

Mobile Technology for Infield Data Collections and Electronic Works Orders.

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1. Introduction

Mobile technology has taken the world by storm and is developing further every day. The capability of transferring data over GSM networks at a relative low cost have also revolutionized the world even more than the industrial age and there is no end to the possibilities yet. New ideas and new processes are now possible in the field of infield data collection.

This paper will deal with a simple, but effective and cost saving application of the new age technology now available to us that will assist municipalities to reduce costs and improve services.

In field data collection has always been a challenge with data collectors making use of paper or a handheld electronic device to capture the data and a separate GPS and a separate camera to take the photos. Linking all these to the same and correct data bundle sometimes proved to be impossible. With new handheld technology incorporating all these features the data collection process has been simplified resulting in improved data received from the field. The GSM network data capabilities now also make it possible to receive this data from the field real time with huge advantages.

2. Data in the Municipal Environment

Data in the municipal environment can impact hugely on the services delivered and the cost effectiveness of the municipality. Incorrect billing data can bankrupt a municipality and incorrect data on which maintenance efforts are based will cause huge additional costs and slow service delivery. Some typical data used by municipalities are.

2.1. Customer data

- ^ Personal information
- ^ Address
- ^ Property

2.2. Meter data

- ^ Meter information such as type, make, number etc.
- ^ Position
- ^ Condition
- ^ Average consumption
- ^ Maintenance required
- ^ etc

2.3. Asset register

- ^ Asset type
- ^ Position
- ^ Value

- ^ Condition
- ^ Maintenance required
- ^ etc

There are many more data sets used and these examples above can each be extended into subcategories extensively as well. It is not the purpose of the paper to list data sets and types, but to illustrate that municipalities rely heavily on data to operate. As does any business in the new age of Information Technology.
Incorrect data costs money.

3. Origin of Municipal data

3.1. Historic data

Municipalities have large data sets that stem from many years of doing business and many years of gathering data from the field. The accuracy of this data is mostly in question as it was gathered using paper infield data capturing techniques and is mostly incomplete as well. This leads to incorrect decisions made as far as proactive maintenance and large billing errors are made as a result of these incorrect data sets. The results are huge losses and inefficiencies. The worst of these are the errors that are not evident and that no one knows of.

3.2. In Field data capturing projects

At some stage all municipalities do some sort of data collection project to update the historic data and or to gather data not previously required. These projects are mostly outsourced and many times the focus is on the price and how quickly the data can be collected instead of on the quality of data received. The result is normally incorrect data as a result of contractors rushing to avoid penalties for late completion and due to short cuts taken to save costs.

Much of the data is also received from maintenance teams. This information is normally on paper and sometimes never reaches the data base.

Monthly processes such as meter reading and credit control are also sources of data.

4. The Solution

4.1. Define processes in advance to maintain all new and old data.

Data sets are “living organisms” in the municipal environment due to maintenance programs, upgrade programs and movement and behaviour of consumers. Processes that will define what must be done with data and how it is done must be defined clearly and these must be managed strictly. History of data must be kept and all changes to data logged. Access to data must be managed and user rights must be well defined.

4.2. Define processes to incorporate the new data with the old.

What to do when newly collected data and the historic data is different? What can be trusted? Normally the historic data will have the least impact on the customer and cause the least amount of work for the municipal official and is therefore accepted as correct, making data collection programs futile. Discrepancies should be investigated in detail and the correct data set used. Influences on customers must then be communicated with the customer, but the correct data must be implemented.

4.3. Define processes to collect the data.

Processes to ensure collection of data is done effectively and accurately must be clearly defined. Deliverables and tolerances must be defined and statistically representative sample audits of data submitted must be done to ensure accuracy levels are maintained. Where access problems occur due to locked properties or due to denied access, a clear and decisive action must be taken to ensure access is obtained. Suspension of the supply of services is a strong tool to use and works very effectively. There is no quick fix when it comes to data purification and therefore sufficient time must be allocated to the data collection process.

4.4. Manage the data user and collector not the data.

If the user and the collector of data is managed to operate within strict boundaries the data will look after itself. Data cannot corrupt itself. It is always corrupted by an action of a human being. Therefore human intervention must be reduced to a minimum. All human interaction must be monitored, reported on and corrective action taken if errors were made.

4.5. Make use of technology.

Technology as discussed in the introduction is available to manage the data users and collectors. Most processes and procedures can be enforced using technology. This will be discussed in more detail below.

4.6. Maintain the data continuously.

Data can be maintained successfully if all users of data is managed to ensure processes and procedures are adhered to. The maintenance effort must be continuous with immense discipline. Systems and technology cannot prevent the effects ill discipline completely.

5. Technology

5.1. GPS

GPS technology cannot just tell you where an asset is located, but assist in managing personnel who has to visit the asset.

5.1.1. Personnel management:

Due to the fact that you can track personnel you can report on how long the person took to complete a specific task and how long the person spent on the road to get there and back. This information is invaluable as management of field personnel is now possible from a desk. Efficiencies improve with huge cost reduction as a result and with improved reaction times and improved service delivery. Planning can be done more effectively as far as number of personnel required, and equipment that is required will reduce as the number of personnel is reduced. A case study on meter reading will show the effect of this later in the paper.

5.1.2. Spatial reporting

Spatial reporting on consumption, maintenance frequencies, credit control actions, access to meters problems, etc is now possible. A picture says a thousand words. This is a very useful tool to evaluate data received. When reporting spatially you can easily see from meter reading data where there are stands with electrical meters, but no water meter associated with the same stand. This can be investigated and corrected resulting in additional income. Consumption data can be shown spatially and when a stand does not have a similar consumption to those in the same area it can be identified and investigated.

5.1.3. Routing

Work certain areas can be combined to allocate to technicians to ensure travelling is optimized. Urgent work can be sent to personnel that are in the area. Meter reading routes can be optimized resulting in fewer resources required.

Personnel can be routed to the asset for maintenance purposes and even for meter reading purposes.

5.1.4. General

If a GPS co-ordinate is taken every time an action is done such as meter reading, this co-ordinate can be used to verify if the work was actually done at the meter or not. IT can therefore be used as a "policing" tool to ensure personnel are kept honest.

5.2. Visual aids

Photos of assets can assist in the planning of maintenance. Know what is required to be done and what tools and parts are required to complete the maintenance before you go to site. Travel time will be reduced and personnel can be used more productively.

Huge cost savings as a result of providing information to customers who might query meter readings as no additional test reading is required and again a picture says a thousand words and cannot be disputed. It can also serve as evidence when tampered meters or illegal connections are photographed with a date and time stamp. Photos are very successfully used to verify meter readings as new processes force the meter reader to take a photo when the system does not agree with the reading or when a maintenance code is entered or a no access code.

If all maintenance technicians are forced to take photos of work done it can be used to do quality assurance as well.

A very simple application is to force any person who opens and closes a meter box to take a photo of the box once the task is completed. There will be no more open meter boxes.

5.3. GSM

Real time communication has become essential in the meter reading industry and will also become essential in all facets of the municipal business. Just as we cannot imagine what we did to communicate before cell phones, we will in future wonder how we managed our business without real time data communication. In some instances it is a reality already with smart phones now receiving and sending e-mail and with smart meters communicating in real time with servers all over the world not to mention old technology such as telemetry and SCADA systems.

The meter reading industry is now using real time data transfers to manage the quality of readings and to reduce turnaround times. Data is validated on the handheld, but is then sent to the server for further validation and can be sent back to the meter reader to confirm while the reader is still in the field.

Progress of meter readers is monitored real time.

Reading of remote areas can now be done much more cost effective as no one has to collect a hand held device from the office to go and read the remote area. A person in the area can download the electronic works order and read the meters. This is especially effective where municipalities are consisting of various rural towns.

6. Electronic work orders / job cards

With electronic works orders a higher level of control is possible resulting in improved quality of work and improved efficiency.

- ^ Processes can be forced onto the person who has to fulfil the work issued on the works order.
- ^ Photos can be made compulsory and the works order cannot be closed if the photo was not taken.
- ^ GPS co-ordinates can be taken in the back ground to ensure no control over this function is possible and therefore keeping the person honest.
- ^ Certain data fields to be captured can be compulsory ensuring essential information is received back.
- ^ Drop down menus can be used to ensure there is only one way of spelling Church Street.
- ^ Completed works orders are uploaded onto the central data base via GSM as soon as it is completed. Now all the information is available for use and for feedback to customers.
- ^ Data is not just loaded onto the system automatically, but is done so accurately.
- ^ Data validation can be done on the handheld before it is accepted and all required data is forced to be entered.

7. Case Study

7.1. Back ground

Meter reading has always been underestimated in both the value it can add in terms of data from the field and in terms of the importance of the function in the revenue chain. The meter is the cash register of any municipality and must be managed as such. Imagine where Raymond Ackerman would be if he did not manage his cash registers properly. It is essential that municipalities come to realize the importance of the meter reading function. It is no longer just about getting a reading for every meter. It is about data collection on the meter and on condition of the meter and factors that make reading the meter impossible. It has become important to report accurately why a meter cannot be read as this will influence the maintenance required and done immensely.

Ekurhuleni is an example of a municipality that realizes the importance of this reporting. Consultants are appointed to manage the meter reading and maintenance of meters and as a result the importance of reporting on meter condition has become part and parcel of the meter reader's function and a very important part thereof. The asset (meter reader) paid for is used optimally by making use of the data received from the asset.

Realizing this need a system was developed that incorporated all the above technology and processes were developed to force the meter readers in the field to collect the required information and to do so accurately.

7.2. Technology implemented

7.2.1. GPS

- ^ GPS co-ordinates are taken in the back ground for every action taken and are date and time stamped.
- ^ GPS technology directs the meter readers on the handhelds to the next meter to be read.
- ^ Spatial reporting is available.

7.2.2. Photos

Photos are forced for the following outcomes

- ^ No access codes
- ^ All maintenance codes
- ^ All note codes
- ^ All high/low exceptions

7.2.3. Quality assurance rules built in

The following rules are programmed onto the handheld to assure correct data is reported.

- ^ Confirmation of the address
- ^ Confirmation of the meter number
- ^ Evaluation of the reading in terms of the average consumption
- ^ Evaluation of the no access code, maintenance code and note code in relation to the history of previously reported codes.
- ^ Confirmation of the GPS co-ordinate in relation to previous GPS co-ordinates taken for the meter.

Strict processes are enforced for certain outcomes. For example if a reading is not within preset limits as per the average consumption, a photo is forced and the reading must be re-entered backwards.

If a maintenance code is not the same as the previous month a code is suggested.

The following rules and processes are built into the back office system

- ^ All entries with a photo are flagged and are investigated by a data analyst.
- ^ The photo is used to determine if the data received is correct or not. If the data is not correct or if the photo is not of good quality the data analyst sends an electronic works order to the meter reader or the supervisor in the field to re-read the meter.
- ^ The data is then again put through the same quality check.

7.3. Results

7.3.1. Data accuracy

- ^ Meter reading data accuracy where actual readings were entered improved from 97% to 99%.
- ^ Accuracy on maintenance codes increased from 80% to 99%.
- ^ Accuracy on no access codes increased from 80% to 99%.
- ^ The most significant improvement was on the number of meters read. This increased from 80% to 87% due to a reduction in the number of no access codes provided and due to more effective maintenance.
- ^ Readings directly onto bill increased from 77% to 86%.

7.3.2. Cost reduction

A cost reduction of 15% was experienced by the meter reading company due to less transport of personnel required and due to increased efficiency of meter readers. If routes could be optimized a further cost reduction would have been possible, but due to the fact that this was implemented half way through a project it was decided that a change in routes would be detrimental to the project. On new projects this cost saving will also be realized. A huge

saving on handheld equipment is also possible as cell phones can be used in the place of this high cost item and is done so very successfully on this project. The cost of the handheld units was already incurred as part of this project and therefore no saving on this was achieved. A further 10% saving can be achieved if cell phones are used as handheld equipment.

8. Conclusion

The use of electronic infield data collection solutions are proven to return not just improved data, but also have cost savings as a result. It will revolutionize the way in which engineers will manage maintenance teams and the way finance departments will do meter reading and credit control. It will improve service levels to the public.

With the age of smart meters on our doorsteps, the quest for accurate data is even more important as visits to meters will become fewer and the chances to collect or correct data from the field will be reduced. Data collected during the process of installation of smart meters must be accurate or it might say incorrect forever.

Mobile technology and electronic data collection systems are widely used in the private sector and is the way of the future for municipalities.