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Strengthening the adoption of data and metadata
standards: the African Development Bank's efforts in
enhancing statistical infrastructure for sustainable
development across Africa

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Abstract

Reliable, timely, and comparable data is essential for evidence-based policymaking and for monitoring progress toward sustainable development goals. Yet many African countries continue to face challenges in harmonizing data production, dissemination, and use due to fragmented statistical systems and uneven adoption of international data and metadata standards.

Through the Africa Information Highway (AIH) initiative, the African Development Bank (AfDB) is supporting countries modernize their statistical infrastructure by promoting SDMX-based interoperability, standardized metadata practices, and integrated data-sharing ecosystems. The rollout of national and regional SDMX-native Open Data Platforms (ODP 2.0) has significantly improved the way national statistical offices, central banks, ministries, manage, disseminate and exchange data.

Drawing on concrete examples from recent technical assistance and capacity-building programs, this paper highlights how standards-driven modernization contributes to improved data quality, transparency, comparability, and policy coordination. It also reflects on strategic priorities that are shaping the next phase of digital transformation across African statistical systems.

Keywords: Data standards; SDMX; Metadata; Statistical modernization; Africa Information Highway; Open Data.

JEL classification: C80; C82; O55

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1. Introduction

High-quality, timely, and interoperable data is increasingly recognized as a strategic asset for development planning, macroeconomic management, and monitoring progress toward global and regional agendas. African countries, however, continue to operate in fragmented data environments with limited standardization, resulting in inefficiencies, duplication, and inconsistent data flows.

The African Development Bank (AfDB), through the Africa Information Highway (AIH), has undertaken a systematic effort to strengthen data governance and promote the adoption of international data and metadata standards across the continent. The initiative's central objective is to create a unified Pan-African data ecosystem where institutions can produce and exchange data seamlessly and reliably.

2. The Africa Information Highway (AIH): Objectives and architecture

2.1 Context and vision

The AIH was launched in 2012 to modernize data dissemination infrastructures and promote transparency across African countries. It provides open and centralized access to key official statistics for governments, researchers, private sector actors, and the public.

2.2 Core components of AIH

The Africa Information Highway (AIH) is built on a set of integrated and mutually reinforcing components designed to modernize data ecosystems across African countries. Each component addresses a specific dimension of data production, governance, interoperability, and dissemination. Together, they form a coherent architecture that supports the digital transformation of statistical systems and enables institutions to meet the growing demand for high-quality, timely, and comparable data.

- *Open Data Platforms (ODP)*: public good portals enabling open access to harmonized datasets.
- *Data Innovation*: use of emerging technologies, big data to complement official statistics and enhance data-driven decision-making.
- *Data and metadata standards*: ensuring interoperability, discoverability, quality assurance, and consistency across institutions.

3. The role of data and metadata standards

3.1 Why metadata matters

Metadata is a foundational element of modern data ecosystems. It provides the essential contextual information—definitions, classifications, sources, units of measure, methodologies, and quality dimensions—that allows data to be correctly understood, interpreted, and reused. Without metadata, datasets become isolated, ambiguous, and difficult to integrate, leading to inconsistencies and loss of trust among users.

In national statistical systems, metadata plays a critical role in ensuring transparency, comparability, and accountability. It documents how data was collected, processed, and validated, helping policymakers, researchers, and partners evaluate the reliability and limitations of the information they use. For institutions managing multi-source data flows, standardized metadata is indispensable for harmonization and interoperability across government systems.

Metadata is even more important in today's environment of advanced analytics and artificial intelligence. AI and machine-learning workflows require clear, structured, and machine-readable metadata to function effectively. High-quality metadata enables:

- *Accurate feature engineering, by providing semantic meaning and relationships between variables;*
- *Automated data discovery and integration, essential for large-scale AI pipelines;*
- *Improved model performance, as metadata-driven validation reduces noise and inconsistencies;*
- *Responsible AI, by documenting data provenance, quality constraints, and potential biases;*
- *Scalability, allowing AI systems to process heterogeneous datasets from different institutions using common standards.*

Standardized metadata also ensures that datasets can be published, consumed, and reused through APIs, dashboards, or SDMX-native systems without requiring manual intervention or complex transformations. This makes metadata a critical enabler of AI-ready data ecosystems, where institutions can quickly leverage modern analytical tools to generate insights, develop predictive models, and support evidence-based decision-making.

3.2 SDMX as a unifying standard

SDMX (Statistical Data and Metadata eXchange) has become the global reference standard for structuring, documenting, and exchanging statistical data. It provides a comprehensive framework that integrates data modelling, metadata documentation, automated reporting, and machine-to-machine exchange. For institutions that manage complex data flows, such as central banks, statistical offices, and ministries of finance, SDMX offers a unified language that ensures consistency across indicators, domains, and countries.

The adoption of SDMX across Africa plays a transformative role in strengthening statistical infrastructure. First, it improves data quality and internal coherence by enforcing standardized classifications, definitions, and validation rules. This helps ensure that macroeconomic indicators, financial series, and social statistics follow comparable structures across time and across institutions.

Second, SDMX acts as a powerful enabler of comparability and harmonization. African countries frequently report data to multiple regional and global partners, often using different formats. SDMX streamlines this process by aligning national data structures with international statistical standards, thereby reducing duplication, inconsistencies, and reporting burdens.

Third, SDMX supports automation and efficiency. Machine-readable structures allow institutions to automate data ingestion, transformation, validation, and dissemination. For central banks, this means faster compilation of monetary, financial, and external sector statistics, as well as more efficient transmission of data to regional bodies, the IMF, the AfDB, or other partners. Automation also reduces operational risks associated with manual data processing.

Fourth, SDMX enables multi-source integration. Many African countries operate in fragmented data environments, where information is dispersed across ministries, agencies, and administrative systems.

With SDMX, heterogeneous datasets can be combined into unified, interoperable data flows—facilitating cross-sector analysis, early-warning systems, sustainability indicators, and SDG monitoring.

Fifth, SDMX enhances data governance and transparency. Its metadata-rich structure documents data lineage, methodologies, units of measure, and update cycles. This is particularly critical in areas such as sustainability data, climate finance, and financial stability, where clear metadata is essential for both national oversight and international comparability.

Finally, SDMX provides the technical foundation for AI-ready and digital-first data ecosystems. By ensuring structured, standardized, and machine-interpretable datasets, SDMX facilitates the deployment of advanced analytics, automated dashboards, and AI-driven insights. In a context where countries are beginning to adopt AI tools for forecasting, anomaly detection, and policy simulations, SDMX ensures that underlying data streams are reliable, interoperable, and scalable.

4. ODP 2.0: A multi-purpose SDMX platform

4.1 Technical architecture

ODP 2.0 represents the next generation of the Africa Information Highway's statistical technology stack. It is a modular, open-source, and SDMX-native platform designed to modernize the way African institutions manage, exchange, and disseminate data. Built around international best practices, ODP 2.0 consolidates data governance, data processing, visualization, and interoperability into a single integrated environment, enabling institutions to operate with greater efficiency, transparency, and automation.

The platform's modular architecture allows countries to adopt components progressively, depending on their institutional needs, technical capacity, and data maturity. Because ODP 2.0 is fully open-source, countries benefit from continuous improvements from the global SDMX community, reduced vendor dependency, and long-term sustainability.

ODP 2.0 offers several key capabilities that directly support statistical modernization:

- *Unified data management and dissemination:* ODP 2.0 consolidates data from multiple domains — macroeconomic, social, financial, or sustainability indicators — into a single SDMX-native repository. This unified structure reduces fragmentation, improves internal consistency, and makes it easier for users to access and compare data across sectors. Central banks and statistical offices can publish official time series, maintain revisions histories, and provide public or restricted access based on governance rules.
- *Automated synchronization between national, regional, and international databases:* The platform enables machine-to-machine synchronization with regional and global partners such as the AfDB, IMF, and specialized agencies. Countries can automatically supply updated datasets to regional institutions, reducing manual reporting burdens and ensuring that regional databases reflect the latest national data. This automation is essential for sustainability indicators, macroeconomic reporting frameworks, and cross-country comparability.
- *Standardized APIs for seamless system integration:* ODP 2.0 provides a suite of SDMX-compliant APIs that allow external systems—national data warehouses, administrative systems, geoportals, or central bank statistical platforms—to connect and exchange data seamlessly. These APIs ensure interoperability across heterogeneous environments and support real-time or scheduled data flows. For central banks, standardized APIs facilitate integration with monetary and financial statistics systems, dashboards, and analytical tools.

- *Advanced visualization and exploration capabilities:* The platform includes built-in visualization modules for interactive charts, tables, dashboards, and thematic analysis. Users—from policymakers to researchers—can explore data directly within the platform without requiring additional tools. Visualization capabilities are especially valuable for sustainability and climate indicators, where trends, disparities, and regional patterns benefit from graphical representation. These tools also enhance transparency and support public communication.

Together, these features enable ODP 2.0 to serve as a comprehensive, future-ready data platform that supports SDMX modeling, strengthens governance, and facilitates evidence-based decision-making. It is a cornerstone of AfDB's efforts to harmonize data infrastructure across Africa and equip countries with the tools needed to participate effectively in regional and global statistical ecosystems.

4.2 Concrete benefits for countries

The deployment of ODP 2.0 delivers a series of tangible and high-value benefits for national institutions seeking to modernize their statistical and data-exchange systems. By providing a unified, SDMX-native infrastructure, the platform helps overcome long-standing challenges related to fragmentation, inefficiency, and inconsistencies across government data systems. Several concrete benefits have already emerged across countries adopting or preparing to adopt ODP 2.0:

- *Automated data retrieval and reporting:* ODP 2.0 significantly reduces reliance on manual processes by enabling automatic ingestion, validation, and dissemination of data. Machine-to-machine synchronization ensures that updates from central banks, statistical offices, and administrative systems are seamlessly reflected in national and regional databases. This automation enhances timeliness, minimizes human error, and strengthens the reliability of high-frequency and macro-financial indicators. In contexts where reporting obligations to regional and international organizations are considerable, automation allows countries to meet deadlines more consistently while reallocating human resources toward analysis rather than data processing.
- *Interoperability across ministries and institutions:* One of the most persistent challenges in African data ecosystems is institutional fragmentation, where ministries, agencies, and central banks use incompatible systems and formats. ODP 2.0 addresses this by providing a harmonized SDMX-based environment that facilitates structured data exchange across sectors. Standardized APIs and metadata frameworks enable ministries of finance, central banks, revenue authorities, planning commissions, and national statistical offices to collaborate more effectively. This interoperability supports whole-of-government approaches to policy design, such as integrated macroeconomic frameworks, fiscal risk analysis, and sustainability reporting.
- *Efficient integration of multiple formats and sources:* African countries increasingly rely on diverse data sources—administrative records, surveys, geospatial data, financial market information, registries, and sustainability metrics. ODP 2.0 can integrate these heterogeneous sources into a unified SDMX-native structure, eliminating the costly and error-prone process of manually converting or reconciling different formats. This capability is especially relevant for compiling climate-related statistics, environmental data, and new structural indicators that rely on multiple systems. Improved integration strengthens analytical coherence and allows policymakers to build more comprehensive, multidimensional assessments.
- *A unified access point for policymakers:* ODP 2.0 consolidates key national datasets in a single, coherent platform, ensuring that policymakers, analysts, and researchers do not need to navigate multiple portals or request information from different institutions. This unified access point improves transparency, enhances user experience, and supports evidence-based decision-

making by providing consistent, up-to-date, and well-documented information. Advanced visualization modules within the platform also allow decision-makers to explore trends, compare regions, and generate customized analytical outputs without requiring technical expertise.

Taken together, these benefits demonstrate how ODP 2.0 serves as a strategic enabler of statistical modernization, allowing countries to build resilient, interoperable, and AI-ready data ecosystems. The platform not only simplifies current workflows but also prepares institutions for future innovations in automation, advanced analytics, and digital transformation.

5. Technical assistance for SDMX implementation

5.1 Recent engagements

The AfDB, working closely with its partners has intensified its support to different institutions across African countries (National Statistics Offices (NSO), Central Banks, etc.) to modernize their data architecture in line with international standards. This collaboration reflects a growing recognition from countries that robust, interoperable, and SDMX-native systems are essential for timely macroeconomic surveillance, financial stability analysis, and efficient reporting to regional and global organizations. Through the deployment of ODP 2.0, the AfDB is helping countries transition from fragmented, manual processes to streamlined, automated, and metadata-driven data workflows.

5.2 Lessons from the technical assistance

The projects undertaken with NSO, central banks and other institutions reveal several critical lessons that shape the path forward for SDMX-driven modernization in Africa. These insights underscore that the transition to interoperable, standards-based data ecosystems is as much an institutional endeavor as it is a technical one.

- *Strong governance frameworks are essential for SDMX adoption:* Experience shows that SDMX implementation cannot succeed without clear, formalized governance structures. Institutions that established data governance committees, defined ownership of datasets, and adopted standard operating procedures progressed significantly faster than those relying on ad-hoc arrangements. Governance frameworks ensure alignment between departments, promote compliance with SDMX standards, and guarantee continuity when staff change. They also provide the mandate needed to harmonize legacy systems and to enforce rules around metadata creation, quality assurance, and revision policies.
- *Institutional coordination accelerates harmonization:* SDMX adoption forces institutions to break down silos. Projects progressed faster in institutions where IT departments, statistical units, and dissemination departments worked jointly on SDMX modeling, system mapping, and governance reforms.
- *Capacity building is a prerequisite for sustainability:* Even when modern platforms such as ODP 2.0 are deployed, their long-term success depends on the skills and institutional knowledge of the teams maintaining them. Without continuous capacity building, institutions risk reverting to manual processes or failing to maintain SDMX registries and metadata repositories. The Bank's regional workshops for Francophone and Anglophone countries directly respond to this need by establishing a sustained learning environment.

6. Capacity building and regional cooperation

Building sustainable and interoperable statistical systems requires more than the deployment of technical platforms. It demands a long-term investment in human capital, institutional collaboration, and peer learning mechanisms that enable countries to transition from fragmented data environments to modern, standards-based ecosystems. Recognizing this need, the African Development Bank has placed capacity building and regional cooperation at the center of its modernization agenda.

To support countries in adopting SDMX and ODP 2.0, the AfDB is organizing regular regional workshops as part of a broader program to harmonize data practices across the continent. Example are provided below:

- *Francophone countries (Tunis, June 2025)* – This workshop delivered intensive training on SDMX data modelling, metadata management, and the processes required to migrate national open data platforms to ODP 2.0. The sessions included hands-on exercises on designing Data Structure Definitions (DSDs), developing mapping tables for legacy systems, and implementing automated data flows. Particular emphasis was placed on aligning macroeconomic, social, and administrative datasets with international standards to strengthen both internal consistency and cross-country comparability. The workshop also fostered collaboration among francophone national statistical offices, central banks, and line ministries.
- *Anglophone countries (Addis Ababa, July 2025)* – The Anglophone workshop focused on advanced SDMX modelling, system integration, interoperability frameworks, and the governance structures required to sustain modernization efforts. Participants worked on real-world use cases related to central banking statistics, sustainability indicators, and automated reporting to regional and international partners. The training also highlighted best practices in cross-departmental coordination, data quality assurance, and the use of SDMX APIs to automate internal workflows. The workshop served as a hub for peer-to-peer exchange among Anglophone countries undertaking similar modernization efforts.

7. Strategic priorities for the future

As African countries continue modernizing their statistical systems, the next phase of the Africa Information Highway initiative will focus on consolidating achievements and ensuring long-term sustainability. Advancing interoperability, strengthening data governance, and embracing emerging technologies will be essential for building resilient data ecosystems capable of supporting evidence-based policymaking, financial stability, and sustainable development.

7.1 Deepening adoption of SDMX and standards

While substantial progress has been made among national statistical offices, the next frontier involves extending SDMX adoption across a broader institutional ecosystem—including line ministries, central banks, revenue authorities, planning agencies, and regional economic communities. Expanding coverage is critical to harmonizing data produced by different government entities and reducing inconsistencies that often arise from parallel reporting systems.

Deepening adoption will also require countries to integrate SDMX principles into their internal data architectures, ensuring that new administrative systems, survey processes, and financial reporting tools are built on standards-compliant foundations. This will not only accelerate automation but also support multi-source integration of economic, social, and environmental data, an essential requirement for sustainability frameworks and global reporting obligations.

7.2 Strengthening governance and data quality frameworks

Sustaining modernization requires robust governance systems that clarify roles, ensure compliance with standards, and promote consistent application of methodologies. The future focus will include developing national data governance frameworks that embed SDMX and metadata management into institutional processes and regulatory guidelines.

A key priority is the implementation of metadata-driven quality reporting systems. By leveraging standardized quality frameworks and automated validation pipelines, institutions will be able to detect anomalies, track revisions, ensure definitional consistency, and reduce manual interventions. This is especially important for high-frequency and sustainability-related data, where timeliness and accuracy are essential for monitoring vulnerabilities, assessing climate-related risks, and informing monetary and fiscal policies.

Improved governance also strengthens cooperation between data producers and enhances transparency for users, thereby reinforcing public confidence in official statistics.

7.3 Integrating emerging technologies

The modernization of Africa's statistical systems will increasingly rely on emerging technologies capable of improving efficiency, scalability, and analytical depth. Artificial intelligence (AI), machine learning, advanced analytics, and new generations of AI systems, such as Large Language Models (LLMs) and Agentic AI, offer unprecedented opportunities to enhance the value of data systems built on SDMX and ODP 2.0.

AI-enabled tools can assist with automated classification, predictive modeling, anomaly detection, and early-warning systems for macro-financial stability and sustainability risks. When combined with standardized, machine-readable metadata, AI systems can integrate multi-domain datasets—economic, administrative, geospatial, climate-related, or environmental—to generate richer insights and support scenario-based policy analysis.

Emerging applications of LLMs provide additional capabilities highly relevant to statistical offices and central banks. LLMs can:

- interpret complex metadata and generate structured descriptions aligned with SDMX standards.
- support automated documentation of methods and data lineage.
- provide natural language interfaces for querying ODP 2.0 databases and SDMX APIs.
- summarize large volumes of statistical or administrative information for decision-makers.
- assist in harmonizing definitions and detecting inconsistencies across national and regional datasets.

Similarly, the expansion of APIs and interoperable digital services will enable real-time data exchange between institutions, improve the timeliness of statistical releases, and support the creation of

advanced dashboards tailored to policymakers' needs. These technologies enhance institutional resilience by reducing reliance on manual processes, improving auditability, and ensuring continuity during periods of operational disruption.

When anchored in robust SDMX and metadata foundations, these innovations—AI, LLMs, Agentic AI, and real-time API-driven services, will allow African countries to transition from traditional reporting systems toward fully digital, automated, and AI-ready statistical ecosystems. This transformation is essential for supporting evidence-based policy, financial stability assessments, climate risk monitoring, and long-term sustainable development across the continent.

8. Conclusion

The modernization of statistical systems across Africa is entering a decisive phase, shaped by the adoption of international data and metadata standards and supported by strong institutional partnerships. The African Development Bank's leadership, particularly through the Africa Information Highway initiative, has played a pivotal role in laying the foundations for harmonized, interoperable, and sustainable data ecosystems. By promoting SDMX as a unifying standard and deploying ODP 2.0 as a modern dissemination and data sharing platform, the Bank has enabled countries to improve data quality, comparability, and transparency while reducing reporting burdens.

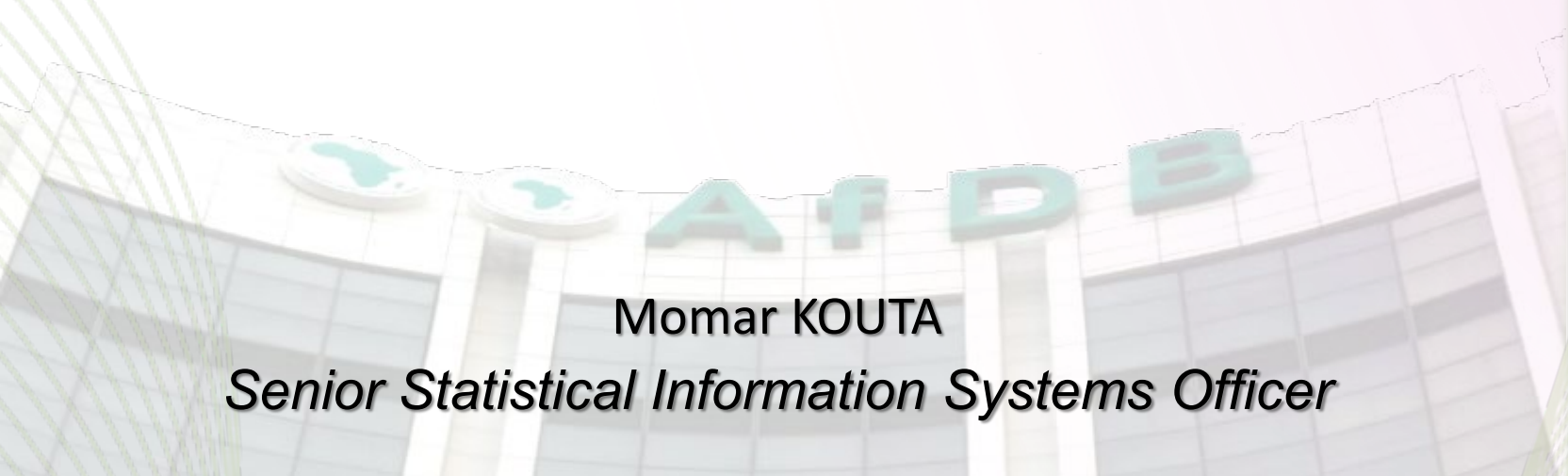
Experiences from different institutions such as NSO and central banks demonstrate that modernization efforts are most effective when supported by well-defined governance frameworks, strong inter-institutional coordination, and continuous capacity building. These elements ensure that SDMX adoption is not merely a technical upgrade but a structural shift toward better-organized, metadata-driven, and standards-aligned data management practices. The regional training programs and the emerging Pan-African Data Sharing Community further illustrate the importance of collective learning and peer support in sustaining modernization across the continent.

Looking ahead, the integration of emerging technologies—AI, machine learning, LLMs, Agentic AI, offers significant opportunities to enhance the analytical capabilities and operational efficiency of statistical systems. When anchored in robust SDMX and metadata foundations, these innovations can support predictive analytics, real-time data integration, climate and sustainability reporting, and advanced macro-financial surveillance.

Consolidating these achievements will require continued investment in capacity building, alignment with global standards, and strengthened collaboration among national, regional, and international institutions. By maintaining this momentum, African countries will be well positioned to transition toward fully digital, automated, and AI-ready statistical ecosystems that support effective policymaking, financial stability, and sustainable development across the continent.

Strengthening the adoption of data and metadata standards

The African Development Bank's efforts in
enhancing statistical infrastructure for sustainable
development across Africa



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AIH: Context & Objectives

 July 2012

 AfDB



Facilitating public access to official statistics

Unlock the power of data for everyone.

Using international standards

Guarantee trusted, high-quality, and comparable statistics.

Enhancing data openness and transparency

Build trust through open and transparent data sharing.

Empowering official statistics ecosystem

Boost the capacity and impact of data-driven institutions.

AIH: Components

Data Innovation

Drives creative data solutions to boost informed decision making in Africa



Open Data Platforms

Provide centralized access to a wide range of data resources for the public and policymakers



SDMX

Promote the use international data and metadata standard



Data & Metadata Standards: Facilitating data sharing and interoperability for evidence-based policy

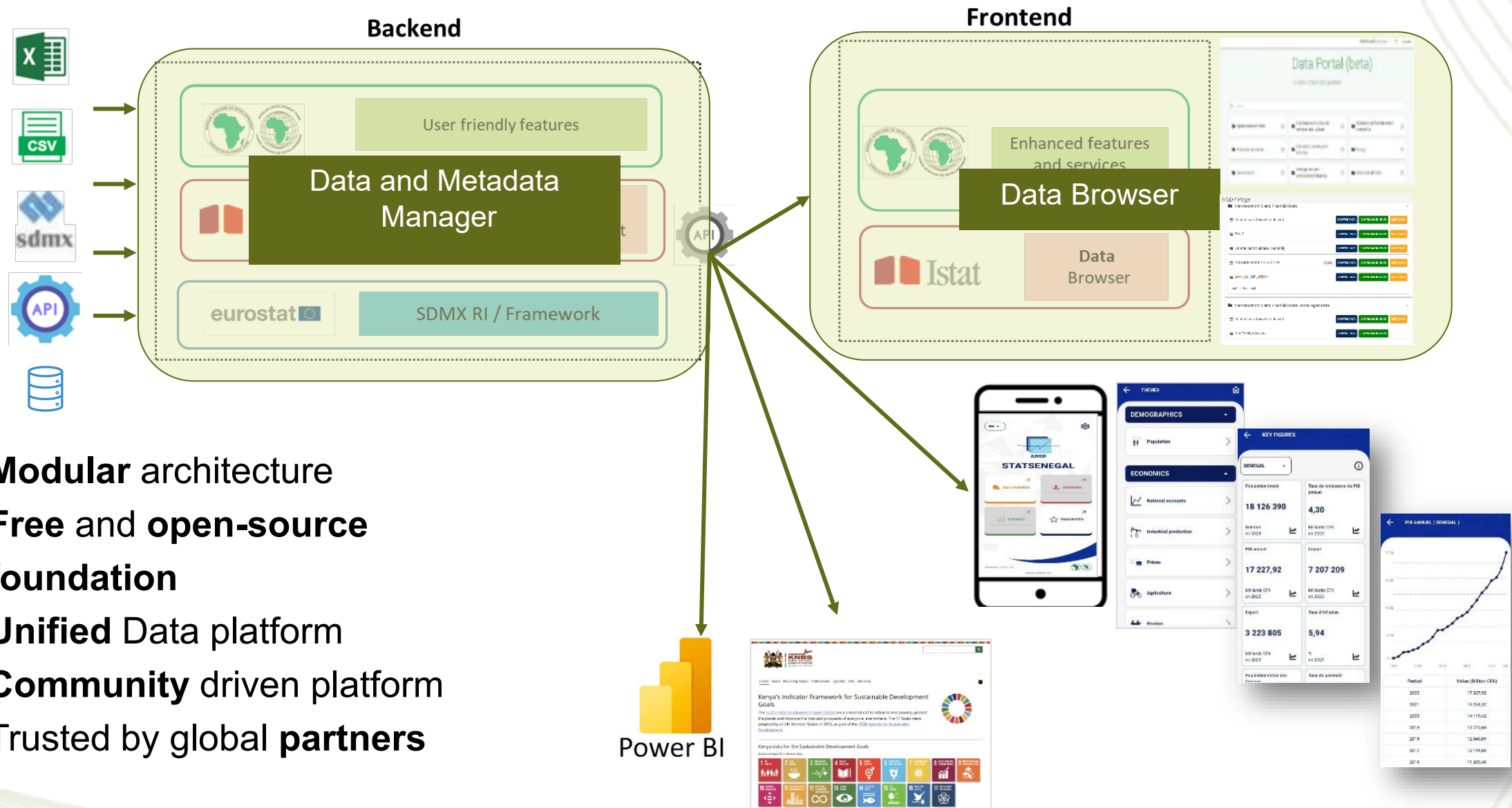


Why Metadata Matters

- **Discoverability and reuse:** Makes data easy to find (catalogs, tags, indexes).
- **Trust & quality:** Ensures reliability by documenting source and context.
- **Interoperability:** Standardized descriptions enable data sharing across systems.
- **Governance:** Tracks ownership, rights, and compliance with policies.
- **Innovation:** Powers analytics, AI, and dashboards for decision-making.



ODP 2.0: SDMX Multi-Purpose Data Platform

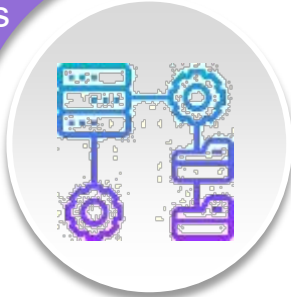


- **Modular** architecture
- **Free and open-source** foundation
- **Unified** Data platform
- **Community** driven platform
- Trusted by global **partners**

SDMX Native Platforms – Key Benefits

Seamless data sharing

- Seamless data exchange
- Automated synchronization
- Interoperability across systems
- Efficient data reporting



Improved collection

- Integration with multiple Data sources and formats
- Automated data Retrieval

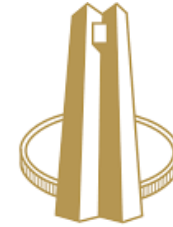


Enhanced accessibility

- Unified Access Point (Data hub)
- Seamless connectivity and multi systems integration
- Data exploration and visualization
- Standardized & open data formats + metadata



ODP 2.0 in Action: Technical assistance to Central Banks and revenue services



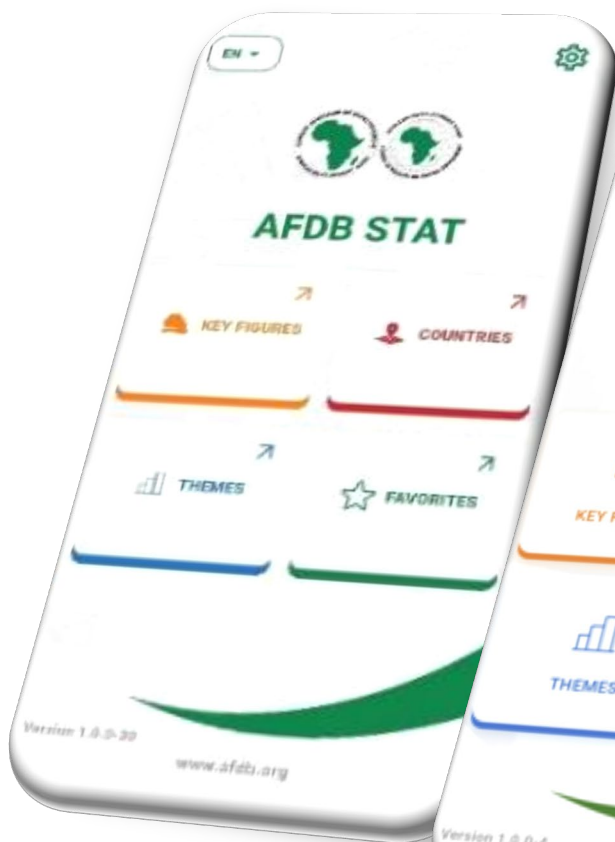
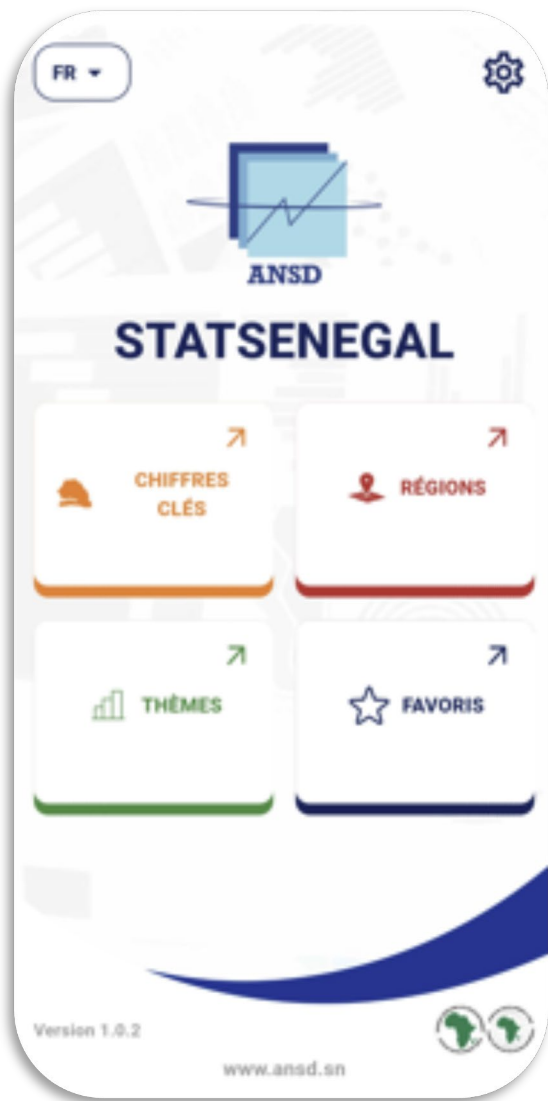
South African Reserve Bank



South African Revenue Service

- In collaboration with the IMF, technical assistance has been provided to the Bank of Botswana, where data modeling is already well advanced for ODP2.0 implementation.
- Discussions are under way with the Bank of Mauritius regarding the implementation of ODP2(potential joint support AfDB & IMF).
- Technical assistance is also ongoing with both the South African Reserve Bank and the South African Revenue Service.

SDMX Native Platforms – Mobile application



SDMX ODP 2.0: Capacity building

Regional workshop to help Francophone countries modernize statistical systems with SDMX and ODP 2.0 (June 23 to 27, 2025, Tunis)



Regional workshop supporting Anglophone countries in data modeling for ODP 2.0 migration (July 21 to 25, 2025, Addis Ababa)



Reveal the Power of Data in Africa



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