, integrated, and put to use in systems and in the organization.

⁶

20. Interviews with key staff confirmed that there is consensus on the need to significantly improve data management in ICAO. In 2022, ICT did a comprehensive self-assessment of the status of data management in ICAO which included several recommendations to Senior Management for improving data management in the Organization. Furthermore, the Secretary General took a decision to engage [REDACTED]⁷ to help ICAO undertake some eight signature projects as part of the digital transformation initiative. While all the signature projects of digital transformation initiative will positively influence the implementation of different domains of data management, three signatures projects⁸ have a direct relation with data management.

Data Quality

21. Best practices in data quality include policies and guidelines, assign responsibilities, data quality measurement, data cleansing and correction, data quality process improvement and data quality education.
22. There is no formal data quality mechanism in ICAO. There are no earmarked resources for implementing a formal data quality framework and maintaining data quality. The data quality aspect in ICAO largely depends on the due diligence and initiatives of individual staff members without much clarity on data ownership/stewardship or accountability for maintaining data quality. A self-assessment made by ICT in 2022 also concluded that data quality domain of data management is not implemented in ICAO.
23. Staff face data quality issues with internal data which require to be checked and verified leading to wastage of resources. The quality of master data and reference data is also poor, that adversely impacts the quality of datasets relying on such master and reference data. Poor data quality results in untrustworthy and inaccurate information which inherently leads to decreased value of organizational data and decreased opportunities to use it, increased costs associated to poor quality data, poor business decisions, and inaccurate findings and reporting.

Recommendation 1	Data Governance, Strategy and Enterprise Data Architecture
Priority	High
Under the leadership of the Secretary General, a data governance body should be constituted with responsibility to define data strategy and implement a data governance and management framework.	
Such a framework would among others:	
- Clearly assign roles and responsibilities over data ownership and stewardship of the enterprise-wide inventory of data assets - Include a data quality policy with data quality metrics.	
Closing criteria:	
Constitution of a data governance body involving relevant Bureaus/Offices.	
Development of a data strategy and defining a data governance and management framework.	

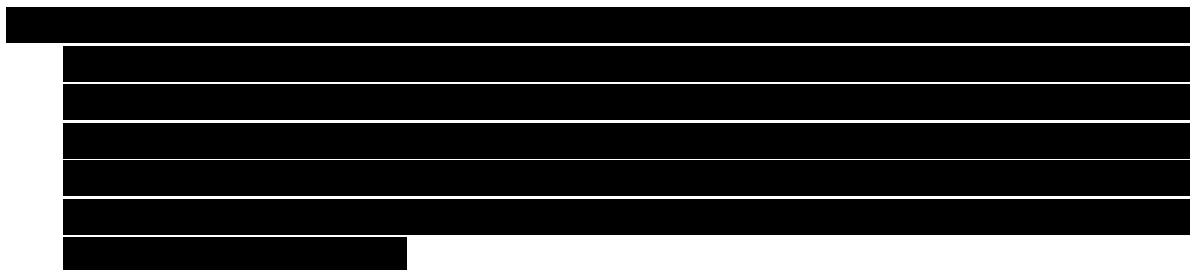
⁷ [REDACTED]

⁸ Document Management System, Business Intelligence and enterprise data management, and Enterprise Resource Planning

Data management culture in ICAO

24. Strong data management culture encompass collective behaviors and beliefs of individuals who value, practice, and encourage the use of data to improve decision-making in the organization, relying on cross-cutting data set across the organization. Best practices in other United Nations organizations encompasses working groups, workshops and training on data management for decision making process. Business Intelligence workshops and contests are organized to emulate and sensitise staff members on data management and its value.
25. ICAO culture is not conducive to data sharing because of the traditional “silo” approach of Bureaus/Offices, which runs strongly counter to a shift towards increased horizontality of cross-cutting data set. Lack of overall coordination between Bureaus, the reluctance in sharing data across the Organization (partly attributed to concerns over data security) and weak data ownership and accountability resulted in data/information being produced in 'silos' and inadequately shared. Coupled with the lack of centralized data repositories, this led to inefficiencies such as unnecessary and costly duplication of efforts to generate data that sometimes already existed, data not being used by its intended beneficiaries, excess storage costs and difficulty in searching for what is most pertinent or up-to-date.

Poor data sharing with Regional Offices illustrates immature data management culture



27. Building an organizational data management culture is an enormous task and cannot happen overnight. The Digital Transformation initiative and its signature projects constitute an opportunity for ICAO to raise awareness and interest of the staff members in data management and Senior Management is setting the tone for it through the Digital Transformation initiative. Consideration of best practices in other UN organizations will contribute to its success.

Availability of useful data for decision-making

28. Availability of “relevant data” is important for informed decision-making and anticipate challenges/risks that may get in the way of achieving strategic objectives. ICAO collects huge volume of data for achieving strategic objectives. This data could be from primary sources (through surveys, safety/security audits, field missions, interviews, observations, etc.) and secondary sources (from Member States, industry and other stakeholders). ICAO also buys data when necessary.
29. The absence of enterprise level data architecture, mentioned earlier in this report, renders very difficult to obtain an assurance that all internal datasets are optimally used for daily activities, informed decision making and ultimately achieving organization’s objectives.
30. The elements below illustrate some of the additional multiple causes affecting the identification of useful available data for decision-making:
 - Absence of central data storage system, at least for the major data sets, and lack of adequate mechanism in place to know which data exist and which don't;

- Staff members in Bureaus/Offices do not always have clear knowledge about all available data scattered in different databases⁹ and few individuals know where these datasets are available;
 - Restricted access to file shares among ICAO Bureaus/offices¹⁰.
 - Same data available in numerous internal sources with no authoritative single source, even for important datasets¹¹;
 - Many legacy IT systems are not integrated causing IT systems limitations and creating user dissatisfaction¹²;
 - Absence of metadata and search engine capability;
 - Inadequate technical skills of ICAO staff¹³; and
 - Lack of communication between data owners and data users or decision makers¹⁴.
31. To illustrate further how data availability represented a challenge for ICAO, OIO undertook an analysis on few key processes/areas in ICAO management: the Business Plan and the triennial Budget developments and assessed ICAO's strategic approach on Business Intelligence tools. These analysis are presented in Annex 2.
32. Overall, ICAO is collecting useful data and information for decision-making from a variety of sources. However, data management culture, and limited human and system capacity present threats to information being available, credible, reliable and useful for decision making process.

Classification and retention schedules

33. Data classification provides an interface for organizations to implement controls and procedures across data formats, structures and storage technologies. Classified data allows an organization to define and implement a single policy for handling sensitive data across multiple systems and data objects. Defining multiple policies per each type of data object is not realistic and inefficient in today's data abundant environments.
34. The ICAO's Administrative Instructions on data classification were revised and adopted in 2020¹⁵. These instructions complemented the Administrative Instructions on Records Management issued in 2014. Whilst the risk of misuse of confidential information was assessed as high in the ICAO corporate risk register, training, guidance and tools to effectively implement the instructions on data classification has been weak or lacking and Bureaus do not always comply with data classification instructions.
35. The Administrative Instructions on Records Management identified two categories of records: vital and non vital, whether they are digital records or physical records. The regular retention schedule is seven years for non vital digital records and indefinitely for vital digital records. However, due to an

¹⁰ Regional Offices and Bureaus do not have access sometimes to data available with other Bureaus.

¹¹

¹²

¹³

¹⁴ For example, no Bureau assesses data needs of Regional Offices or other potential users before deciding to buy data. Presentation of data is also contributing to difficulty in using available data (e.g. data disaggregated by regions: SAM Region versus Latin America Region or African Continent versus data categorized by ICAO regional Offices)

¹⁵ Information Classification administrative instruction – IS AI 004 - issued 8 Sept. 2020

absence of tools, mechanisms, focal points, training and/or guidance to support Bureaus and Offices, data are kept forever which represents unnecessary costs in terms of server storage and maintenance personnel or cloud services but also increase the risks related to loss and protection of data or inability to retrieve data.

36. A dedicated strategy on data classification and data retention, setting the appropriate mechanisms such as information sessions, workshops, and focal points, could be a remedy to the consequences mentioned above.

Personal data protection and privacy

37. Without prejudice to the immunities and privileges of the UN Common System Organizations, the UN System Chief Executives Board for Coordination (CEB)¹⁶ adopted principles on personal data protection and privacy in 2018 providing a basic framework for the processing of "personal data". These principles aim at harmonizing standards for the protection of personal data across the UN system organizations, facilitating the accountable processing of personal data for the purposes of implementing the mandates of the UN system Organizations and respecting the individual's right to privacy. As a participating organization in CEB, ICAO needs to adopt these principles and issue detailed operational policies and guidelines on the processing of personal data in line with these principles.
38. There is inadequate mechanism and associated procedures in ICAO to protect personally identifiable information that should be invariably protected. While considerable private information is collected from staff members, processed using the ERP system and other ICT applications, there are no institutional measures in place to regulate access and secure handling of confidential and sensitive information in areas such as HR, Medical Unit, and other sensitive data. Soft copies of sensitive data are often sent by emails, which is not a secure way of dissemination. The HR data is received by Regional Offices in excel sheets from the Headquarters (contract expiration, leave stats, etc.).
39. Identifying compliance with personal data protection and privacy is a critical part of data governance. Interviewed staff members recognize the need and importance of complying with privacy laws, however, this issue has not yet been given due consideration by senior management. Partly because due to lack of a data governance body, this was never planned in a formal manner.

Recommendation 2

Personal data protection and privacy

Priority

High

Based on principles adopted by CEB in 2018, ADB should take the lead in developing an organizational policy on personal data protection and privacy to embed personal data protection and privacy management standards in business processes and information systems in a consistent manner.

Closing criteria:

Development of a personal data protection and privacy policy.

¹⁶ ICAO is a participating organization of CEB mechanism

Document Management

40. As per DAMA¹⁷ framework, the document management is an important element of data management¹⁸. Document management comprises the processes, techniques and technologies used for controlling and organizing the storage, inventory and lifecycle management of electronic and paper documents, records and files of the organization¹⁹.
41. Document management in ICAO faces challenges such as lack of clarity on data ownership creating ambiguity over the responsibility for data inaccuracies. Metadata is not systematically used for unstructured data creating obstacle for data retrieving and several document management systems coexist.
42. ICAO engaged in 2021 into a digital transformation (see next section of this report) and the document management system (DMS) is one of the prioritized signature projects of the transformation. At the time of the audit, the migration of email infrastructure to Cloud started and constitutes a positive development improving the security posture of the Organization with regard to the risk of email servers being on premises. An important positive outcome will be also be the migration of shared drive to Cloud which will enhance possibility of unstructured data owners to use and develop metadata and facilitate management of these unstructured documents. The digital transformation constitutes an opportunity to address document management challenges and current weaknesses.

The digital transformation action plan 2023-2025

43. At the end of 2021, ICAO engaged [REDACTED]²⁰, to conduct a review of the ICT environment, digital transformation opportunities, and a proposed future ICT organizational structure at ICAO. An ICT strategy and action plan for 2023-2025 was produced which was endorsed by the Secretary General in May 2022. The document outlined the need for a digital transformation in ICAO to respond with agility to changing needs and requirements and secure the business, drive efficiencies as well as transparency, and to catch up to the technological maturity and best practices of ICAO's United Nations counterparts.
44. The Digital Transformation initiative comprises of eight signature projects. All signature projects of digital transformation initiative are large projects involving considerable expenditure. There are risks associated with implementation of enterprise wide large projects which should be considered at the inception stage itself.
45. OIO noted the following:
 - The staff members, including members of the top management, may not be sufficiently clear about the scope of the projects. The involvement of relevant stakeholders in the planning phase seems inadequate.
 - It is not defined how the signature projects interact and will be linked to make meaningful advance analysis that is crucial to make effectiveness and efficiency analysis.
 - Digital transformation initiative has not been adequately communicated to staff members.

¹⁷ Data Management Association International

¹⁸ Usually, document management represents more than 70% of all stored data, in an unstructured format and maintained outside of relational databases

¹⁹ These files and documents could be electronic or paper documents, flat files, graphics, images, chats, texts, reports, social media, videos, sound recordings etc.

²⁰ [REDACTED]

- Over reliance on consultants and absence of active involvement of key staff members may result in deficient implementation of signature projects.

46. There are many reasons why large IT project implementations can go wrong in the initial design and definition stage: lack of planning and management participation, lack of business focus, unrealistic schedules, shifting requirements, unaligned teams, poor communication, failing to manage user expectations, to name a few. It is very important for ICAO to assess and mitigate these risks at the earliest stage of the project while embarking on implementing digital transformation.

Recommendation 3	Digital Transformation Action Plan
Priority	High
The sponsors of signature projects of Digital Transformation should undertake (a) a risk assessment to identify significant risks that can materialize at the design and definition phase of the projects, (b) confirm the business case and milestones of the project implementation, (c) define roles and responsibilities, and (d) ensure effective communication and active participation of all stakeholders.	
Closing criteria:	
Documented risk assessment, detailed business case and initial project documentation defining communication strategy, milestones and roles and responsibilities of key stakeholders.	

Data Management Maturity Assessment

47. There are various notable data management frameworks to achieve and sustain effective management of enterprise data assets; (a) Data Management Book of Knowledge (DMBOK²¹) by Data Management Association (DAMA International), and (b) Data Management process (APO14) of COBIT 2019²². These framework provide clear and recognize criteria to assess the maturity of ICAO data management.

Maturity assessment with DMBOK as criterion

48. In 2022, ICT carried out a self-assessment using DMBOK of DAMA. According to this self-assessment, the following domains of data management have not been implemented in ICAO:

Data Management Domain/Area	Status reflected in self-assessment
Data Governance	Not Implemented
Data Architecture Management	Not Implemented
Reference and Master Data Management	Not Implemented
Metadata Management	Not Implemented
Data Quality Management	Not Implemented

(Source: ICT)

²¹ DAMA International's DMBOK (Data Management Book of Knowledge) is a comprehensive guide to international data management standards and practices for data management.

²² COBIT 2019 is an IT Governance and management framework of ISACA (Information Systems Audit and Control Association). The best practices on data management are outlined in one of the processes (APO14), which deals with on data management.

49. The self-assessment also concluded that the rest of the assessed domains were implemented or partially implemented. However there are gaps and ample scope for improvements in these areas:

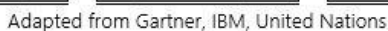
Data Management Domain/Area	Self Assessment by ICT	OIO's analysis (June 2022)
Data Development/Modeling	Implemented	ICAO does not have enterprise level view of data and conceptual data modelling. There are no tools for updating and storing the data models.
Database Operations Management	Implemented	Upgradation of database of key system (Unit4 ERP) in planning stage. Unit4 is hosted on Oracle 11g which is already out of support.
Data Security Management	Partially Implemented	Information Security Roadmap is under implementation.
Data Warehousing and Business Intelligence Management	Partially Implemented	Some positive end-user developments in Bureaus were noticed. More progresses are needed. Renewed focus in Digital Transformation initiative as one of the signature projects deal with enterprise data management and business intelligence.
Document and Content Management	Implemented	Overall, DCM needs revamping under the Digital Transformation DMS project.

50. In the absence of a data governance strategy combined with lack of enterprise data architecture, it is not expected or possible to fully implement the domains related to data modelling, data security, database operations, data warehousing/BI and document and content management.
51. ICAO has no documented conceptual models and ICT applications of the portfolio suffer from lack of integration. The business analysts and software developers in ICT who maintain the ICT applications can analyze data on the basis of their knowledge of databases but end users in technical Bureaus will not be able to analyze data in the absence of conceptual and logical data models.

[REDACTED]

53. On the aspect of Data warehousing and business intelligence, the investments made already in procuring enterprise licenses of Dundas could not be utilized during past five years. Some recent developments regarding usage of BI tools are encouraging but ICAO is yet to adopt a comprehensive plan to adopt business intelligence.
54. The Document Management System needs a total revamp of the existing capabilities as SharePoint 2013 will be out of support in April 2023 and there are problems with the metadata of documents managed in Record Management System.
55. OIO also used the management practices included in the COBIT 2019 data management process (APO14) as a best practice and a criteria to assess ICAO's maturity in data management. While it is not expected that ICAO, as a public sector international organization, attains very high levels of maturity of implementation of data management practices of COBIT 2019, OIO found that ICAO lacks sufficient maturity level with regard to all ten management practices. The data management practices of COBIT 2019 are given in Annex 3.

6. The United Nations also adopted a data strategy for 2020-2022²³ with emphasis to generate more value from the UN's wealth of data. This strategy document outlines the strategic foundation, priorities and focuses on fostering enablers and nurturing capabilities. While the UN data strategy is focused on the UN Secretariat, the strategy can guide any UN organization seeking to accelerate the data-driven digital transformation.
7. The UN data strategy presents a maturity model showing stages of organizational development in its journey to attain objectives of data management and realize value from data assets. OIO also assessed the current maturity of ICAO's data management processes using this maturity model. The results are given in the following infographics:



58. Current maturity level on data management is low and ICAO is at a basic stage or initial level of the capability maturity model²⁴. It will require a lot of efforts in terms of investment and top management steering to improve. Realizing the full potential of data will not happen in the short term but ICAO needs systematic action based on strong strategic foundations. The digital transformation initiative should define the end points of a journey, while simultaneously taking care of the domains and components of data management.

²³ Data Strategy of the Secretary General for action by everyone, everywhere, 2020-2022

²⁴ At this level, Processes are seen as unpredictable, poorly controlled, and reactive. Businesses in this stage have an unpredictable environment that leads to increased risks and inefficiency.

ANNEX 1: DEFINITION OF AUDIT TERMS

Audit Ratings

In providing an overall assessment of the results of the audit, OIO uses the following standardized audit rating definitions:

Audit Assessment	Definition
Effective	Controls evaluated are adequate, appropriate, and effective to provide reasonable assurance that risks are being managed and objectives should be met.
Some Improvement Needed	A few specific control weaknesses or areas for improvement were noted; generally however, controls evaluated are adequate, appropriate, and effective to provide reasonable assurance that risks are being managed and objectives should be met.
Major Improvement Needed	Several key control weaknesses were noted and/or several areas of strategic/high importance were identified where significant improvements can be made to increase efficiency and effectiveness.
Unsatisfactory	Controls evaluated are not adequate, appropriate, or effective to provide reasonable assurance that risks are being managed and objectives should be met.

Internal control is defined as a process effected by senior management and staff, designed to provide reasonable assurance regarding the achievement of objectives relating to operations, reporting and compliance objectives. Whilst internal control provides reasonable (but not absolute) assurance of achieving organizational objectives, limitations may result from:

- suitability of objectives established as a precondition to internal control;
- reality that human judgment in decision making can be faulty and subject to bias;
- breakdowns can occur because of human failures such as simple errors;
- ability of management to override internal control;
- ability of management, other staff, and/or third parties to circumvent controls through collusion;
- external events beyond the organization's control.

Priority of Audit Recommendations

The audit recommendations in this report are categorized according to priority as a guide to management in addressing the issues raised. The following categories are used:

High: recommendations, which address significant and/or pervasive deficiencies or control weaknesses, or areas where significant improvements can be made.

Medium: recommendations, which address important deficiencies or control weaknesses, or areas where some improvements can be made.

Low: suggestions, which represent best practice, or general opportunities for improvement.

ANNEX 2: EXAMPLES OF DATA USE CASES

To illustrate further how data availability represented a challenge for ICAO, OIO undertook an analysis of a sample of key processes/areas in ICAO management: the Business Plan and the triennial Budget developments, ICAO's strategic approach on Business Intelligence tools and data use requirements of TCB.

Business Plan development

- (a) The Business Plan is a high level document used for the strategic direction. The preparation of the triennium Business Plan is based on high level data. The Business Plan is not adequately analysing and utilizing data available in the Corporate Monitoring and Reporting Tool (CMRT). A recent evaluation of Results Based Management in ICAO found also that management is not using available data and information in CMRT for decision-making²⁵. While Business Plan is a document for guiding on strategic direction, implementation details are specified in the annual operating plans. These plans are clearer in terms of operations though there is little analysis and reporting on outcomes.
- (b) There is inadequate link between business plan and the budget. These two documents are not adequately aligned with each other and there is no integrated approach. Triennium budget focuses only on regular budget whereas the Business Plan also includes activities which are funded by carry over funds from previous budgets and voluntary funds.

Budget preparation affected by unstructured data and scattered information

- (c) While linked together, the Business Plan and the triennial budget are not adequately aligned with each other and suffer from a lack of integrated approach. The budget preparation relates on important data sources including information on HR costs (which is about 82% of the regular budget), Council Decisions, Business Plan, and new requirements from managers. However, the budget preparation suffers from data in silos and lack of data identification and availability.
- (d) The Finance Branch (FIN) faced challenges in identifying the data for costing the new expenditures²⁶ of the draft budget for 2023-25. The lack of automated systems to aggregate data from different internal sources and Bureaus made the budget process rather manual with data processing heavily relying on spreadsheet analysis. Capturing data having an impact on future budgets, such as Council decisions, remained a challenge and led to changes in budget proposal documents at later stages. Despite multiple consultations of Bureaus as compensating controls there is a risk that data relied upon by FIN while preparing budget proposals may not be complete.

Business Intelligence tools in ICAO lacked a well defined strategy

- (e) Analytics work varies in terms of time, effort and level of complexity. It can range from simple static reporting of historical data to predictive or prescriptive analytics with complex interactive visualizations.
- (f) Though data visualization is a challenge across the board in ICAO, recent developments in Technical Bureaus and Regional Offices are very positive in terms of developing staff capacity for data analytics and visualization. ATB uses business intelligence software for aviation analytics. The monthly monitor presents economic impact analysis of COVID-19, passenger and freight forecast scenarios, world air transport results, aviation data, and passenger and freight volumes by mode of transport, etc. ANB also used business intelligence software for its data analysis requirements. SAM started processing internal data in

²⁵ Evaluation of RBM in ICAO, 2019

²⁶ For example, a new IT system for enabling efficiencies, or hiring a consultant for a specific unforeseen purpose

a more structured manner and also use business intelligence software tools and created their own dashboards and further plan to develop procedures to maintain these dashboards.

- (g) These business intelligence initiatives use latest tools available at ICAO which are reasonably cheap, intuitive and easy to learn and built towards end user computing without continued involvement of ICT staff.
- (h) However, in absence of a data governance, management framework and enterprise data architecture, ICAO lacked a well-defined BI strategy. There is no underlying mechanism to assess the data requirements, and translating the data into actionable information for decision-making to efficiently serve ICAO stakeholders. BI projects are in an early stage of deployment and the BI signature project of the Digital Transformation will pave the way to a data culture in the Organization.

Data Use requirements of TCB

- (i) A project to develop a Business Process Management Solution (BPMS) for the bureau was first initiated in 2015. However, it could not be implemented in last seven years because of difficulties in managing integration with Unit4 ERP. This issue was also highlighted in the OIO report on TCB project management²⁷.
- (j) At present, TCB does not have the necessary automated tools and systems to support the effective and efficient management of projects. In particular there is no automated system to manage project budgets. Project expenditures are recorded in Unit4, however there is no information in Unit4 on project budgets.
- (k) The financial status of projects is managed by the Business Support Section (BSS) using Excel spreadsheets. Project officers are not able to track project expenditure by individual objectives, and cannot link what has been spent to date against the work plan. Other important information on each project, such as the status of individual project activities or procurement requests, is managed in standalone spreadsheets or using Microsoft Project worksheets, created and maintained by the responsible project officers.
- (l) Budget Forecasting is done twice a year for hundreds of projects and this task is very laborious and presently involve manual computations. Budget check does not exist in Unit4 because budgetary details on projects itself are not available in Unit4.
- (m) With new digital transformation project, further developments on BPMS are frozen because one of the signature projects in digital transformation is about enhancing ERP integration with Project management module.

²⁷ TCB Project Management Audit, 2020

ANNEX 3: DATA MANAGEMENT – APO14 (COBIT 2019)

Domain: Align Plan and Organize

Managed Data

Achieve and sustain effective management of the enterprise data assets across the data life cycle, from creation through delivery, maintenance and archiving.

Purpose

Ensure effective utilization of the critical data assets to achieve enterprise goals and objectives.

Management practices

APO14.01 Define and communicate the organization's data management strategy and roles and responsibilities.

Define how to manage and improve the organization's data assets, in line with enterprise strategy and objectives. Communicate the data management strategy to all stakeholders. Assign roles and responsibilities to ensure that corporate data are managed as critical assets and the data management strategy is implemented and maintained in an effective and sustainable manner.

APO14.02 Define and maintain a consistent business glossary.

Create, approve, update and promote consistent business terms and definitions to foster shared data usage across the organization.

APO14.03 Establish the processes and infrastructure for metadata management.

Establish the processes and infrastructure for specifying and extending metadata about the organization's data assets, fostering and supporting data sharing, ensuring compliant use of data, improving responsiveness to business changes and reducing data-related risk

APO14.04 Define a data quality strategy.

Define an integrated, organization wide strategy to achieve and maintain the level of data quality (such as complexity, integrity, accuracy, completeness, validity, traceability and timeliness) required to support the business goals and objectives.

APO14.05 Establish data profiling methodologies, processes and tools.

Implement standardized data profiling methodologies, processes, practices, tools and templates that can be applied across multiple data repositories and data stores.

APO14.06 Ensure a data quality assessment approach.

Provide a systematic approach to measure and evaluate data quality according to processes and techniques, and against data quality rules.

APO14.07 Define the data cleansing approach.

Define the mechanisms, rules, processes, and methods to validate and correct data according to predefined business rules.

APO14.08 Manage the life cycle of data assets.

Ensure that the organization understands, maps, inventories and controls its data flows through business processes over the data life cycle, from creation or acquisition to retirement.

APO14.09 Support data archiving and retention.

Ensure that data maintenance satisfies organizational and regulatory requirements for availability of historical data. Ensure that legal and regulatory requirements for data archiving and retention are met.

APO14.10 Manage data backup and restore arrangements.

Manage availability of critical data to ensure operational continuity.

ANNEX 4: MANAGEMENT ACTION PLAN

Ref	Recommendation	Priority Rating	Accepted (Y/N)	Management Comments	Agreed Actions	Office/ Section Responsible	Target Date
1.	Under the leadership of the Secretary General, a data governance body should be constituted with responsibility to define data strategy and implement a data governance and management framework. Such a framework would among others: - Clearly assign roles and responsibilities over data ownership and stewardship of the enterprise-wide inventory of data assets - Include a data quality policy with data quality metrics.	High	Y	The Organization lacks an overall data management and utilization structure. The proposed data governance group (DMG) will involve representatives from ICAO bureaus and offices, including Regional Offices. It will report to the Information Management Committee (IMC). The proposed DMG will review and approve related data management policies, standards, and strategies such as: - ICAO data quality management strategy - ICAO master and reference data management policy - Data privacy policy - Other pertinent strategies or policies representative of other domains of data management It will also monitor their implementation through relevant metrics.	Administrative Instructions to ratify ICAO's enterprise data management framework and TOR for the Data Management Group (DMG) have been drafted and presented for review and endorsement by the IMC in its meeting held on 1 November 2022. After review by IMC, the draft AIs on Enterprise Data Management and TOR for DMG will be submitted to the Secretary General for approval. Data quality policy and metrics will be defined and monitored by the DMG	ADB/IMS	30 June 2023

Ref	Recommendation	Priority Rating	Accepted (Y/N)	Management Comments	Agreed Actions	Office/ Section Responsible	Target Date
2.	Based on principles adopted by CEB in 2018, ADB should take the lead in developing an organizational policy on personal data protection and privacy to embed personal data protection and privacy management standards in business processes and information systems in a consistent manner.	High	Y	The proposed DMG will review and approve the future ICAO data protection and privacy policy.	ADB will write a data protection and privacy policy, according to UN principles, that will be reviewed and endorsed by the DMG.	ADB/IMS	31 December 2023
3.	The sponsors of signature projects of Digital Transformation should undertake (a) a risk assessment to identify significant risks that can materialize at the design and definition phase of the projects, (b) confirm the business case and milestones of the project implementation, (c) define roles and responsibilities, and (d) ensure effective communication and active participation of all stakeholders.	High	Y	The sponsors of signature projects are involved in project governance through regular board meetings. The mandatory project management elements for all signature projects includes: • Risk assessment • Business case • Planning and milestones • Change management strategy	The set-up of all digital transformation projects includes these mandatory project management elements and involve sponsors in their governance.	ADB/IMS	30 June 2023