A Revenue Protection Success Story – eThekwini

Background

eThekwini Metropolitan Municipality ("*eThekweni*") is located in the Province of Kwa-Zulu Natal. The harbour city of Durban is within eThekweni's area of jurisdiction. Durban has a large economy, which includes a significant industrial sector. The port of Durban is the busiest container harbour in Africa. Durban is also a major tourist destination in Kwa-Zulu Natal, well-known for its beaches and pleasant sub-tropical climate. In September 2004, eThekwini was awarded the highest credit rating in Africa for a municipality by the Global Credit Rating Company.

Size	2297 km^2 (1.4% of the province of KZN)
Municipal Budget	More than R 24 billion ($ 3 Billion)
Population	3 million people
Demographics	African 68%, Asian 20%, White 9 %, Rest 3%
Electrified Households	632 700 (rounded)
Pre-Payment	287 000 meters

Table 1: eThekwini Municipality at a glance

Revenue Protection Challenge

The electrical department of eThekwini seeks to reduce its non-technical losses. This is necessary not only to optimise financial returns, but to address also the external challenges of conservation and peak demand reduction. The department's revenue protection division is tasked, among others, with meeting these objectives.

Tampering constitutes one of the biggest challenges within the pre-payment meter domain. The main obstacle in the prevention of tampering is the lack of addresses for many of the metering points. Historically, many pre-payment meter deployments in South Africa happened without recording the detailed address in an effort to save time and costs. It was assumed that the meter address would be of secondary importance only. However, practice has shown that the lack of a proper address inhibits meter management and, more specifically, revenue protection. This lack of adequate addressing: (1) Limits knowledge of and control over the point of connection, and (2) Limits revenue protection programmes to costly and ineffective random sweep inspections.

An inherent negative scenario is created if the utility needs to open a Blind Vending channel. The token is generated based only on a meter serial number. Limited validation checks are possible and the vending transaction is processed without a reference to a central data system. eThekwini incorporated a large number of pre-paid meters to their management domain that were historically controlled by ESKOM. The original datasets of these meters was distributed and many of the records were incomplete. Due to the lack of decent addressing & poor meter management processes, eThekwini had to enable blind vending. This unfortunately left a gap in terms of the visibility on purchase patterns and a pro-active response to exceptions was difficult.

Another big challenge was the number of data systems involved. These systems include:

- Coin – The Financial Billing System
- Contour – Pre-Payment Vending System
- GIS System – With Cadastral data, Road data, Metering & Infrastructure data as well as Aerial Images
- MIMS Ellipse – Central Customer database. This system is positioned as the Master Data System

The utility is working towards consolidating all records into the central MIMS Ellipse database, but historical pre-payment meter information may still be distributed over many of the data systems.

The Solution

eThekwini invested in a structured Revenue Protection department with three regional offices and field teams reporting to each office. They are focusing on reducing losses over the entire meter base, but the inherited information gaps in pre-payment system made it difficult to get "ahead of the game". The following was required to address this challenge:

- One Central Master System that reconciled all records
- A structured field audit with the aim of normalizing all pre-payment and as well as residential credit meter records
- An integrated Work Order system to manage all follow up field operations and record updates
- Data Reporting and Data Mining to plan and execute a pro-active Revenue Protection program

With more than 250 000 pre-payment meters under their control, field operations and data management could quickly become a daunting task. A high level of data validation and seamless system integration would be required. Previous audit objectives were met with limited success because of these challenges.

eThekwini embarked on a phased approach to tackle this project. The first step was to identify a small project area for a pilot. This pilot tested the viability of the proposed solution and also acted as a blueprint to update and optimize the operational processes. The project was then expanded to a full operational level.

The field operations consisted of two separate, but sequential actions. The first action was the physical meter audits. The primary aim of the audit was to update the meter records and to identify each meter position with an accurate GPS coordinate. The audit teams would finish the work in a designated area before the next action was initiated. This follow up action addressed the remedial field work identified by the initial audit. These operations were executed by a specialised normalization team. The advantages of this approach included:

- The audit team could focus on the data acquisition and their productivity was optimized.
- There is a negative impact in terms of access when tamper disconnections are started. By first completing the audit sweep the level of access to the installations was much better.

- The audit team had no direct contact with the normalization team. Fraud was limited since there is no impetus to bribe the audit team not to report anomalies.
- The normalization team's skill set was selected towards the remedial tasks to be performed. An electrician's time was not wasted by being held back by the overhead of a full data audit.

The Audit Process

The following diagram highlights the audit process and data flow

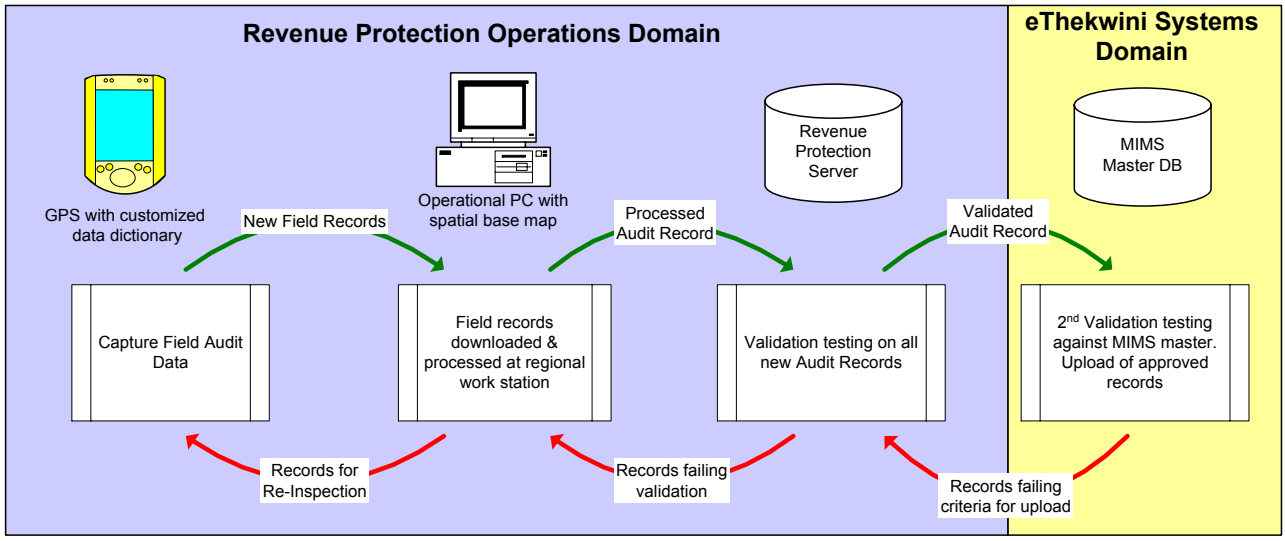


Diagram1: Audit Process Data Flow

The field audit is completed on a GPS hand held unit (HHU) with a customized data template built specifically to meet the requirements of eThekwini. The field operator can select many of the data entries from a drop down box. The new HHU unit is also equipped with an integrated bar code scanner. It allows the operator to scan the meter serial number instead of manually entering the value. The system minimizes capturing mistakes.

At the end of each day the operator docks his GPS at the regional operational office. The office administrator is able to view the position of each audit on a detailed base map of the project area. This ensures full visibility on all the field work. The records are then automatically uploaded to a central operational server. A series of validation tests – as agreed upon with eThekwini – are run against each of the new records. If a record fails any of the tests it is returned to the operational machine. These records are loaded back on the GPS unit and must be corrected the next morning by the responsible field operator.

Records that pass field validation are placed in a dedicated central repository for upload to the MIMS Ellipse database. Before any MIMS Ellipse record is updated another set of validation test are executed. This second validation compares the new record to the original record in the MIMS Ellipse database. If primary field values of the new record disagree with the corresponding record in MIMS Ellipse, the

record is automatically flagged for attention by a MIMS Ellipse administrator. The same flag will be raised if the meter in question is not registered on the central database. The administrator has the option of updating the historic MIMS Ellipse record manually, registering a new record on MIMS Ellipse or returning the field record back to the revenue protection system for a follow up field inspection.

The audit process is designed to protect the integrity of the central data system by enforcing rigorous validation. The high level of data integrity must be balanced with ease of operation. Most of the validation processes and the data uploads is therefore automated to run in the background. The operator is only alerted to those records that failed any of the validation steps.

The Remedial Process

The remedial work follows from the initial audit. These actions will include meter replacements, tamper disconnections and meter sealing. The prerequisite is that these actions must be coordinated from the central database. Much effort was spend to update the original record through a field audit. It is crucial not to compromise the integrity of the central database once again through a badly controlled meter or field data management process. The diagram below illustrates the elements of the remedial field operation.

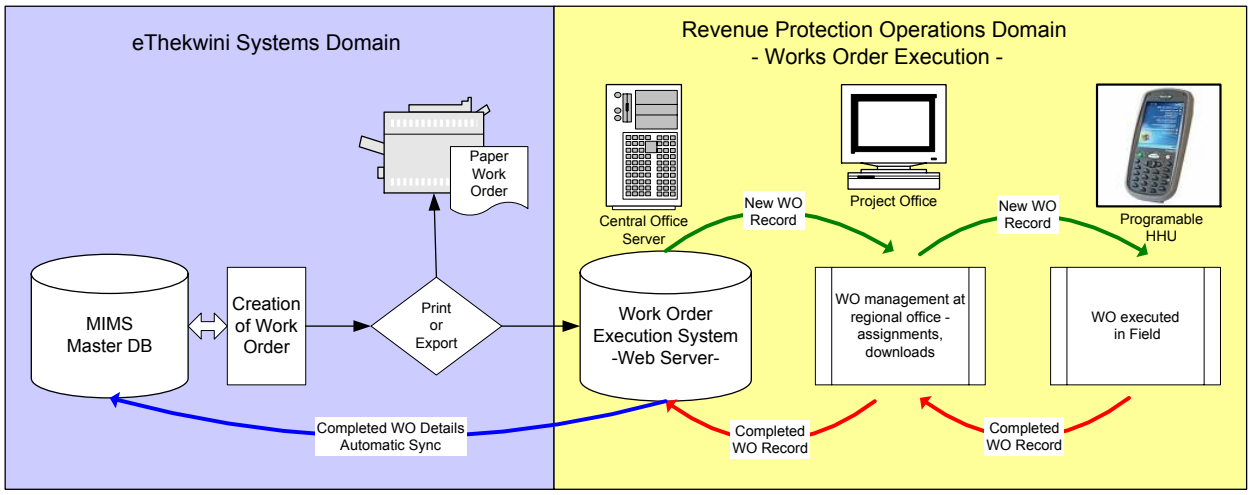


Diagram2: Execution of Work Orders for Remedial Actions

The MIMS Ellipse system has a Works Order Management interface. It allows the operator to create a work order directly from the central system. This ensures that the works order reference is always linked back to the original record. A limitation was that the process was still a paper based field operation. This was addressed with the electronic works order execution system deployed. After an administrator created a new works order from the MIMS Ellipse system he/she had the option of either printing it to a printer or submitting it to the works order execution system. The work order record is transferred to a holding database and is accessible from the regional offices through the systems web interface. The operational manager is able to select the desired work order(s) and assign it to a specific field technician.

A hand held unit is allocated to a specific field technician. When the technician synchronizes his hand held unit with the system, all the works orders assigned to him is automatically downloaded to the unit. The field technician now has an electronic work order record originally generated directly from the MIMS Ellipse system. After the works order is successfully completed it is automatically synchronized back to the central system.

The hand held unit guides the field technician with a wizard through all the required steps to complete a specific task. The hand held unit system includes user access control, validation testing, customizable & mandatory data fields as well as an integrated bar code scanner and GPS receiver. The advantages of this paperless system include:

- Full traceability of a works order through its entire life cycle. The works order is always linked to a specific user and an update is recorded with a date time stamp.
- It is always possible to link the work order back to the original master record in the MIMS system. The unique work order reference is generated from the master system and this value is respected and maintained through the entire work order life cycle.
- The electronic integration prevents a works order from getting lost.
- Changes to the original record (i.e. a meter replacement) are automatically updated to the master system when the completed record is synchronized to MIMS. This prevents operator error due to manual capturing from a paper form and ensures the integrity of the central master system.

Navigation to a Meter location

All work orders are generated from the central MIMS Ellipse database. The coordinates captured during the original audit was uploaded to the MIMS Ellipse system and can now be utilized to navigate to the specific installations. The operational HHU's are equipped with GPS receivers, but the software does not allow for easy navigation. The feedback from the spatial map is limited to pointing in the direction of the location. An easy to use navigational solution was therefore deployed. It utilized an inexpensive recreational GPS unit that can be fixed to the operational vehicle. A custom build interface guides the administrator through the steps to create and download waypoints for all the works orders on the system to the GPS units. The technician is able to utilize the built-in software (with mapping & voice prompts) to navigate directly to any installation.

Figure 1: Screen view of GPS used for navigation

The user can search for a location using either the meter serial number or the works order reference as a lookup. This solution has been very effective in areas where physical addressing is limited or where the operator is unfamiliar with the area.

The Results

Just more than a year after the operational launch of the project it is possible to look at the impact of the program and hopefully answer the question – "*Are we winning*?"

The teams have been deployed in three regional areas. The focus was on pre-payment metering, but residential credit meter details were also captured. In May 2009 a total of 144 568 metering points were successfully audited and 103 802 of these records passed the validation testing for upload to the MIMS Ellipse system. The table below gives a high level description breakdown of the audit results

Re-Audit Recommended	Credit Meters Flagged for Replacement	Credit Meters Successfully Audited	Prepayment Meters Flagged for Replacement	Prepayment Meters Successfully Audited	Other (meter removed etc)	**Total**
40766	28	11412	171	87415	4776	**144568**

Any records that failed initial validation as well as first "*No-Access*" findings are selected for a re-audit. There were also a number of very old credit and pre-payment meters of which the meter serial number was not readable. These meters were flagged to be replaced with a new pre-payment meter. The next table highlights some of the exception findings logged during the audit process

Finding	Total
Faulty Meter	1066
Free Supply	2130
Meter Damaged	103
Tampered Meter	2229
Disconnected	1515
Total Exceptions	**7043**

The points listed as "*Free Supply*" was a direct electrical connection without a legitimate meter. If the number of successful pre-payment meter audits (87400) are considered, the exceptions highlighted by the audits equates to around 8% of the pre-payment meter total. The focus of the initial audit was to normalise the data records, but already the benefits are apparent. The table below examines the potential impact of fraudulent activity based on the total exceptions. The exception records were cross referenced with the vending history of these meter installations to estimate the potential loss incurred due to illegal activity.

Description	Number of Points	Potential Loss Extropolated from Vending History
Tamper / Free Supply	1887	R 2,073,780
No Purchase for at least 3 months	4207	R 3,936,022
Total	**6094**	**R 6,009,802**

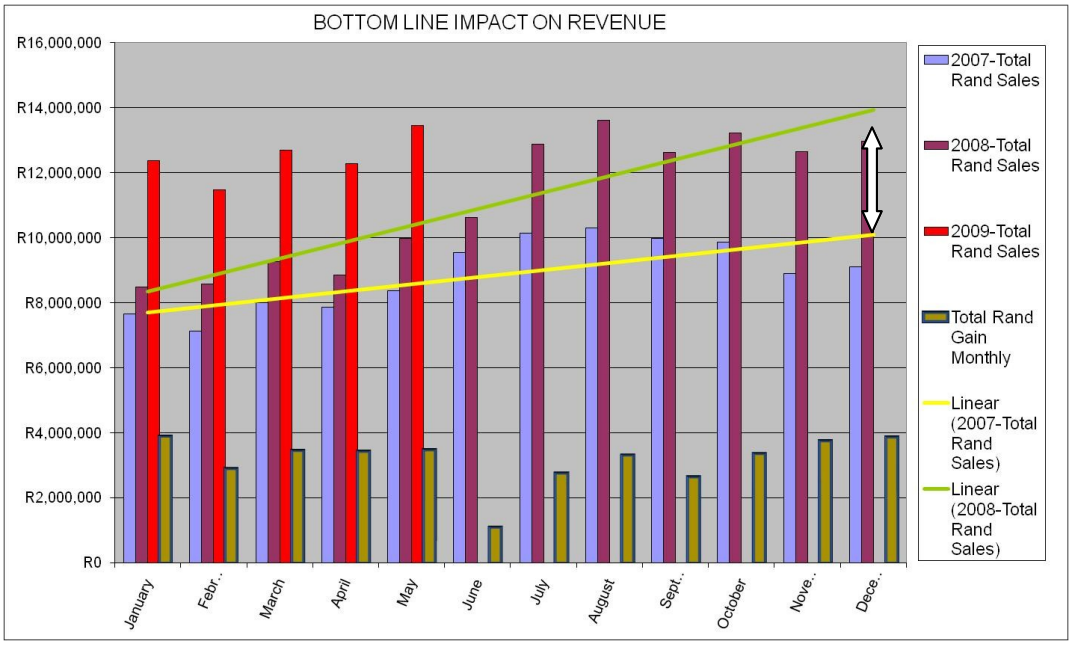
The primary aim of the initial audit was to reconcile and update all the pre-payment meter records into the central MIMS Ellipse data repository. The table below examines the impact of this exercise by comparing the updated audit records to the original records registered in MIMS Ellipse.

Area	Record not on MIMS - No Vending History	Record not on MIMS - Blind Vending	Record on MIMS - No Vending History	Record on MIMS - Normal Vending History
Central Region	1598	4152	2949	21956
Northen Region	1857	2994	2066	31650
Southern Region	2098	5733	6036	19323
Total	**5553**	**12879**	**11051**	**72929**

The four categories highlighted can be summarized as follows:

- *Not on MIMS / No Vending History* – These are pre-payment meters identified in the field without a configured account record in MIMS Ellipse. There is also *NO* historic vending transaction linked to this meter serial number. This is highly suspicious. These locations will be selected for a follow up detailed investigation.
- *Not on MIMS / Blind Vending* – The meter accounts were not configured in MIMS Ellipse, but because of the blind vending option a transaction history did exist. The records will be updated on the central system and the need for blind vending are then eliminated.
- *Record on MIMS / No Vending History* – Although the meter account is configured in MIMS Ellipse, no transaction could be found for the meter. This also very suspicious and the locations will be flagged for a follow up investigation.
- *Records on MIMS / Normal Vending History* – This result is the ideal. The extra data fields captured during the audit (i.e. the GPS coordinate) not available in the central record was updated after the synchronization.

The last and most important view to quantify the success of the revenue protection program will be to examine the impact on the bottom line. The total pre-payment transactions over the last 3 years were calculated for this exercise. This included all the metes on the system, not only those audited up to date. The graph below highlights the results.



The revenue protection operations started in the beginning of 2008. A first glance at the data sets show a steady chronological increase in the monthly income realized through the pre-payment channels, but comparing the difference between the results for 2007 with those for 2008 the impact of the revenue protection program is clear. The big (and widening gap) between the green line representing the average increase for 2008 and the yellow line representing 2007, confirm the positive return already in the first year of the program.

The green bar graph compares the increase in the monthly revenue for a month in the current year with the same month the previous year. eThekwini has realised an average monthly increase of between R 3 - 4 million over the last year. Even allowing for tariff increases and an increasing meter total, the return on the initial investment is substantial.

Summary

eThekwini have embarked on a 3 year program to normalize their pre-payment data set and in parallel launched a paperless works order system to follow up on all remedial tasks identified through this project. They are now in the position to run an intelligent revenue protection program based on back office analysis and targeted inspections. The positive results are already evident and the future returns should be even greater. The success of the operation can be measure by having the correct building blocks in place comprising:

- People – A project can only be effective with committed and dedicated resources
- Processes – The correct processes and procedures established at the start of the project are essential
- Technology – This is the last element, but it is only effective once the first two pillars are in place. Investing in technology on its own will not ensure success.