

Non-Revenue Water and Revenue Collection Ratio: Review, Assessment and Recommendations

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The initial draft of this paper was prepared by Michel Vermersch and Fatima Carteado as part of a draft Apparent Loss Guidance Note for the Water Loss Specialist Group of the International Water Association in April 2010. Some updates have been included in the current version (14th February 2016).

This Paper now acts as Appendix 6 of the free Guidance Notes on Apparent Losses and Water Loss Reduction Planning by Vermersch, Carteado, Rizzo, Johnson, Arregui and Lambert as Paper AppLoss 2016A at <http://www.leakssuite.com/guidance-notes-app-loss/>

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15th September 2016

APPARENT WATER LOSSES AND REVENUE COLLECTION RATIO: REVIEW, ASSESSMENT AND RECOMMENDATIONS

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Keywords: Non-Revenue Water, Apparent Losses, Revenue Collection Ratio, Unpaid Bills, Outstanding Debt,

Abstract

In the IWA Water Balance, Revenue Water refers to the volumes of water that are billed during the reference period, regardless of whether those bills are paid or not by the customers. Therefore, it seems that there is no direct relationship between the NRW ratio and the Revenue Collection Ratio. This is a wrong statement, which may lead to paradoxical and erroneous attitude in specific cases.

In many utilities, unpaid bills are a significant source of apparent losses. Sometimes, consumers who are disconnected for non-payment reconnect their house connections illegally and become illegal consumers. In that case, the Utility is losing twice: through outstanding debts and through apparent losses.

In some utilities, some consumers living in low revenue areas are not billed at all because the managers think that these people will never pay the bills. Billing these consumers would reduce the NRW rate but at the same time, it would reduce the Collection Ratio, with no financial interest for the utility. With such a policy, no improvement is possible. The right policy is to bill everybody and to take appropriate measure to optimize the Collection rate.

Anyway, Unpaid Bills and Outstanding Debts do generate real financial losses. In order to get sustainable result, an action plan should always consider both indicators as interdependent indicators. Finally, it is important to stress that cost benefit analysis of apparent loss reduction should be based on collected revenue and not only on billed revenue.

This paper lists some approaches and solutions to address this issue either in the frame of current operation or corrective actions. Emphasis is placed upon payment and revenue collection procedures that need to be adapted to the local technical and cultural background as well as on the customer information system (CIS) that is an essential tool with respect to revenue collection but also to apparent loss control.

1. Definition and basic issues

In the IWA Water Balance, NRW is defined as the volumes of water that are not billed. NRW consists of three components: unbilled authorised consumption, real losses and apparent losses.

Some practitioners are of the opinion that there is a fourth component of NRW: the volumes that are billed but remain unpaid. Based on this statement, these practitioners propose to modify the water balance by splitting the Revenue Water box into collected and non-collected revenue. Most of the

members of the AL initiative are not in favour of this change and consider that purely technical issues should be separated from purely financial issues. This is because volumetric amounts of water are internationally defined and comparable while the financial value of water differs widely and cannot be globally compared nor equated to a universally comparable volume. The value of water differs due to different tariff structures, currency exchange rates and the time value of money to such an extent that assigning a volume to an unpaid amount would unlikely be a generally accepted benchmark. The matter is further complicated by the common practice of adjusting the value of consumer accounts (bills) to allow for penalties, to distribute the financial losses (i.e. adjustments for billing errors) or to compensate for meter reading errors thereby making the relationship between volumetric amount and unit cost of water differ significantly from official tariffs.

The unpaid bills and their impact on the operation and water tariff of water utility are well known. Low collection rates generate insufficient cash flow to face the challenge of many water utilities such as availability of water quantity and quality, ageing infrastructure and other resources, growing population and urbanisation, human resources, tariff issue, increasing accounts receivables. In addition, it is necessary to deal with various political/legal and regulatory aspects.

Unpaid bills often influence the generation of additional apparent loss for example consumers disconnected for non-payment require water to survive and they usually get it through illegal means such as unauthorised reconnections.

In addition, economical and financial targets may not have been met if the cost benefit analyses have been based on the amounts billed instead of the amounts effectively collected.

This paper presents some practises that can be implemented to reduce unpaid bills.

2. Review and Assessment

The existing situation in terms of unpaid bills and accounts receivables need to be reviewed and assessed. Usual indicators are as follows:

- Collection Efficiency is the percentage of the total amount billed that is collected, i.e. amount collected divided by amount billed. This is directly related to account receivable. As there is a time delay from the time the billing is done until payment is received the two values compared would be for different months, however the assumption is that on average over longer periods the goal should be as close to 100% efficiency as possible.
- Outstanding customer's debt is usually measured in days or months.

There are many items to be considered and many preliminary surveys and analysis to be carried out before developing and implementing the correct strategy and policy. A list of selected examples is provided as follows:

- Establish the revenue collection ratio and level of outstanding debts: analysis of billing, revenue collection, accounts receivables and collection ratio on a 5-year period and analysis of tariff change in order to detect any relation between tariff change, billing and revenue collection ("elasticity" survey)
- Establishment of revenue collection procedures is critical.
- Obtain an understanding of the customer's behaviour such as: motivation for payment, consumers' ability to pay and consumers' willingness to pay
- Obtain an understanding of the behaviour of the utility's staff' such as: motivation of bill collectors and causes of any internal unauthorised practices
- Understanding of water disconnection procedures such as: disconnection for non-payment procedures and penalties for non-payment
- In countries where disconnection is prohibited, identify detailed procedures and detailed results

3. Set of corrective actions: (1) about laxity and impunity

In some cases, high levels of apparent loss and outstanding debts are due to a certain level of laxity on the Utility's side that results in a feeling of impunity on the customer's side. A general audit will permit better analysis of the situation.

Corrective actions to reduce outstanding debts will depend on the result of the audit. They may include complete change in the utility's organisation or the use of new procedures. Selected examples of organisation procedures that are used worldwide are provided; however, solutions need to be tailored to suit the local situation and culture.

Failure of the utility to fulfil its service mandate and lack of legislative powers to deter payment defaulters contribute to high levels of outstanding debts. This is particularly relevant in low-income (developing) countries but can also occur in high income countries, although at a different scale. Addressing these issues is a prerequisite for any water utility.

Quality of service delivery

Generally, low rates of revenue collection are not only due to the social and economic background of the area but also, to the lack in the quality of service provided by the utility and the inability to enforce payment of bad debts.

The following sequence of events is common in some developing countries:

- The customer does not pay his/her bill,
- After some time and issue of warnings his water supply is cut off by the utility.
- The customer reconnects his water supply illegally.
- In many cases, the illegal reconnection will not be detected and reported and it generates apparent loss as unauthorised consumption.
- If the fraud is detected, the authority negotiates the payment of the fine and former consumption by instalments
- After some time, the consumer does not pay for the agreed instalment anymore and he will be disconnected again.
- The process repeats then itself creating a 'vicious' circle.

Such a process is sometimes facilitated by internal corruption, absence of clear regulations, absence of enforceable and applicable legislation, etc.

If the consumers continue receiving water free of charge, this is a clear encouragement for the neighbours to adopt the same procedures.

The consequences are therefore:

- Increasing outstanding debts
- Increasing level of apparent losses
- Lack of funds for the Utility

About unavoidable level of unpaid bills

In many developing areas, high levels of unauthorised consumption and outstanding debts are considered as unavoidable due to the social and economic background. In such a context, one could relate Unavoidable Level of Apparent Losses and Unavoidable Level of Outstanding Debts to the socio-economical background of the country. In fact, this so-called unavoidable level is generally due to the level of lack of enforcement and effective management of the water utility.

Such a statement does not solve all the problems because the running of the utility is also influenced by the social and economic background of the area/country. There have been some successes by utilities that faced the same initial conditions but were solved by implementing more rigour (strictness) in their management and control of the level of apparent loss. This resulted in a reduction in the number of unpaid bills. The solutions put in place by these successful Utilities are described below.

In the endless circle described above, two cases may be considered: either the consumer really cannot pay their bills (“can’t payers”) or they do not want to pay (“won’t payers”) because they are aware that the utility will not take any action.

Reluctance to pay

For the consumers who do not want to pay their bills and consume water illegally, the following could be considered when developing a solution:

- Ensure that the legal environment is clarified.
- Ensure good communication with consumers is undertaken.
- Establish an effective organization to combat commercial losses.
- Implement personnel training and incentive policy.
- Have a understandable and comprehensive metering policy

These conditions are similar to those already mentioned in Section 9.3 about addressing unauthorised consumption.

Inability to pay

For consumers who really cannot pay their bills other solution needs to be implemented. Some of them are mentioned below.

- Implement a social tariff applicable for a social range of consumption (including a life-line free minimum amount)
- Use of public stand pipes
- Enable social empowerment (in low income areas)
- Encourage payment by social organisations situated at municipality or state level (used in many European countries)
- Use of equipment to limit pressure and water flow

Some actions and procedures to improve collection and reduce outstanding debts

These actions should be based on a better communication to inform and assist the customers and a less permissive policy in terms of payment. .

- Improved collection procedures: better reception at the payment agencies, automatic payment, creation of new agencies, payment at the bank, the post, some shops, etc.
- Motivation to pay: discounts for early payment, penalties for late payment, lotteries, etc....
- Implement a large disconnection campaign for recurring debtors and special monitoring programs.
- Ensure appropriate communication using various types of media, direct communication with the users, etc.

The following related aspects are discussed below:

- Identifying the most appropriate payment and revenue collection procedures
- Reducing outstanding debts
- Special cases

4. Set of corrective actions: (2) Optimizing Payment Procedures

4.1. Definition of payment and collection

A simplified commercial cycle is represented below in Figure 1. The Payment and Collection stages treated by this report refers to the point in time after which the client has received the bill for the services received and the payment is made within the deadline specified on the bill. The stages linked to late payments or debt recoveries refer to late payment.

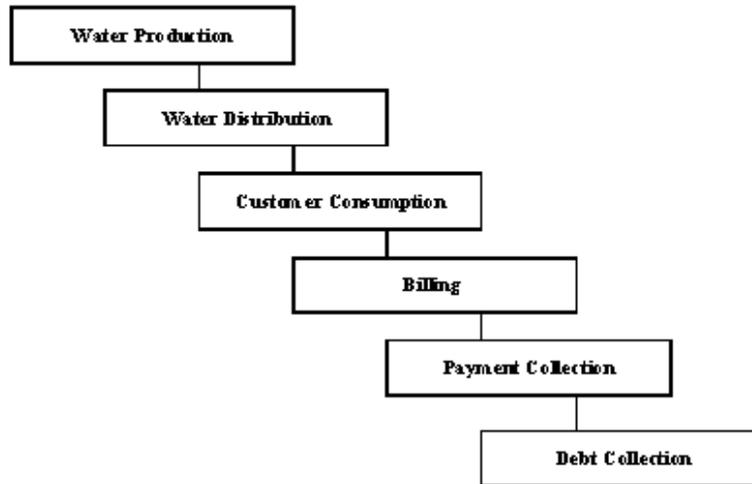


Figure 1 : Payment and collection: simplified commercial cycle

4.2. Payment method

This relates to the means used by the customer to pay the bill, these include the following : Cash, Bank Cheque, Postal Order, Credit Card, Payment Card, Direct Debit, Standing Order, Prepaid Account, Prepaid Meter.

The choice of the most adequate payment method should be based on a multi-criteria analysis:

- **Category of customers:** for each category of customers - domestic, commercial, industrial, administrations, state institutions – the Utility and the Banks needs to find the methods and means of payment that is considered the most adapted to his situation and needs.
- **Cultural characteristics:** in each country, there is a balance between the different systems of payments that guide their evolution and the possibilities of substitution of one method by another.
- **Socio-economic characteristics:** In developing countries and in areas where the customers do not have access to banking facilities, or are unable save money, the payment of services and products is undertaken with cash.
- **Security of the payment and risk analysis** including: technical environment, human errors and frauds
- **Cost of the payment:** It is recommended to analyse what are the direct and indirect costs for both the customer and the Utility
- **Technological evolutions:** The evolution of the payment methods used by the different utilities is dependent on the evolution of the banking system itself: Internet based payment (account based e-payment and other s-mail/online payments) and Mobile phone based payment (telephone banking service, access channel, reverse charging/ex-post billing, premium rate services and pre-paid airtime)
- **Prepaid Meter**
The principle is that the service is paid before being consumed. In the past, this has been carried out by placing coins in the meter. This system of course required someone to pass and empty the meter to collect the revenue. There are security risks.

The modern versions work via a kind of electronic key that is charged at collection points (Utility's office, shops, post-offices etc.). The customer decides how much the amount that he is able to pay and the volume of water that he will require. This system may be used for public fountains (standpipes, hydrants) or individual supplies.

Security: The risks for the Utility are limited as this type of service is usually paid for in cash by the customer. Possibility of deliberate or accidental destruction needs to be considered in some specific context.

Cost: The maintenance of such systems would appear costly, and may breakdown from wear and tear.

5. Set of corrective actions: (3) Optimizing Collection Method

5.1. Collection methods

Either the money may be collected by the utility itself using different vendors or by a third party to whom the utility has delegated this activity.

The collection vendors used by a utility could include the following:

- Agency (main office, branch or mobile office, meter reader and payment collector)
- Passive (bank service)
- Remote (phone, internet, mail, payment terminals)

The third parties often used by the Utilities as collection points may be separated into two groups and include:

- Traditional or Specialized Financial institutions (banks, post offices, specialized service companies)
- Commercial Institution (supermarkets, pharmacies, petrol station, lotteries, etc.)

5.2. In-House Collection

Main Office / Branch / Mobile Office

To pay a bill the customer is obliged to travel to the offices, local branch or mobile office. In order to increase the availability for this point of contact the access must be as large as possible in terms of localization, possible means of transport to these offices, opening hours and days, speed and ease of service.

The solution presents a number of inconveniencies that are multiplied when dealing with large cities where the constraints of transport become increasingly difficult. The number of staff and therefore the cost incurred by this solution have notably pushed various utilities to consider the remote or automatic methods of payment collection.

It should also be noted that security is an issue due to the presence and transfer of large amounts of cash.

Meter Reader / Payment Collector

This service is proposed in a number of water utilities in developing countries where the socio-economic level or banking facilities are not as advanced as they could be.

Some water utilities propose to domestic and commercial customers that utility staff (or third party), who may also read the meter, collect the amount due. The customer is therefore not obliged to travel to the utility's offices. This solution, though costly for the utility, remains popular among the customers for its convenience.

Remote Collection

The customer pays his bill without travelling to the offices or having contact with the utility staff: telephone, internet or e-payment, payment terminals, post and others.

5.3. Outsourcing - Service Partners

The Banks, Post Offices and other service providers are increasingly offering their services for payment collection using their network of high street branches and automatic cash terminals.

A water utility can decide whether they will use these services depending on following factors:

- Commercial advantage that this solution provides the utility. In other words, will this solution work towards collecting payment quicker at a competitive cost and reducing the number of customers that are treated in the debt recovery procedures
- Cost of the solution compared with the other solutions.
- Image, will the level of service provided or the technological level of the solution reflect positively on the utility.
- Overall advantages of the solution, the reduction of financial or security risks, the facility of the solution (data transfer) or the coherence with the overall strategy of the utility.

Cost: The cost will depend on the services offered both to the customer, either in terms of payment or operations on the customer's account with the utility and with respect to the services offered to the utility (transfer of funds, online direct payment information etc.). The remuneration of the service provider may be determined using a fixed rate, payment per bill or a combination of both.

5.4. The advantages and disadvantages of each of these payment and collection facilities.

The advantages and disadvantages of the various payment and collection methods for both the Customers and the Utility needs to be reviewed and tailored to the local background before promoting a new revenue collection policy.

Impact that the Choice of Payment and Collection Method has on the Utility Operation

For a number of departments in the water utility the effect of the operation or the change of the payment and collection policy may have important effects on the way they are organized or operate. For example, it has been noted that a campaign operated by a utility to increase direct debit payments for domestic customers, will increase the incoming calls on the call centre. Should global or widespread problems arise with the billing process, the payment process will be impacted, and the customer services department will suffer a temporary work overload

Customer Management Service

The organization of the customer management services department will of course depend on the payment and collection methods used. Certain methods that are labour intensive such as collection in the customers' homes, in agencies etc. will require a large number of staff to be trained and present. The competence and the attitude of the staff will have an impact on the customers' perception of the utility. The staff will equally be dispersed among the different agencies or branch offices. It should be noted that in these cases security might be an issue due to the presence / use of cash.

In water utilities where cash payments are no longer accepted, or present an insignificant percentage of the payments received "remote" methods of payment are used. The customer management service is then centralised in one location. In this configuration, all customer contacts (payments, enquiries etc.) are dealt with via a call centre, by post and through third parties such as banks or the post office.

Communication

The communication policy developed by the utility, the nature of the messages and the way the messages are passed, will depend on many criteria relating to the different commercial challenges or operational organization and general environment.

The payment and collection methods prove to be important criteria as the moment of payment is very often the only contact that the customer will have with the utility.

Should the customers of a utility pay their bills in the utility's offices or branch agencies then a communication campaign will have a greater effect if it is orientated around the branches. Where "meter reader / payment collectors" are used, they represent a possible and often an efficient vendor for passing information and convincing the customer of the message being passed. Training of the personnel is obviously a key point here.

Conversely, in operations where all the payment methods are remote e.g. direct debit, post or call centre; the utility will be obliged to produce high quality concise paper-based communication, or use radio or television and to make the most of any contacts with the customer. These contacts may be at the initiative of the customer (change of address, billing details or method), or the utility through information campaigns via the call centre personnel to pass on a message or "push" a method of payment that may be more economic.

Financial / Accounting department

The choice of billing dates, payment dates, methods of payment and collection are all important criteria when considering the financial position of the utility. The choices of payment dates may well correspond to an optimization of the Utility's cash flow situation, investment needs or other financial obligations.

The payment methods offered or used by the customer, produce a cost that is often difficult to reduce.

6. Set of corrective actions: (4) Reducing Outstanding Debts and Bad Debts

6.1. Water disconnection

Disconnection of the water supply to a customer is an effective ways to get payment from customers who are reluctant to pay, for whatever the reason. The case of the countries were water disconnection is prohibited is considered in Section 7

Water disconnection is not the best solution and should be considered as a last possible action for the following reasons:

- It alienates the customer
- It provides a motivation for the customer to be use water illegally (illegal reconnection, by-pass etc.)

When the disconnection cannot be avoided, the following actions are essential:

- A warning notice should have been issued
- Installation of a device that will make the illegal reconnection as difficult as possible and easy to detect.

Follow-up actions:

- Specific follow-up contact with the disconnected customers should be made by the water utility.

6.1. Recuperation of arrears and bad debts

Developed countries

In developed water utilities, a juridical department is usually in charge of the continuous follow-up of bad debts. There are generally clear procedures on pre-legal and legal actions.

Developing countries

It happens that special operations are planned to reduce arrears and bad debts. It may be implemented by the water utility or within the frame of a technical assistance.

Such operations consist of following components: communication campaign, implementation of motivating actions, debt negotiation and write off operations, extensive disconnection campaigns, possible amnesty and juridical actions.

These operations have generally satisfactory results but the results are not sustainable sometimes without the reorganisation of the water utility.

7. Countries where water disconnection for non-payment is not allowed

In some countries especially in Europe, water disconnections are not allowed, generally for social reasons.

In most countries, the rate of disconnection is lower than 0.5% of the number of bills issued. In most cases water utilities and public authorities generally seek a social solution with regard to low-income customers.

Water utilities can undertake water disconnection under different circumstances as detailed below:

- Utilities where disconnection has already been prohibited except in some specific cases; these utilities have had to consider alternative ways to receive payments. The analysis of their procedures can be very helpful for those who will have to face similar problems.
- Utilities where disconnections are authorized as the main method encourages payment but actual disconnections are a very rare procedure. Actions are tailored for each segment (category) of customers. Generally, special procedures exist for those customers who need special social assistance.
- Utilities where disconnections are considered as the only way to encourage payments. This is the case in many developing countries where a large part of the population has low income and have no social assistance. When no effort is made to find solutions for the low-income areas, the utility enters in the vicious circle of “disconnection/illegal reconnection or frauds”. There are only two possible issues: accepting a large level of unauthorized consumption and outstanding debts or looking for specific solutions by category of customers as explained in the former chapter.

In general, the practice of water disconnections has the following general consequences:

- Increase (lasting or temporary) in the number of unpaid bills
- Increase in the outstanding debt.
- Cash flow problems

In order to minimize these problems there are some prerequisites to be considered:

- Knowledge of the cultural background
- Detailed knowledge on the customer population: by category and segment
- Full knowledge of law, by-laws and regulation: often disconnection is not absolutely banned and may be made in some specific cases or for some category of customers

- Full knowledge on the payment procedures (case in which payments are covered or partly covered by land or habitation taxes)
- Knowledge of the social provisions: Are there specific mechanisms under which collectively will pay for low-income families?

A set of specific solutions may be envisaged and experienced, separately or simultaneously.

- Improve the customer segmentation and define a specific policy by segment of customer
- Put into place an appropriate organisation structure in order to collect debt, consistent with the geographical location
- Define debt collection process, both pre-legal and legal processes;
- Communication programs by segment of customers
- Define specific coercion tools or procedures by segment of bad payers
- Full range of pre-legal and legal action
- Redefine “written off” procedures
- Re-define the social function of the Water Utility against poor people

In addition, in more specific cases:

- List of bad payers or specific code based on “payment quality” (in the countries where it is authorized). Make a difference between those who are not willing to pay to those not able to pay.
- Motivation measures for good payers: discount for fast payment for instance, lotteries, etc.
- Free water supply to low income areas as a social contribution from the utility
- Poorer quality of service for bad payers: limitation in flow or pressure
- Pre-payment procedures

The interdiction of water disconnection for non-payment must be considered as a chance for the utility to develop a more customer-oriented policy and to change and improve its commercial policy and procedures.

8. Customer Management System

The Utility Customer Information System (CIS) - also often known as Billing System - is the most important tool for dealing with unpaid bills and dealing with apparent losses. When it is performing well, it is a paramount assistance for the Utility; when it is poor, it may jeopardize the other actions to reduce apparent losses and outstanding debts.

The detailed audit of customer files and meter files has already been emphasized previously as a prerequisite to detect and evaluate various kinds of apparent losses. However, this is possible only when a reliable customer management system is available.

Some CIS cover a very large range of functions; others are used for billing purposes only. Between these extremes, there are many options. The following list shows the various functions that a comprehensive CIS may cover. The reader will easily understand how these functions may be used in the frame of an apparent loss and/or unpaid bills reduction program.

A complete CIS should enable a very accurate management in terms of Commercial Data, Technical Data, Meter Reading, Billing, Revenue Collection, Outstanding Debts, Action Plan, Statistics and key business indicators, parameters. Recommendable IT Links are the following: GIS or GIS/GPS or GIS/AMS, Meter reading (PDA, AMR), Accounting System, Stores Management System and Web / Internet

Following sections summarises how the CIS may be an essential tool for the Utility in order to detect apparent losses and reduce outstanding debts.

(i) Management of technical data

- **Management of the delivery point and type of building**

Comment: in terms of apparent losses, the analysis of the delivery point's database is essential: missing delivery points are responsible for unregistered consumers and consumption and the analysis of the registered delivery points is the base for any action program to detect unregistered consumption.

One of the main objectives of the customer census is to update the customer database but a poor CIS is sometimes responsible for the loss of delivery point and the poor sustainability of the database.

- **Management of metering points**

Comments: automatic location of unmetered delivery points

- **Management of meters**

Comment: the meter database is the base for any meter loss analysis. The relevant action plan will be ineffective if the meter database is not updated and the results of the plan will not be sustainable if there is no effective procedures to keep the database updated. A performing CIS reduce the risks of errors and deterioration of the water meter database.

(ii) Management of commercial data

Commercial data allows management of three main components: (i) the customer (i.e. the subscriber or the user who enjoys the service) (ii) the contract that is signed with the subscriber for providing the service at a meter point and (iii) the special conditions that specify the tariff applicable, the standard bill, the billing batch, the type of use and the address.

- **Customer management**

Comment: the user of the CIS can search for a customer through different criteria: customer code, surname and forename, customer category, customer sensitivity, active, good / slow payer, date of last reminder, guilty of fraud, meter number.

- **Management of contracts**

Comment: The user can search for a contract through different criteria: safety deposit, contract number, subscription date, date of last bill, type of use, flat rate for special case (customer with very low income), standard bill code, delivery point code, meter point code, tariff code. It may be useful to detect customers that are not billed anymore and to understand the reason why.

- **Management of addresses and coding**

Comment: All these CIS functions help to reduce the deterioration of the customer database and the relevant creation of apparent losses.

(iii) Meter reading and billing

- **Meter reading**

The meter reading subsystem includes all the functions necessary for the monitoring of the meter-reading batch:

- organisation of meter reading routes (standard round by default)
- allocation of routes
- printing of the meter reading batch
- recording of indices (batch or individual mode)
- monitoring (which can be parametered) of recorded indices and printing of lists of anomalies
- estimate of consumptions
- initialisation of interventions or business in case of technical anomalies
- printing of follow-up meter reading statement

- **Meter reading route**
- **Historical report of indices**
- **Periodical and Non-periodical billing**
- **Management of billing rules and prices**

Comments: the procedures described above reduce the risk of apparent losses due to accounting errors such as lack of consideration of positive or negative water consumption registered by manual billings or non-periodical billing when a meter is changed for instance.

(iv) Action Planning

- **Management of business**

A business is the application of an action plan for a given situation. The system automatically triggers a business from the action plan chosen by the user.

Comment: the business management module enables an accurate follow-up and monitoring of the commercial component of an action plan to reduce apparent water losses. Unfortunately, when the Billing System does not have such a module, it frequently occurs that the results of the actions carried out in the field are not reflected by the billing module. Relevant improvements are delayed or sometimes they never happen.

- **Management of interventions**

The interventions, which can be monitored by the system, are the following: disconnection of supply, reconnection, and water meter removal, change of meter, meter installation, and visit.

Comment: The management business module allows avoiding following apparent losses due to a poor GIS: e.g. (i) Water consumption at the moment of meter replacement is not charged, (ii) Newly connected consumers are not billed during several months until they are taken into consideration by the billing module (iii) New connections are not registered..

(v) Revenue Collection and Outstanding Debts

- **Management of the customer account**
- **Cash**
- **Management of payment schedules**
- **Management of reminders**
- **Management of disconnections**
- **Accounting extraction**

Comments: The procedures mentioned above enable an adequate policy to reduce the delay for payment and a proper disconnection policy. The monitoring of the disconnected consumers is very important: illegally reconnected and unbilled consumers is a huge source of apparent loss for many Utility (especially when laxity prevails to that respect)

(vi) Security

- **Management of access rights**

The user can access to the system by entering his or her connection code and password.

Comments: Internal misuse of authority has also been identified as a huge source of apparent losses by some water utilities. No need to fraud in the field or to install a bypass on your meter: it is simpler to ask someone to cancel your connection in the customer database: you will receive no bills anymore. To avoid this kind of fraud, the GIS can identify under which password any each operation on the database has been carried out.

9. GIS/GPS

The GIS/AMS system provides a modern and elaborate database with spatial information on all assets including house connections, delivery points and water meters. When the CIS is linked to GIS/AMS it enables to locate a customer in the field and to get information quickly. This improves operational speed and makes available additional resources to increase performance and viability. There is still more accuracy when the delivery points are mapped by GPS coordinates.

Comments: The link between CIS and GPS enables calculation of water consumption in a predefined area. It is then possible to calculate the water loss by DMA, including both real and apparent losses, on a certain period of time.

As far as apparent losses are concerned, it is possible to easily locate large water meters, defective water meters, suspected water meters and customers "at risk" on a map and organise relevant field inspections.

The GIS approach enables premises with no registered connection to be located on a map and organisation of relevant field monitoring survey.

Finally, the GSM system linked with GIS enables easy location of customers' water meters in rural areas where there is no reliable address system.

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