Case Study 2: Operationalizing Grid Data for Cost Optimization in Utilities

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Context

nLine collects granular, high-resolution utility data from distribution networks, offering daily insights into power quality and reliability at the transformer level.
Metrics like SAIDI (average outage duration), SAIFI (average outage frequency), and undervoltage hours are tracked consistently across distribution transformers.

This kind of data already supports the generation of summary reports and dashboards, which are useful for tracking long-term trends and informing periodic planning. But this data holds more opportunity: to use this data to support day-to-day operational decision-making.

This data has the potential to power:

- Daily alerts for major grid events, such as large outages or severe voltage drops.
- Real-time prioritization by utilities of transformers for repair crew dispatch and scheduling.
- Investment planning in grid infrastructure based on chronic historical performance issues.
- Track the impact of grid interventions (upgrades, repairs, and maintenance) over time on grid performance.

Your Challenge

> ***This case study challenges you to take on the role of a utility data analytics team developing an actionable data-driven tool that helps operations teams use performance data to guide operations—from power outage response and monitoring, to long-term grid network planning.***

Data Provided

1 year of daily performance data from several transformers in Accra, Ghana:

- SAIDI (average outage duration per customer)
- SAIFI (average outage frequency per customer)
- Hours of undervoltage

Guiding Questions

- What are the roles of these teams in power distribution utilities such as Kenya Power (Kenya), ECG (Ghana), SENELEC (Senegal), and UMEME (Uganda). What specific functions do each of these teams perform?
  - system operations team
  - field services/ maintenance team
  - planning & engineering team
- Analyze the performance of the transformers based on SAIDI, SAIFI, and undervoltage hours.
- Identify which transformers are performing poorly on a daily basis and determine a repair and maintenance schedule for the field services team.
- Propose a scoring system for utility planners to use when allocating maintenance funds.
- Determine which transformers consistently underperform, and how this information should influence budget allocation for grid infrastructure upgrades.

- Formulate rules for grid upgrades and investment decisions from the power quality and reliability metrics?
- Identify areas/transformers with exemplary performance for operations bench-marking?
- How can a utility use your tool to reduce operational costs?

Utilize appropriate data analytics and visualization tools such as plots and maps to respond to these prompts.

Deliverables

- A detailed report responding to the guiding questions
- Exploratory data analysis notebook (with clear visualizations)
- A decision-support dashboard (scored/ranked transformer recommendations)
- A short slide deck to present your tool to a utility company e.g. Electricity Company of Ghana.