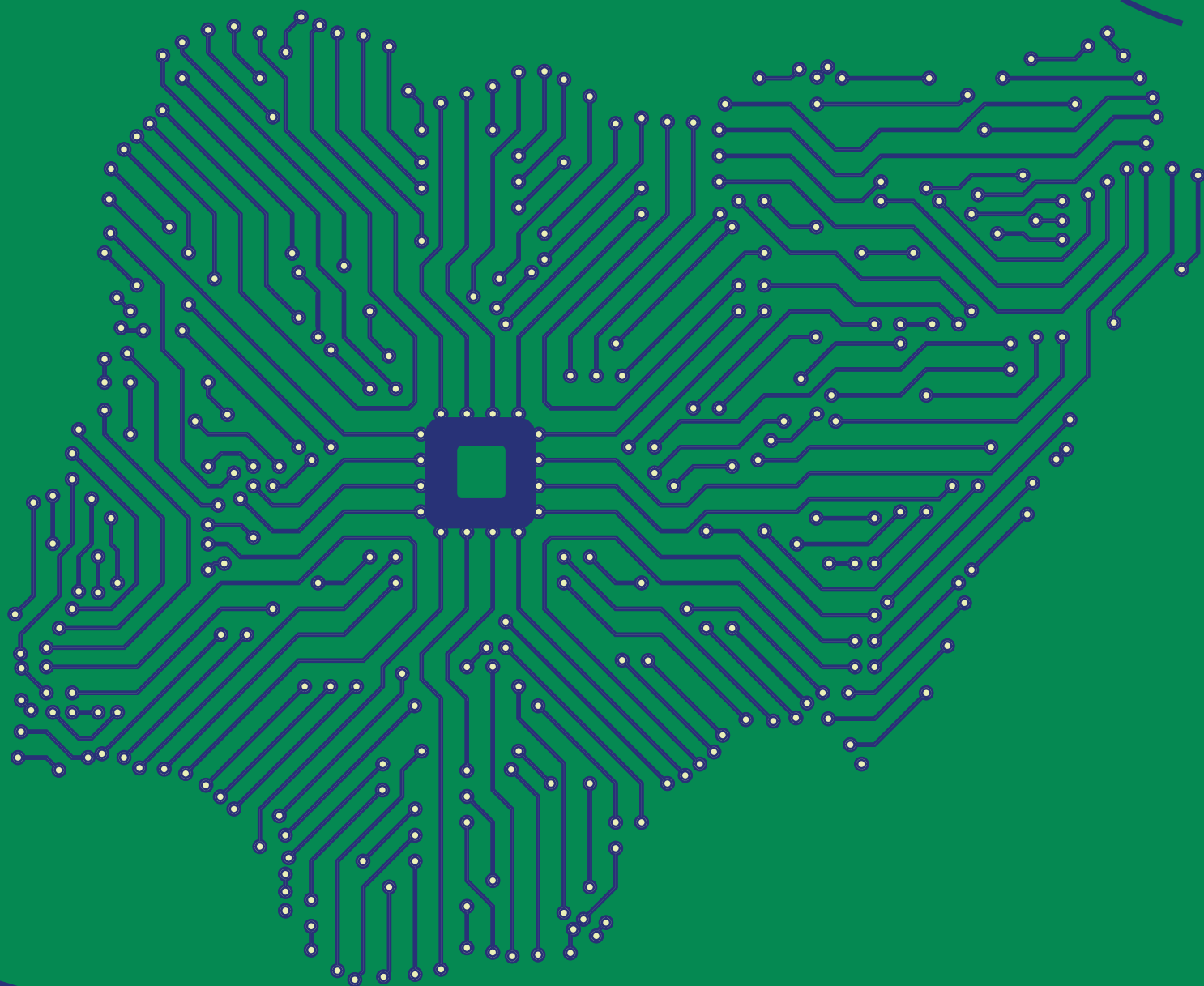


UKNiAF

United Kingdom Nigeria Infrastructure Advisory Facility



Lessons Learnt on How Capacity Building Shaped the UCD Integration Process

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This knowledge piece captures key challenges, lessons learned, and recommendations from the integration of the Unified Customer Database (UCD) and the role of capacity building in its success. A primary lesson was the importance of adaptive innovation, such as automating data collection for State disaggregation, which reduced manual errors and improved efficiency. Stakeholder engagement with NERC and State regulators was critical in aligning the system with regulatory needs, highlighting the need for continuous collaboration to address challenges like DisCo compliance.

Capacity building significantly shaped the integration process, with training workshops empowering NERC and State regulators to leverage the UCD for data-driven decision-making. The participatory approach, including UAT and feedback sessions, fostered ownership and ensured the system's relevance. These lessons will inform future interventions, emphasising the need for robust training and stakeholder buy-in to sustain technology-driven regulatory tools.

Some of the key knowledge areas detailing the challenges, lessons learnt, and recommendations are as follows:

1. UCD System Requirements Recommendation and Set-up



The establishment of the Unified Customer Database (UCD) system requirements completed in January 2024, was a structured process to support NERC's regulatory oversight of Nigeria's electricity sector. This structured process involved focus group meetings with Benin, Eko, and Abuja DisCos, and consultations with NERC's technical team at the Planning, Research, and Strategy Unit. The project team defined a template and specifications to track meter installations, billing/vending data, and consumer classifications, aligning with the universal access goals. Stakeholder engagement ensured buy-in and mitigated DisCo resistance, while the template focused on real-time data for smart meter rollouts under the Meter Asset Fund (MAF).

The technical specifications outlined a Power BI-integrated, SQL-based database with robust bandwidth, firewalls, and distributed switching/routing for scalability

and security. A staging environment was planned for testing, and NERC committed to building in-house capacity for sustainability. The process concluded with NERC's sign-off on the flexible template, allowing revisions based on test runs. Lessons learned emphasised early stakeholder collaboration and adaptable requirements, laying a foundation for the testing phase. This process strengthened NERC's ability to monitor meter deployment, enforce consumer protection, and enhance regulatory transparency in Nigeria's electricity market.

What We Did

- UKNIAF specified a Power BI-integrated, SQL-based relational database for scalability and compatibility with NERC's IT infrastructure, supporting real-time data updates from 11 DisCos.
- UKNIAF presented the draft UCD template and specifications to NERC's Planning, Research, and Statistics division, securing formal sign-off from the PRS-NERC department.

Approved and Signed UCD System Requirements

PW0035 – Unified Customer Database									
System Specifications									
S/N	Online Applications	No of VPS	No.	Uses	Processor	OS	RAM	Storage	Internet Bandwidth
1	Unified Customer Database	3	i	App-Prod-DISCO	4 CPU @ 1.8 GHz	Linux Cent OS 7	16 GB	400GB (4X100GB) SSD	Public IP & 5Mbps
			ii	App-DB-DISCO	8CPU @ 1.8 GHz	Linux Cent OS 7	32 GB	1TB SSD	Public IP & 5Mbps
			iii	Staging Server	8CPU @ 1.8 GHz	Linux Cent OS 7	32 GB	100GB SSD	Public IP & 5Mbps
NERC's Approval Officer									
Name: MOHAMMED UMAR FUDIRE									
Signature: [Signature] 27/3/24									

- Addressed bandwidth, query performance, and security through firewalls and distributed switching/routing, incorporating offline tracking for prepaid and postpaid meters.
- Documented specifications in meter tracking templates, validated by NERC's IT unit for operational feasibility.

Challenges Encountered

1. **Limited Initial Stakeholder Buy-In from DisCos:** Potential negative exposure of DisCo operations led to initial resistance during focus group meetings with Benin, Eko, and Abuja DisCos. Concerns about data transparency were mitigated by engaging NERC to highlight UCD benefits like operational efficiency and visibility.
2. **Diverse Data Management Practices Across DisCos:** Varying data systems among DisCos, some manual or outdated, complicated standardisation of the UCD template. UKNIAF addressed this through iterative consultations and included offline tracking capabilities to accommodate less digitised operations.
3. **Capacity Gaps in NERC's Data Management Unit:** Limited data analytics expertise in NERC's Data Management Unit risked delays in validating specifications. UKNIAF planned in-house capacity building and secured NERC's commitment to resource system management.
4. **Balancing Security and Accessibility in System Design:** Designing a secure yet accessible UCD required balancing robust firewalls with performance. UKNIAF collaborated with NERC's IT unit to select appropriate security measures, ensuring data protection and usability.
5. **Anticipating Future Scalability for State-Level Disaggregation:** Designing a flexible template for future State-level data needs was challenging. UKNIAF ensured adaptability by incorporating provisions for revisions based on test runs.

Learnings and Recommendations



UCD System Specification and Requirements

Lessons Learned:

- **Early and Continuous Stakeholder Engagement is Critical to Overcoming Resistance:** Initial DisCo resistance due to transparency concerns highlighted the need for early engagement. UKNIAF's focus groups with Benin, Eko, and Abuja DisCos secured buy-in by showcasing UCD benefits, but delays risked progress.
- **Capacity Gaps in NERC's Data Management Unit Must Be Addressed Early:** Limited DMU expertise risked delays. UKNIAF's capacity-building plans were proactive, but early training could have enhanced efficiency.
- **Diverse DisCo Data Systems Require Flexible and Inclusive Design:** Varying DisCo data practices complicated template standardisation. The system cron-job synchronizer tracking capabilities addressed this, but flexibility was key to inclusivity.

Recommendations:

- Implement a structured stakeholder engagement plan with regular workshops and NERC's Public Affairs department involvement to proactively address concerns and ensure sustained collaboration.
- Integrate introductory data analytics workshops for the DMU in the initial phase, with a tailored Power BI and SQL curriculum to build capacity from the start.
- Conduct a baseline data system assessment using data maturity frameworks and develop modular templates with configurable fields to support all DisCos.



2. DisCos Data Collection, Cleaning, Exploration and Integration into the UCD System.



Data collection involved aggregating customer details, billing/vending records, and meter installation data from DisCos, starting with Eko, Ikeja, and Benin, and expanding to nine others in the extension phase. Diverse DisCo systems, from manual to outdated digital formats, posed challenges, which were addressed by the UCD standardised data collection templates capturing DisCos customer details, tariff types, and consumer classifications. Data cleaning tackled inconsistencies like missing IDs and non-standardised tariffs using automated pipelines and manual validation with DisCo focal points, ensuring data quality.

What We Did

- **Developed Standardised Data Collection Templates:** UKNIAF created uniform templates for DisCo data, including customer details, billing/vending records, and meter data. These templates addressed diverse systems with fields like tariff types for low-income consumers.
- **Facilitated Stakeholder Engagement with DisCos and NERC:** Coordinated meetings with DisCos (Eko, Ikeja, Benin, and others) and NERC to align data requirements, overcoming resistance by emphasising UCD benefits like transparency.
- **Supported Data Cleaning and Validation:** Managed data cleaning to fix missing IDs and inconsistent tariffs using automated pipelines and manual validation with DisCo focal points, ensuring data quality.
- **Conducted Data Exploration Using Power BI:** Analysed datasets with Power BI to identify trends (e.g., unmetered billing in Oyo, industrial patterns in Enugu), visualising insights in the UCD dashboard for regulatory use.
- **Led Data Integration into the UCD System:** Mapped and cleaned data into the UCD's SQL database, enabling real-time updates and State-disaggregation for Oyo, Enugu, and Akwa Ibom in Version 6.

Challenges Encountered

1. **Diverse and Inconsistent DisCo Data Systems:** Varied DisCo data systems, from manual to

outdated digital, caused inconsistent formats, delaying collection and integration. UKNIAF used standardised templates and offline tracking to mitigate this.

2. **Initial DisCo Resistance to Data Sharing:** DisCos hesitated to share data due to scrutiny concerns, risking incomplete datasets. UKNIAF's engagement highlighted UCD's benefits to build trust.
3. **Data Quality Issues Requiring Extensive Cleaning:** Missing IDs, inaccurate meter statuses, and non-standardised tariffs necessitated time-intensive cleaning. UKNIAF implemented automated pipelines and manual validation.
4. **Limited Technical Capacity at NERC and State Regulators:** NERC's DMU and State regulators lacked analytics skills, slowing exploration and UAT. UKNIAF conducted training to bridge this gap.
5. **Technical Challenges in State-Disaggregation Integration:** State-disaggregation for Oyo, Enugu, and Akwa Ibom required complex schema updates, with slow refresh rates noted in UAT. UKNIAF optimised pipelines with NERC's IT unit.

Learnings and Recommendations



DisCos Data Collection, Cleaning, Exploration and Integration into the UCD

Lessons Learned:

- **Standardised Templates Are Essential for Managing Diverse Data Systems:** Diverse DisCo systems delayed data collection. UKNIAF's templates ensured consistency, but early system mapping was needed.
- **Proactive Stakeholder Engagement Mitigates Resistance to Data Sharing:** DisCo resistance risked incomplete data. UKNIAF's engagement built trust, but earlier efforts could have expedited progress.
- **Robust Data Cleaning Processes Are Critical for Quality Assurance:** Poor data quality required intensive cleaning. UKNIAF's pipelines and validation worked, but proactive checks were needed.
- **Technical Optimisation Is Key for Scalable Data Integration:** State-disaggregation caused slow refresh rates. UKNIAF's optimisations resolved issues, but proactive planning was needed.

Recommendations:

- Audit DisCo data systems pre-project and design flexible templates with offline options for seamless collection.
- Launch a stakeholder communication strategy with benefit-focused workshops and compliance incentives to reduce resistance.
- Implement a data quality framework with automated validation and train DisCo staff on entry standards.
- Conduct stress tests and use scalable cloud solutions with indexed fields to ensure real-time performance.

3. UCD Dashboard Design and Development



The UCD dashboard's design, initiated in January 2024, focused on user-friendly visualisations like charts and heatmaps to track meter installations, revenue, and billing, integrating data from Eko, Ikeja, and Benin DisCos initially, and all DisCos by Version 6 (May 2025). State-disaggregation functionality supported Nigeria's State electricity markets, with filters for Oyo, Enugu, and Akwa Ibom. Development involved stakeholder engagement with NERC and DisCos, cleaning inconsistent datasets (e.g., missing IDs, non-standardised tariffs) via automated pipelines, and mapping to a SQL database for real-time Power BI integration.

Challenges included diverse DisCo systems, data-sharing resistance, and NERC's limited analytics capacity, mitigated through UKNIAF's training, User Acceptance Testing (UAT), and performance optimisations for slow refresh rates. The dashboard evolved iteratively, with Version 6 offering State-specific insights and an updated User Guide. This ensured that NERC and State regulators could enforce consumer protection and reduce non-technical losses, with sustainable management post-UKNIAF handover in May 2025.

What We Did

- **Defined Dashboard Specifications and Requirements:** Collaborated with NERC to establish Power BI-based dashboard specifications for visualising meter installations, billing, and revenue, ensuring SQL database compatibility.
- **Facilitated Stakeholder Engagement:** Engaged NERC, 11 DisCos, and State regulators (Oyo, Enugu, Akwa Ibom) to align dashboard design with regulatory needs, overcoming DisCo resistance.
- **Supported Data Integration and Cleaning:** Developed templates and cleaned inconsistent DisCo data (e.g., missing IDs) using automated pipelines and manual validation for accurate visualisation.
- **Designed User-Friendly Visualisations:** Created interactive Power BI charts and heatmaps, with State-specific filters by Version 6, highlighting trends like unmetered billing in Oyo.

- **Conducted Training and Capacity Building:** Trained NERC and State regulators on Power BI and dashboard use, enhancing analytics capacity for sustainable operation.
- **Facilitated User Acceptance Testing (UAT):** Coordinated UAT to validate functionality, incorporating feedback on refresh rates and filters to refine the dashboard.

Challenges Encountered

1. DisCo datasets had missing IDs and non-standardised tariffs, delaying integration. UKNIAF used cleaning pipelines and validation, but it was resource intensive.
2. DisCos resisted sharing data due to scrutiny fears, risking incomplete inputs. UKNIAF's engagement with them built trust, but it required significant effort.
3. NERC and State regulators lacked Power BI skills, slowing UAT. UKNIAF's training helped, but initial gaps delayed validation.
4. State-disaggregated data caused slow refresh rates. The UKNIAF team worked closely with NERC's IT unit, but complexity delayed version 6.
5. Creating a user-friendly yet advanced dashboard was challenging. UAT feedback on unclear filters led to redesigns which extended timelines.

Learnings and Recommendations



UCD Dashboard Design and Development

Lessons Learned:

- **Robust Data Quality Processes are Critical for Reliable Visualisations:** Inconsistent DisCo data required extensive cleaning. UKNIAF's pipelines worked, but proactive measures were needed.
- **Performance Optimisation Requires Proactive Testing:** Slow dashboard refresh rates delayed Version 6. UKNIAF optimised the system, but proactive testing was needed.

Recommendations:

- Implement a data governance framework with quality checks and DisCo training on entry standards.
- Conduct stress tests and use scalable cloud solutions with optimised indexing for real-time performance.
- Involve users in co-design workshops and use agile methods to iterate based on feedback.

4. NERC DMU Support Team Training on the UCD System



Training began with intensive workshops by May 2025, focusing on Power BI navigation, querying State-disaggregated data (Oyo, Enugu, Akwa Ibom), and database maintenance. Hands-on sessions used scenarios like Oyo's meter deployment and Enugu's industrial billing, tailored to the DMU's varying expertise. Challenges, including limited analytics skills and complex State-disaggregation, were addressed through adaptive modules, simplified guides, and SQL training. User Acceptance Testing (UAT) feedback refined sessions, and an updated User Guide provided comprehensive instructions. By May 2025, the DMU was adept at generating reports and maintaining the system, ensuring sustainability post-UKNIAF handover, supported by State regulator engagement.

What We Did

- **Designed and Delivered Tailored Training Workshops:** Conducted hands-on workshops from June 2024 to May 2025, covering Power BI, State-disaggregated queries, and SQL maintenance, using scenarios like Oyo's meter deployment.
- **Created Adaptive Training Modules for Varying Expertise Levels:** Developed simplified and advanced modules for non-technical and IT staff, addressing limited analytics skills to ensure effective UCD use.
- **Incorporated User Acceptance Testing (UAT) Feedback:** Integrated UAT feedback on filters and refresh rates into training, refining content to enhance DMU proficiency with Version 6 features.
- **Updated and provided a Comprehensive UCD User Guide:** Revised the User Guide with detailed navigation, querying, and troubleshooting instructions, serving as a DMU reference.
- **Facilitated Stakeholder Engagement with State Regulators:** Included Oyo, Enugu, and Akwa Ibom regulators in training, fostering collaboration for State-level data analysis.
- **Built Long-Term Capacity for System Sustainability:** Trained DMU on advanced administration and scenarios, ensuring independent management post-UKNIAF handover.

Challenges Encountered

1. **Limited Initial Analytics Expertise in the DMU:** The DMU's limited Power BI and SQL skills slowed adoption, especially for State-disaggregation. UKNIAF used simplified modules, but progress was delayed.
2. **Complexity of State-Disaggregation Functionality:** Some trainees were overwhelmed by complex querying for Oyo, Enugu, and Akwa Ibom States. UKNIAF's scenario-based exercises helped, but extra sessions were needed.
3. **Varying Technical Proficiency Among Trainees:** Diverse skill levels complicated training design. UKNIAF tailored modules, but balancing content extended timelines.
4. **Time Constraints Due to Project Deadlines:** Tight May 2025 handover timelines pressured condensed training. UKNIAF scheduled follow-ups, but time limits risked incomplete skill transfer.
5. **Resistance to Change Among Some DMU Members:** Some preferred manual processes and resisted new tools. UKNIAF's engagement highlighted benefits, but overcoming resistance took effort.
6. **Coordination Challenges:** The coordination challenges with State Regulators diluted DMU focus. UKNIAF structured joint sessions, but coordinating diverse stakeholders was complex.

Learnings and Recommendations



NERC DMU Support Team Training on the UCD System

Lessons Learned:

- **Tailored Training Modules Are Essential for Diverse Skill Levels:** Varying DMU proficiency required customised content. UKNIAF's tailored modules worked, but early assessment was needed.
- **Scenario-Based Training Enhances Practical Application:** Complex State-disaggregation benefited from scenarios. UKNIAF's exercises improved engagement, but more were needed.
- **Comprehensive Documentation Supports Long-Term Sustainability:** The User Guide was vital late. Earlier distribution could have reinforced learning.

Recommendations:

- Assess skills pre-training to design tiered modules, ensuring targeted delivery.
- Implement a data governance framework with quality checks and DisCo training on entry standards.
- Develop a scenario library for training and include in the User Guide.
- Distribute a draft User Guide early, with video tutorials and FAQs.

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