British Journal of Multidisciplinary and Advanced Studies, 5(4),54-67, 2024
Business and Management Sciences
Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by the European Centre for Research Training and Development UK

Deployment of A Data Consolidation System in an Aeronautical Administration: Application to the Rva/City of Kananga in the Democratic Republic of Congo

Seraphin Buambaka Buambaka
Kananga Pedagogical University
(UPKAN), Department of Business Informatics, Kananga town, Democratic Republic of Congo
E-mail : buasera1@gmail.com

doi: https://doi.org/10.37745/bjmas.2022.04155 Published August 07, 2024

Citation: Buambaka S.B. (2024) Deployment of A Data Consolidation System in an Aeronautical Administration: Application to the Rva/City of Kananga in the Democratic Republic of Congo, *British Journal of Multidisciplinary and Advanced Studies*, 5(4),54-67

ABSTRACT: *This article examines the specific challenges encountered by the aeronautical administration of the Airway Authority of the City of Kananga in the Democratic Republic of Congo in the management and consolidation of its aeronautical data, as well as possible solutions to remedy them. We present the different stages of the system deployment process, highlighting the technical, organizational and operational aspects to consider. Finally, the study provides an analysis of the results obtained after the implementation of the data consolidation system, highlighting the benefits and possible remaining challenges.*

KEYWORDS: donation consolidation, consolidation techniques, aeronautical administration, web application

INTRODUCTION

In a world increasingly focused on digitalization and data centralization, aviation administrations must constantly evolve to meet the requirements of safety, performance and operational efficiency. The Democratic Republic of Congo (DRC), as a developing nation, is no exception to this reality, particularly in the aeronautical sector where accurate and rapid data management is of paramount importance for flight safety and fluidity. operations.

In this context, this study focuses on the deployment of a data consolidation system within the Aeronautical Administration for the city of Kananga, located in the DRC. This City, as the nerve center of air transport in the central part of the country, represents favorable terrain for the implementation of modern aeronautical data management tools.

The main objective of this study is to analyze the specific challenges faced by the RVA city of Kananga terms of collection, processing and management of aeronautical data, as well as to propose a viable and effective solution in the form of a data consolidation system. Furthermore,

Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by the European Centre for Research Training and Development UK

this research aims to evaluate the potential benefits that this solution could bring in terms of flight safety, resource management and process optimization.

Through a methodical approach, this study explores the different stages of deploying such a system, highlighting the technical, organizational and financial considerations inherent to this process. Finally, based on empirical data and case studies, it offers practical recommendations for the successful implementation of a data consolidation system within this administration.

With this in mind, this research aims to contribute to the continuous improvement of data management practices in the aeronautical field in the DRC, while providing avenues for reflection and concrete tools to strengthen operational efficiency and flight safety in the DRC. within the RVA City of Kananga.

Related Works

1. Home Web applications on virtual levels, optimizing the availability of resources and ensuring a high availability.
2. **DEPOERES, F.,** consolidation of environmental data : Issues and practices. Crises and new problems, Nice, May 2010. This article will impact the donation consolidation to support enterprise reporting and contribute to the development of pratique environmental issues.
3. **Helena Hadjipavlou** , Big Data, monitoring and trust: the question of transportation in the airport. This will focus on the analysis of the impact of surveillance technologies based on Big Data in airport environments, especially in that which concerns the privacy of individual users in these systems. The driver provided an evaluation of the effectiveness of basic surveillance systems on Big Data in detection and effective menace prevention.
4. **Kaffa Jackou Rakiatou Christelle « *Contribution to the operation of the***

***Aéroportuaire: Modification and optimization* .** The driver pays a contribution method to the receipt of resources mises in the aeroports to ensure the security of the passagers.
By combining these different perspectives and adapting them to the specific needs of the aeronautical administration of the RVA/City of Kananga, our contribution aims to provide a complete and innovative solution for the deployment of a data consolidation system in an aeronautical environment. constantly evolving.

RESEARCH METHODOLOGY

To carry out our study, we used the following methods:
- Comparative method: Compare different contexts or situations and finally analyze the differences and similarities;
- Descriptive method: This method consists of mapping data on a specific aspect. It is often quantitative and is based on previous studies;
- Field research: which helped us observe data directly on the ground in order to understand real practices and the challenges encountered in a heterogeneous environment.

Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by the European Centre for Research Training and Development UK

- The Unified process: software development methods. It is characterized by an iterative and incremental approach
- Data Warehouse: Consolidation technique used to centralize data from heterogeneous sources

IMPACT OF WEB APPLICATIONS IN AN AERONAUTICAL ADMINISTRATION

The web applications are designed to be sent to the Aeronautical Administration. There are a variety of applications available in the aeronautical network. For example, WePub is a web application that allows organizations to deliver aeronautical information to produce automated aeronautical publications.
Digitalisation is available in the aviation network, augmenting the complexity of all systems. For example, NASA has been working with the Federal Aviation Administration for more than 25 years to develop technologies for drone traffic (FAA, 2024).

The Web applications use the latest information systems. Exposition on the Internet of these applications continues in new forms of menaces that may occur in the security of the information system. (Abdelhamid MAKIOU (2016, p.10)

The web applications may not be able to connect to the server, and the users will be able to download the latest version. It's not necessary to install the installer because it means: The web applications can be used directly on the web.

A multiplate format that allows collaboration between users (**Joëlle, D et Cazes** , A: 2016, p.92) : Web applications can be used on all device types: ordinateur, smartphone, tablette. If they are responsive, they allow users not to use the mother terminal or the mother system exploring the travailer ensemble at certain times on a mother document or project.

Web applications have many advantages, particularly in a heterogeneous environment:

- ✓ Improved User Experience: With responsive design, it is much easier and cheaper to make a web system user-friendly across multiple platforms and different screen sizes.
- ✓ Flexible Access: Employees can work from anywhere with Internet access.
- ✓ Secure Customer Login: Customers are impressed with a modern web portal and customer service is improved through automated processes.
- ✓ Easy setup: It takes a few minutes to setup a new user; provide a URL, username and password and they are gone.
- ✓ Always up to date: As everyone accesses the same version of the web application via a URL, they will always access the most recent version of the software.
- ✓ Increased storage: With the availability of cloud, storage space is virtually infinite.

Please note that other inconveniences must be included in the account:

- ✓ **Dependence on the Internet** : If 4G Internet access and Wi-Fi are available on any endpoint, if you connect to the connection, you cannot access your Web application.
- ✓ **Security** : When a number of professionals peuvent penser que les Web applications sont security, il ya toujours des risques associés à l'utilisation d'Internet. In a hot

Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by the European Centre for Research Training and Development UK

environment, the advanced principles are the simplification of the gesture on the system. The process in all the systems, as long as the manipulation is simple. Moreover, the succès of the hybrid cloud plateforms expand the notification by the position of the applications on the better endroit, the migration of the public cloud and the storage donation.

IMPACT OF DATA CONSOLIDATION IN AN AERONAUTICAL ADMINISTRATION

Data consolidation is the process by which businesses can create a master data record, in order to examine the knowledge that this historical information carries to guide future decisions, for business operations, etc.
Data consolidation is a crucial process for any business or organization looking to improve the management of its operations.
- Data consolidation first makes it possible to obtain a more precise and complete overview of the organization's data. By combining data from different sources, we will have a clearer picture of the situation, which is essential for making informed decisions.
- Additionally, data consolidation helps improve operational efficiency by reducing redundancies and eliminating potential errors. By centralizing data, we avoid duplication and ensure that all information is up to date and consistent.
- Data consolidation finally paves the way for the application of artificial intelligence for predictive analysis and automated decision-making. By leveraging consolidated data, it is possible to identify trends, predict future needs and even set up alert systems to detect potential anomalies. (Astera.Com).

However, the donation consolidation is not safe. It can be difficult to assemble the installed data of disparate systems and the integrator of many other components. Moreover, it is necessary to guarantee the security and confidentiality of the data. These techniques are used to consolidate the donation:
- ETL (Extract, Transform, Load)
- Virtualization;
- Data warehousing

Data consolidation is a critical aspect of data management in a heterogeneous environment. The choice of consolidation technique depends on many factors, including the specific requirements of the organization, the nature of the data, time and budget constraints, and available skills. It is important for organizations to understand the advantages and disadvantages of each technique in order to make an informed choice. (GIORDANO, A: 2011, p.91)

SPECIFICATION OF THESE ITEMS

1. Functional needs

- ✓ Real-time data collection;
- ✓ Integration of heterogeneous data;

- ✓ Data cleaning and quality;
- ✓ Analysis and operational reports;
- ✓ Performance management;
- ✓ Data security;
- ✓ Systems interoperability;
- ✓ Planning of air operations;

2. Operational needs

- ✓ Availability and reliability of the system;
- ✓ Optimal performance;
- ✓ Scalability;
- ✓ Incident management and maintenance;
- ✓ Data security and regulatory compliance;
- ✓ Data backup and recovery;
- ✓ User training and support.

3. Technical constraints

- ✓ Massive data volume;
- ✓ Variety of data sources;
- ✓ Complexity of relationships between data;
- ✓ Real-time performance requirements;
- ✓ Data security and confidentiality;
- ✓ Interoperability with existing systems;
- ✓ Fault tolerance and disaster recovery

By taking these constraints into account, the RVA/Kananga aeronautical administration can ensure that the deployment of the data consolidation system takes place smoothly and in accordance with requirements, thus contributing to improving the management of operations in this sector. .

Choose the application or donation consolidation technique

When it comes to choosing the best data consolidation technique for a heterogeneous environment, several factors need to be considered. Compatibility with different data formats, ease of integration with existing systems, scalability and data security are all crucial considerations.

As part of this research, we set our sights on the data warehousing technique. Indeed, the data warehouse is essential for the consolidation of data because it makes it possible to centralize, integrate, historize and analyze data efficiently, which facilitates the making of informed decisions within the organization. The data warehouse is essential for data consolidation because it allows data to be centralized, integrated, historicized and analyzed in an efficient manner, which facilitates informed decision-making within the organization .

Development of the Consolidation Solution

Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by the European Centre for Research Training and Development UK

In the design of an information system, data modeling consists of analyzing and designing the information contained in the system. It makes it possible to represent the structure of this information and to structure storage and computer processing.

Model PROV (Provenance Data Model)

The Provenance Model (PROV) is a data model used to represent and manage data provenance, that is, the origin, history and transformations undergone by data over time. It provides a framework for capturing metadata that describes all of the activities and processes that led to the creation of a particular piece of data. The PROV model helps answer questions such as "Where did this data come from?", "Who modified it?", "When was it modified?" and "What were the processes involved?" (French Ministry of Culture and Communication: 2015)

1. Primary data sources:

- Flight Data: Flight information including departures, arrivals, delays, cancellations, etc.
- Weather Data: Information about weather conditions at various locations and altitudes.
- Air Traffic Data: Real-time air traffic information, including flight paths, air routes, etc.
- Aircraft data: Information about aircraft, including technical characteristics, performance, maintenance performed, etc.
- Passenger Data: Passenger information including reservations, boarding lists, etc.

2. Processes involved:

- Flight planning: Process of planning routes, flight schedules, aircraft capacities, etc.
- Operations Management: Real-time flight management process, including weather monitoring, air traffic management, crew communication, etc.
- Aircraft maintenance: Process of maintaining and repairing aircraft to ensure their airworthiness.
- Passenger management: Process of managing reservations, passenger boarding, baggage management, etc.

3. Example of PROV model:

Activity: Planning a flight

- ✓ Agent: Flight planner
- ✓ Entities used: Weather data, Air traffic data
- ✓ Generated entity: Flight plan
- ✓ Start time: 08:00
- ✓ End time: 09:30

Activity: Monitoring of royalties

- ✓ Agent: Responsible for the sales department
- ✓ Entities used: Flight plan, Air traffic data

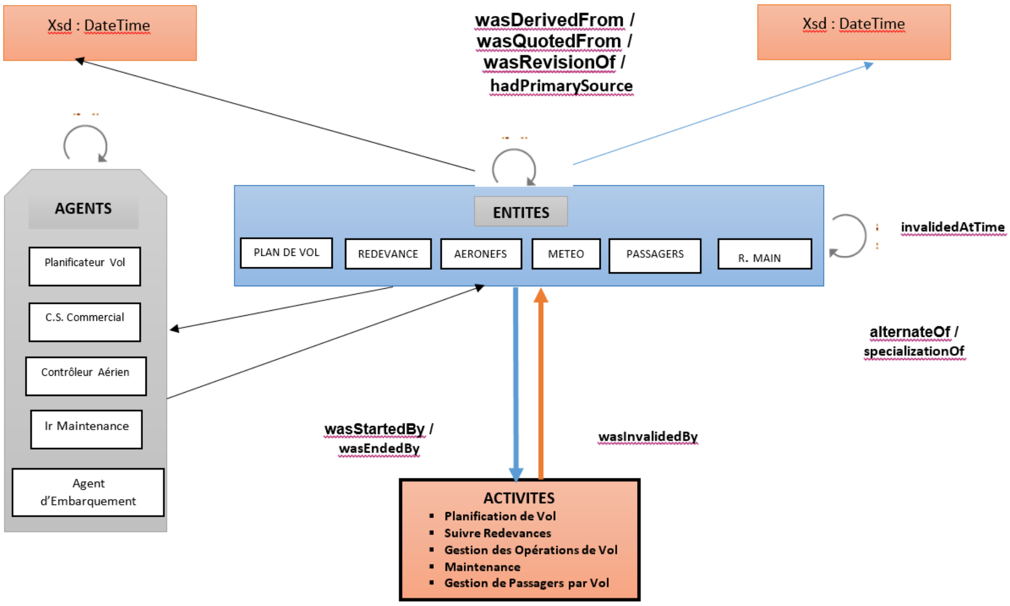
- ✓ Entity generated: Royalties
- ✓ Start time: 09:30
- ✓ End time: 10:30

Activity: Management of flight operations
- ✓ Agent: Air traffic controller
- ✓ Entities used: Flight plan, Air traffic data
- ✓ Entity generated: Flight operations report
- ✓ Start time: 10:00
- ✓ End time: 12:00

Activity: Maintenance of an aircraft
- ✓ Agent: Maintenance engineer
- ✓ Entity used: Aircraft data
- ✓ Entity generated: Maintenance report
- ✓ Start time: 2:00 p.m.
- ✓ End time: 4:00 p.m.

Activity: Passenger management for a flight
- ✓ Agent: Boarding agent
- ✓ Entity used: Passenger data
- ✓ Entity generated: Boarding list
- ✓ Start time: 5:00 p.m.
- ✓ End time: 6:30 p.m.

Figure 3.1: Model PROV.O



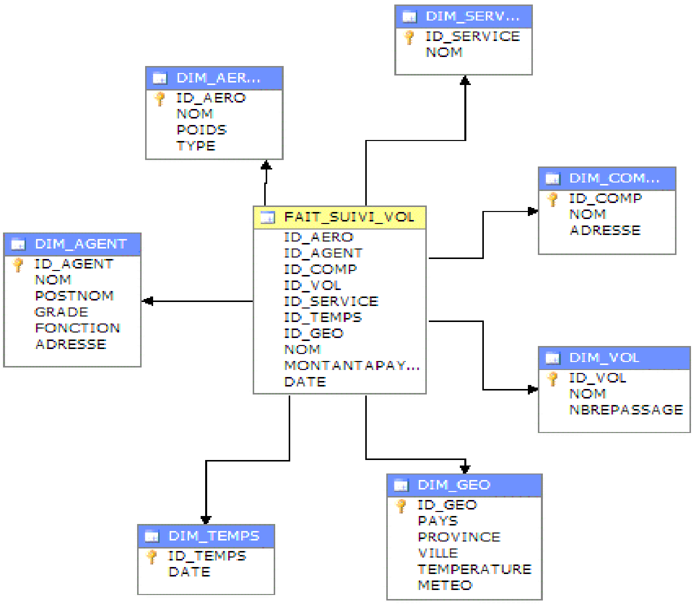
Source: Elaborate with us.

British Journal of Multidisciplinary and Advanced Studies, 5(4),54-67, 2024
Business and Management Sciences
Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by the European Centre for Research Training and Development UK

This model allows you to support the proven data.

Data cube following star model

Figure 2. Data cube following star model



Source: Created by us.

The data cube plays a crucial role in the effective management and analysis of data within a data warehouse, providing a multi-dimensional view, improved performance and ease of use for end users.
The PROV model tracks where data comes from, while data warehouses are centralized storage systems for analysis and decision-making.

Together, the PROV model and a data warehouse can be used to track the provenance of data stored in the warehouse, providing insight into its reliability, quality, and usefulness for subsequent analytics. By integrating data provenance capture into the warehouse itself, we can facilitate data auditing, improve traceability and transparency, and ensure better data governance.

Incremental Model and Incremental Learning Algorithm
As with all manufacturing, it is important to have a software manufacturing process that is well defined and explicitly described and documented.

Incremental learning (also sequential or online learning), is the process by which an entity increases its knowledge over time, at the same time as it uses it. (Vinh, N. Xuan., Epps, J., Bailey, J: 2009)

An incremental learning algorithm can be executed in five steps:

1. Learn the rules from the learning base data;
2. Store new rules and delete oldest examples;
3. Use the rules learned to predict and navigate;
4. When new examples arrive, learn new rules using old rules and new instances;
5. Proceed to step 2.

Two-phase incremental algorithm

```
Pour new models in the class C faire
        This class C is in phase 1 also
              Appel the algorithm for creating prototypes including;
              Appel the algorithm adjustment;
            There are several examples of class in others
              Basculer in phase 2
                 Finsi
Finsi
This class C is in phase 2 also
          Appel the algorithm adjustment;
          This is mal-classé alors
          nbErr[C] + +;
          Si Err S alors
          Appel the algorithm for creating prototypes;
          nbErr[C] = 0;
          Finsi
          Finsi
          Finsi
 Finpour

 Fin
```

This algorithm is an iterative process that, like new examples, comes with a classification model that uses algorithms to create prototypes and adapt. It uses a mechanism to detect and correct classification errors.

Example 1: Iterative algorithm for managing aeronautical charges

```
Function calculateRoyalty(aircraft):
    redv := 0
    For each type of service in aircraft:
      If service is landing then
        redv := redv + calculate Landing Fee (aircraft)
      Otherwise if service is parking then
        redv := redv + calculateParkingFee(aircraft)
      End if
      //Add other types of services if necessary
    End For
```

```
    Return redv
aircraft := AircraftData()
Total fee := calculate Fee (aircraft)
Show "The total charge for the aircraft is:", chargeTotal
End Function
```

This algorithm assumes that we have a dataset of aeronautical transactions with characteristics (e.g. aircraft type, distance flown, etc.) and corresponding aeronautical charges. It uses online updating (also called Stochastic Gradient Descent), where the weights and bias are updated after each transaction.

```
//Initialize the Weights (w) and the bias (b) of the linear regression
w = 0
b = 0
// Each epoch
For i=1 to n
// Each aeronautical transaction as a whole
For j = 1 to n
// Obtain the actual characters of the transaction and the redevelopment
Show "Enter transaction"
  Read x
Show"Saysir royalty"
Read there
// Predict the royalty
y_pred = w or b
y_pred = (w*x) + b
//Calculator error of prediction
      e = y – y_pred
//Update weights and biases using prediction error and a learning rate
      w = (w + tx) * (e * w)
b = (b + tx) * e
```

VIII. Choice of Security Policy in data consolidation and traceability.

In a data warehouse, data lineage is essential to ensure data integrity, reliability and quality. As far as we are concerned, our choice concerns the following algorithms:

1. Combining Change Data Capture (CDC) and Data Tagging (DT) can provide improved traceability in a data warehouse
2. RSA asymmetric encryption algorithm that specifies requirements for encrypting data during storage, transmission and use, to protect sensitive information from unauthorized access.

Combination of CDC and DT Algorithms

```
1. CaptureModifyData() function:
2. While true:
modified_data = MonitoringModifications()
For each modified_data in modified_data:
```

Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by the European Centre for Research Training and Development UK

```
SaveModification(modified_data)
LabelData(modified_data)
3. MonitorModifications() function:
4. modified_data = []
5. For each data in aeronautical_data:
If data_modified:
Add data to modified_data
6. Return modified_data
7. SaveModification(modified_data) function:
8. log_record.add(modified_data)

9. LabelData(modified_data) function:
10. tags = ExtractTags(modified_data)
11. UpdateTags(modified_data, tags)
12. ExtractTags(modified_data) function:
13. tags = Tagging_Algorithm(modified_data)
14. Flip tags
15. Function UpdateTags(modified_data, tags):
16. aeronautical_data[modified_data].add_tags(tags)
```

In this pseudo-code:

- ✓ The `CaptureChangeData` function is the entry point that monitors changes in aeronautical data continuously. For each modified data detected, it records the modification in a log and adds labels to the modified data.
- ✓ The `MonitorChanges` function checks aeronautical data for changes and returns a list of changed data.
- ✓ The `SaveChange` function saves the detected modification in a log.
- ✓ The `LabelData` function extracts the appropriate labels for the modified data and updates them.
- ✓ The `ExtractTags` and `UpdateTags` functions are responsible for extracting and updating tags respectively.

This provides a real-time approach to monitoring aviation data, recording changes and applying labels for easier management and subsequent analysis.

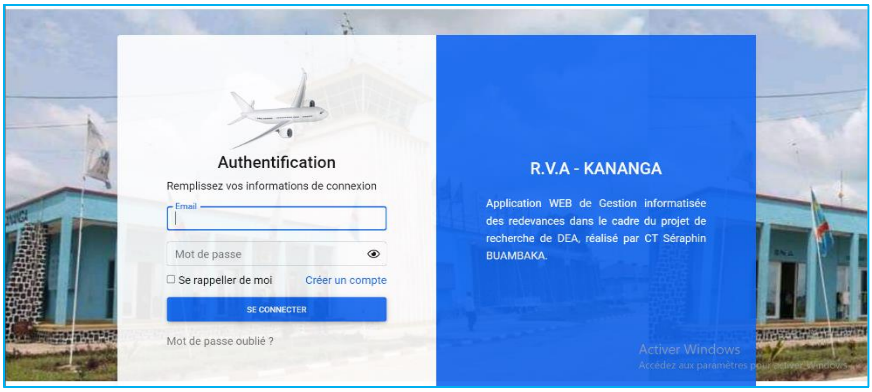
RSA asymmetric encryption algorithm

```
1. ALGORITHM GenerateRSAKeys
2. ENTRY: None
3. OUTPUT: public_key (n, e), private_key (d, n)
4. FUNCTION CalculateMMI(e, m)
5. RETURN d
6. END FUNCTION
7. FUNCTION EncryptRSA(message, public_key)
8. RETURN encrypted_message
9. END FUNCTION
10. FUNCTION DecryptRSA(encrypted_message, private_key)
11. // Uses the RSA algorithm to decrypt the message encrypted with the private key
12. // Example: decrypted_message = encrypted_message^d % n
13. // (Actual implementation uses operations on large numbers)
14. // ...
```

```
RETURN decrypted_message
END FUNCTION
Main FUNCTION
// Generation of keys
p, q = GeneratePrimeNumbers()
n = p * q
m = (p - 1) * (q - 1)
e = ChooseExpositor(m)
d = CalculateMMI(e, m)
public_key = (n, e)
private_key = (d, n)
// Example of use
message = "Confidential data"
encrypted_message = EncryptRSA(message, public_key)
decrypted_message = DecryptRSA(encrypted_message, private_key)
DISPLAY "Encrypted message: " + encrypted_message
SHOW "Decrypted message: " + decrypted_message
END FUNCTION
```

IV.3. Presentation of some interfaces

1. Authentication interface



2. General Menu Interface

CONCLUSION

The modernization of aeronautical information management is a major challenge for organizations in the sector. In the specific case of the Régie des Voies Aériens (RVA) in Kananga, the consolidation of data offers considerable advantages.

The web application implemented at RVA Kananga achieves several essential objectives:

1. Optimization of operations: Thanks to this application, RVA can more efficiently manage information flows related to flights, passengers and crews. Data consolidation helps centralize and synchronize information, reducing errors and duplication.
2. Improved security: The web application facilitates the monitoring of flights and aviation activities. It allows anomalies to be quickly detected. Data consolidation ensures an accurate, real-time overview.
3. Increased accessibility: Web applications can be accessed from any device connected to the Internet. RVA agents in Kananga can thus access essential information wherever they are.
4. Cost reduction: Data consolidation helps avoid redundancies and loss of information. This results in greater operational efficiency and reduced costs.

Data consolidation is an essential lever for modernizing aeronautical administration. RVA Kananga should continue to invest in these technologies to improve its performance and competitiveness.

REFERENCES

1. Abdelhamid MAKIOU, Web application security: Analysis, modeling and detection of attacks by machine learning, doctoral thesis in computer science and networks, Institute of Sciences and Technologies, Paris, 2016.
2. DEPOERES, F., Consolidation of environmental data: Issues and practices. Crises and problematic news, Nice, May 2010
3. GIORDANO, A., Integration plan and data modeling: techniques for a scalable and sustainable architecture 1st edition Press IBM, 2011.
4. Helena Hadjipavlou, Big Data, Surveillance and Trust: the question of traceability in the airport environment, doctoral thesis, Université Cote d'Azur, 2016
5. Hermenier, F Lawall, L, Menaud, J-M., Gilles Muller, Dynamic consolidation of high availability web applications, CFSE article, Saint-Malo, France, 2011
6. https://www.faa.gov/air-traffic/flight_info/aeronav/aero-data accessed Thursday April 11, 2024 at 11:00 a.m.
7. Joëlle, D and Cazes, A., developing a web application, DUNOD, Paris, 2016
8. Kaffa Jackou Rakiatou Christelle "Contribution to the Management of Airport Security Operations: Modeling and Optimization, doctoral thesis from the University of Toulouse, 2010.

9. French Ministry of Culture and Communication., Traceability of digital data. What models for the provenance of digital data: State of the art, Creative Commons editions, France, 2015.
10. Vinh, N.Xuan., Epps, J., Bailey, J. "Information theoretic measures for clusterings comparison: is a correction for chance necessary?". In: Proceedings of the 26th annual International Conference on machine learning, pp. 1073-1080, 2009.
11. www.stera.com/fr/type/blog/data-consolidation, consulted on 04/14/2024 at 11:41 a.m.