OPERATING IN A DARK REVENUE PROTECTION ENVIRONMENT WITH DIMINISHED CASH FLOW – IN THE LIGHT OF SCARCE RESOURCES

Paper on revenue protection and generation through technological enhancements in data operations management

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I. Abstract

The intent of this paper is to present a business case on how using new models for structuring the data can positively impact revenue generation for the utilities. Utilities have a wealth of data coming in from the smart meters along with other traditional sources of data. The utilities need to mine this data to generate tremendous value not just for themselves but also for the end customers. The study will highlight how Big Data Opportunities can be converted into actual revenue by adopting multi-variable predictive systems within data analytics.

II. Challenges faced by South African Municipalities

Utilities across Africa are in a state of distress and failing to meet their financial obligations in the short term because of not achieving the targeted gross margin, negative cash flow and a deficit which is compromising business operations, delivery on the mandate. Changing market dynamics threaten the sustainability of their business model. **At the centre of the problem statement lies external macro challenges within the energy sector as well as internal inefficiencies embedded in the system**. ***In the last financial year, the cities of Johannesburg, Tshwane, and Ekurhuleni lost a combined R7.9 billion worth of water and electricity. A little under R4 billion of that was from theft and other non-technical losses. Tshwane loses a quarter of all the water it buys without any outside help, while Ekurhuleni's numbers suggest it is excellent at preventing electricity theft.***
If energy losses are curbed, it would either reduce costs and ease demand on the system to be used by other customers or recover additional revenue the utility would have otherwise not recovered. This makes it imperative for the utilities **to manage energy losses tightly to avoid strain on the system and the profitability of utilities.**

III. Where are the utilities going wrong?

Apart from the external macro factors such as illegal connections, meter tampering and theft, **internal inefficiencies such as poor data management** add-up to the non-technical losses.

a) Poor maintenance of customer data (Addresses, Account Number, etc.): Lack of customer data quality management and associated system updates leads to inconsistency in data sets giving rise to challenges as follows;
   i. **Un-located addresses** for manual read meters: Inability to respond swiftly to detected energy theft, and inability to fast-track maintenance of meter change out for customers who logged queries
   ii. **Poor data capturing** of meter readings: Meter readers often capture data that throws exception during the validation phase. Some of these errors are not resolve within the meter reading window and therefore impact on accurate billing of customers. Meter readers must face penalties for poor data capturing.
   iii. **Inaccurate billing of customers**: Inaccurate billing tends to promote the culture of non-payment with disgruntled customers. Inefficient management of meters or not fulfilling work orders often leads to customers being billed on estimates rather than actual consumption. There are cases where customers on prepaid are still billed and invoiced for some time after they have been converted to prepaid. Inaccurate billing is a major contributor for customers having negative sentiments about the organisation. One of the key causes of incorrect billing is due to a gap between the “Actual” and the “estimated” readings and the “inaccurate readings” which get recorded by meter readers.

b) **Service delivery**: Service delivery to customers is another major concern for struggling municipalities. Inaccurate billing, lack of adequate supply of electricity, aging infrastructure, failing systems resulting in poor service delivery.

c) **Poor outage management** -Utilities are unable to provide accurate restoration time to the customers, leading to consumer protests for non-service delivery.

d) **Lack of data synchronisation** – Utilities are unable to collate the data they receive from multiple sources into a centralised pool of data. Due to an unstructured data formats and incomplete information the utilities are unable to plan their utility services and hence service delivery to customers is hampered.

IV. How can utilities make use of data management operations to resolve their crisis?

Of all industries, utilities expect the biggest returns (73%) on its big data investment (against 39% for insurance and 38% for telecommunication). While 80% of utility player agree that big data provides new opportunities for business, only 20% of utilities have already implemented big data analytics.

Utilities are sitting on a wealth of opportunity, with more information than ever before flowing from smart meters and other sensors, along with traditional sources of data about their operations. Utilities can mine this data to get valuable insights. Although utilities are aware that their data will generate valuable opportunities for the organisation they unaware as to where to start.

Most utilities executives think that enormous investment will be involved to enhance the system and the quality of data. This is true if the utilities decide to invest in all aspects of data management. But even before the utility managers define a data management strategy for their business, an **introspection is required into the capabilities and abilities of the organisation**.

Supportive Capabilities

Exploiting data and generating productive analytics requires four supportive capabilities within the organisation. These are depicted in the diagram below;

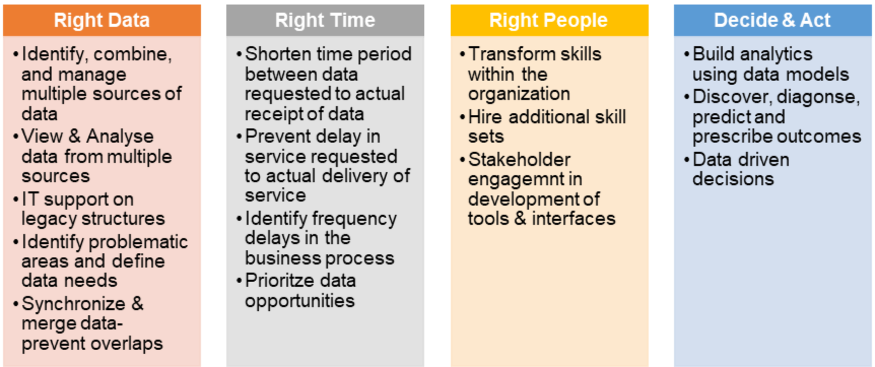


Fig 1: - Supportive capabilities for data operations management

Database Operations Management Strategy

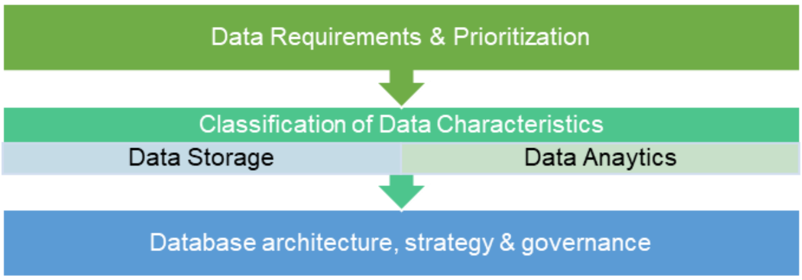


Fig 2: - Data Operations Management Strategy

Once the utilities have dealt with understanding the need for data and defining the capabilities required, the next step is to move to a **Database Operations Management Strategy**. A database operations management strategy can be defined in such a way that it is well aligned with the objectives of the business.

I. <u>Data requirement and prioritization</u>

Data requirement refers to conducting detailed due diligence to identify the key fields required to conduct analysis and generate actionable insights. Overall, data requirement can broadly be classified into five categories:

a. ***Profile data:*** Includes data required to create segments such as customer segment, business/property segments, appliance holding type and meter type.
b. ***Subscription data:*** Information related to customer subscription including contract, tariff and product holdings.
c. ***Behavioural data:*** Data clusters that help understand customer behaviour like payment data, invoice data, debt data and digital transactions.

d. ***Contact/Interaction data***: Data regarding customer interactions including call centre data, CSAT/NPS, complaints and visit data.
e. ***External data:*** The different external data sources that would augment your internal database to derive meaningful insights, for example market research data, etc.

Utilities need to begin with prioritized data to ensure that the most pertinent data is covered first.

II. Classification of data characteristics

Most utility players need to differentiate between several categories of data found across customer life cycle and the time-related aspects related to data types. To manage data effectively, it is essential to understand the differences of each data class, their potential applications and their respective latency considerations.

a. ***Data segment:*** A data segment corresponds to various stages of the customer lifecycle where data is captured, including customer application submission, payments, meter installation, meter reads, updates performed and saved.
b. ***Data class:*** Data arising from smart meter devices needs a completely different form of storage and treatment compared to data for customer registration, regular use and pay cycles.
c. ***Data latency:*** Latency/ inactivity is defined as both the time interval between when data is requested by the system when it is provided by a source, and/ or the time that elapses between an event and the response to it.
d. ***Data lifespan:*** Depending on how the data is to be used, there are various classes of storage that may have to be applied. For example, while a utility would like to store customer specific details forever, details corresponding to the exact consumption of a household within 30 minutes intervals might not be of interest beyond a few years. An ideal solution would be hierarchical data storage architecture, with different types of storage applied to different data sources, coupled with latency requirements.

III. Data Storage

To manage the associated data volume and complexities, traditional methods need a paradigm shift towards an approach where customers have higher visibility, control and participation.

a. Cloud computing provides a highly automated, dynamic and cost-effective solution to this challenge because it offers massive scalability and collaboration capabilities.
b. It can be used to deploy new services with greater speed without significant capital investment.
c. Utilities can shift from on-premise, slow and sub-optimal data management methods to online, optimized virtual data centres.
d. Cloud computing's pay-per-use model helps organisations avoid capital expenditure with flexibility to instantly scale up or down.

For utilities, a hybrid model combining best of private cloud (owned by the organisation on a private network and highly secured) and public cloud (owned by cloud service provider and highest level of efficiency) would work optimally.

IV. Analytics

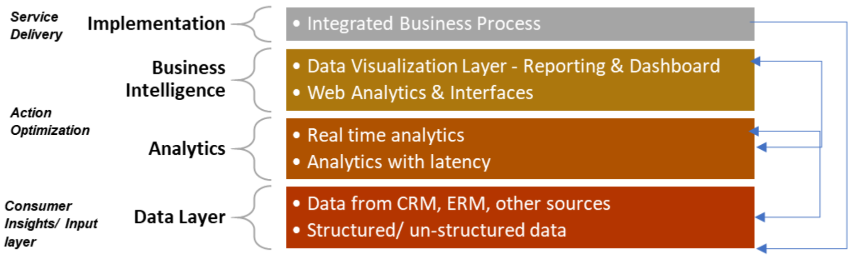


Fig 3: - Analytics Data flow

The objective for analytics is precisely automating high-volume decisions on a unified platform in a consistent, scalable, fast and economical manner that allows a high degree of adaptability.

V. Database architecture, strategy and governance

With the enormous growth in data, it is imperative for utilities to have a supportive architectural framework to support real time driven operations. Inter-relationship between business processes, business applications, data management and overall infrastructure to have a positive effect on customer experience.

To facilitate the development of good analytics architecture, it will be helpful to develop classifications for the structure of data and analytics classes. By combining this taxonomy with business strategy and requirements for protection and control along with other applications, utilities can develop a full database architecture and analytics strategy.
Data governance is a set of processes which ensure that important data assets are formally managed throughout the enterprise.

Sizing up on the analytical opportunity

Utilities can get started with data analytics to extract meaning from the huge volumes of data to help improve decision making. Analytics can be categorised into four levels of progression and utilities can commence on the basic to intermediate level to get substantial insights from their data. The four levels of progression are;

1. Descriptive
    a. What's happening in my business?
    b. Comprehensive, accurate and live data
    c. Effective visualization
2. Diagnostic
    a. Why is it happening
    b. Ability to drill down to the root cause
    c. Ability to isolate all confounding information
3. Predictive
    a. What's likely to happen
    b. Business strategies have remained fairly consistent over time
    c. Historical patterns being used to predict specific outcomes using algorithm
    d. Decisions are automated using algorithms & technology
4. Prescriptive
    a. What do I need to do?
    b. Recommended actions and strategies-based o champion challenger testing strategy outcomes
    c. Applying advanced analytical techniques to make specific recommendations

Maturity Model for data driven decisions with examples under each category

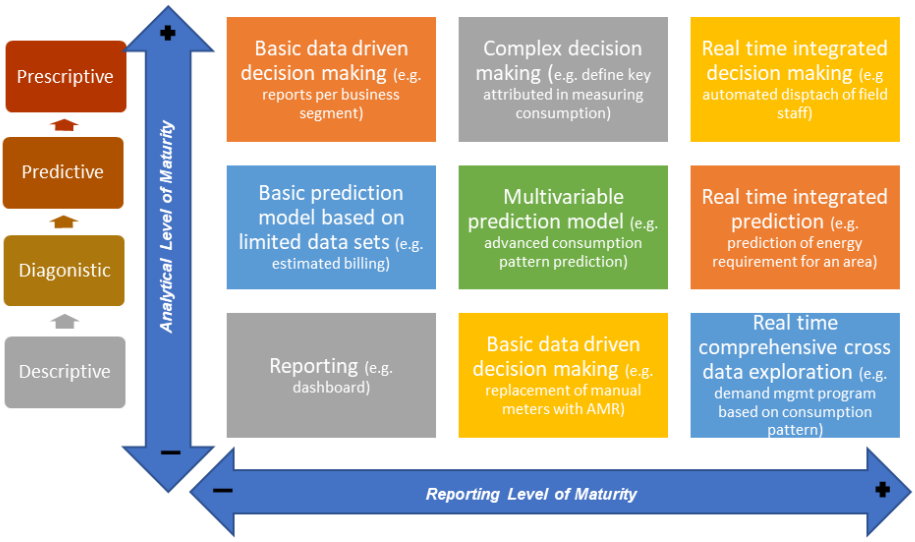


Fig 4: - Maturity Model for data driven decisions

No one type of analytics is better than another, and in fact, they co-exist with, and complement each other. For a business to have a holistic view of the market and how a company competes efficiently within that market requires a robust analytic environment. This means, Utilities will have to aim at progressing towards the advanced prescriptive systems level. However, utilities can commence with ***the basic to intermediate levels before reaching the advanced complex level of analytics***.

Identifying the business need for analytics

Hiring and retaining good data science talent, improving business operations and gaining insights from each process, re-training existing staff and getting them to use data are some of the challenges that restrict analytical expansion of utilities.

For instance, their current data system has been set up to facilitate operations in an unstructured manner thereby restricting the flow of information within the multiple business units.
Consider a simple meter reading system which records utility consumption for the consumer. This system maintains a simple log of customer details and the consumption of the customer. Such systems may not capture or retrain all the details about the *changes to the customer meters*, the *average readings of the customer* for the past few years. Even if such information is captured it is difficult to *assemble this information* and use it across business units to make effective decisions.
A more ***advanced system would capture the data*** in a structured form, perform quality control tests while recording the meter consumption data, which would facilitate faster turn around times for the utilities. Even with simple logs of data, utilities can use analytical methods to mine the unstructured data set to make effective decisions.

Areas to benefit from data analytics

Improvement in data operations management strengthen the relationships with customers. It targets investments in the right areas of business and offers opportunities for the growth of business.

Cost Reduction

- Increases capital productivity
- Save millions in operations & maintenance
- Improved service delivery leading to reduction in call centre volumes.
- Optimizing capital deployments by identifying ways to reduce risk
- Supply chain management –weighing spending against value.

Reliability

- Imprves data reliability
- Efficiency in response time for outages
- Efficiency in overall business processes
- Identfying real time issues and acting accordingly

Customer Engagement

- Design new products and services
- Defining of demand side management programs to optimise use of electricity during peak times
- Accurate expected time of restorations on outages
- Provide additional power grids for areas with shortage of power

Business Case - Quick win for Utilities through Data Analytics

Utilities need to identify the key problematic areas to develop targeted analytics to gain momentum within the organisation. Such areas may include meter reading management process, outage management process, supply chain management, demand side management or asset analytics. Focusing on a single area can help in several ways.

- First, it focuses the **organisation on exploring data resources** available to resolve the issues. This makes it easier to define the infrastructure framework as everything is within a single design and with few stakeholders.
- Second, structuring data for a smaller data set is much easier as all efforts of the IT analysts can be focussed on data cleaning. Once the data is cleaned it can be merged with other data sets and advanced applications at a faster pace.
- Finally, any drawbacks of the current data clean up process can be identified and better managed for future projects.

Case 1: - Improvement in meter management process

Problem: - The utilities are aware that estimated billing is a serious problem in the meter management process, leading to non-technical loss for the municipalities. In the 2018, City of Tshwane, Johannesburg and Ekurhuleni have lost around ZAR 3.5 billion to non-technical losses.
Background: - Due to the multiple data issues and absence of regular consumption readings being received, utilities usually bill the customer on estimated readings. These estimated readings are an average of consumption over the previous months. However, average consumption often does not give a true picture of the actual consumption of the customer and hence results in disputes.
Proposed Solution: - One of the leading Utility decided to focus first on using analytical data i.e. making predictions using a multi variable statistical model to reduce the number of estimated bills being sent to the customers.
Data received from smart meters and automated metering devices is to be stored in a central database. This data includes the consumption statistics, the status data of the meters and facilitates diagnostic solutions for the meter management process. Using statistical methods an estimation model can be built by incorporating additional variables which are required to calculate consumption values. Below is a snapshot of the old and the new data models used for calculating customer consumption.

Variable	Old Model	New Model
Location	✓	✓
Average Reads	✓	✓
Weather	✓	✓
Month of the year	✓	✓
Peak and off-peak period consumption pattern		✓
Leaks		✓
Size of the property		✓
Type of measuring device (manual, smart)		✓
Energy type (solar, coal, gas etc)		✓
Utility Pricing		✓
Customer demographics		✓

Table 1: - Estimation model for prediction consumption pattern

By adding *variables to estimation models* and using more advanced statistical methods, the utility will be able to double the accuracy of its billing system, forecast utility demand, find new ways of communicating with customers with regards to their consumption pattern, thus further strengthening customer engagement. *By analysing* the consumption pattern in sync with the customer demographics an accurate set of predictions can be made which will facilitate the utilities to predict the consumptions more accurately. Utilities can then develop new programs to suit the *demand of their customers, further strengthening customer engagement*. This case applies to all three benefit areas mentioned above namely, cost reductions, improving reliability and promoting customer engagement

How will the manual reading process benefit from predictions?

The above methodology will not just facilitate improved dialogue with customers but will also improve internal meter management processes.

Fig 5: - Meter Management Process

Improved information flow and quality control checks all along the meter management process will improve the **quality of the data and thereby increase reliability on the data se**t. Utilities can begin to forecast the utility requirements per customer and then group them to determine the overall utility requirements for the area. This will facilitate better control and enable to define better demand side management programs.

Case 2: - Outage management process

Problem Statement: - High pressure on grid, age old infrastructure increases the frequency and duration of power outage. Customers are not informed about the unplanned power outages and as a result they complain about the feedback on restoration times for these power outages. Utility is aware of the average duration of power outages, the areas being most effected. But they not sure about the duration of such outages and why some outages last longer than the others. They in need of a solution which can assist with the restoration times.

Background: - During an unplanned power outage, the customers complaint on multiple platforms in order to receive response on restorations times from the Municipality. These platforms include an online fault logging portal, social media platform, call centre numbers, community chat forums etc. The power outage restorations are managed by engineering services field managers and the updates communicated to their respective teams. The customer complaints are managed by the communications department. A disconnect between the flow of information between the two teams can further delay the outage restoration.

Proposed solution

a) **Adding GPS co-ordinates: -** It is imperative to mine the data in its outage-management system and adding data sources such as location of the service utility fleet, scheduling of service utility fleet, asset-location data and weather, areas effected with outages, etc will assist in defining a more accurate view of the outage process and the time taken at each step to restore power. Knowing about the availability of a service vehicle and its location will be extremely beneficial to the field managers as it will allow them to dispatch the closest available unit to an area effected with outage to improve the response time.

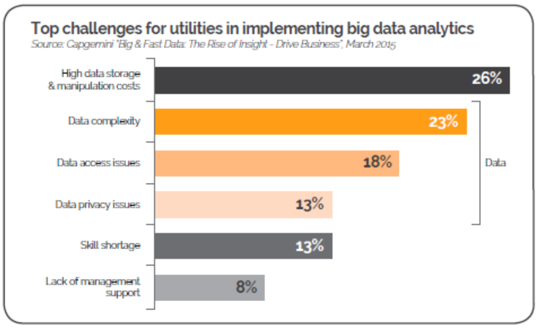
b) **Linking customer data: -** Analysing and linking the customer complaint data with the outage management system would also facilitate in understanding which areas experience maximum power outages. By extracting data such as customer location, frequency of outages in an area, nature/ type of customer complaints within an area and adding this data to the outage management system would add value to the entire outage management system.

Variable	Old Model	New Model
Equipment type	✓	✓
Region	✓	✓
Weather	✓	✓
Repair status	✓	✓
Spread of outage		✓
Hour of day		✓
Customers affected		✓
Day of week		✓
Concurrent incidents		✓
Month of year		✓
Type of faults		✓
Frequency of outages		✓
Area most impacted		✓
Supply segments for the area		✓
Location of outage management fleet (GPS)		✓
Source of power supply/ distribution to the area		✓

Table 2: - Estimation model for predicting outage restoration time

Using advanced analytical techniques, the utility also was able to normalize differences across work locations and determine what processes and business rules affected the duration at each step. This effort helped it prioritize process-improvement initiatives, based on their value potential. It also improved process transparency for all stakeholders involved. **On a real time, basis, the field managers were able to prioritize resource re-allocation to resolve the outages**.
Using predictive models, utilities will be able to forecast restoration times more accurately thereby providing correct information to their customers. This leads to improved customer satisfaction which is a critical component of the utility's performance measurement**. Data reliability improves which enhances the overall process efficiency bringing a turnaround for the utilities**.

Conclusion



The market research firm GTM Research predicts that the global **utility company expenditure on data and analytics will grow to USD $3.8B in 2020, with gas, electricity and water suppliers in all regions increasing their investments**. This investment is expected to lead a reinvention of utilities business. Utility players can best leverage these reinventions by capturing the maximum benefit through a well-defined strategy that's suited for their data management and analytics requirements. This framework would consider the prioritization of data, its classification, required storage, analysis and architecture. Doing so would help utilities realize significant cost savings while developing a state of art data management process.