

# **20 YEARS WORTH OF EXPERIENCE IN USING GIS IN NORWEGIAN UTILITIES – LEADING TO SUBSTANTIAL IMPROVEMENTS IN OPERATIONS, MAINTENANCE AND PUBLIC INFORMATION**

Paper id #030

## **Background**

The total water and wastewater infrastructure in Norway has an estimated value of 433 billion NOK (64 billion USD). Most of the pipelines have been laid during the last 60-70 years, parts of the system are (very much) older, but the majority dates from the last 40-50 years. Currently, the annual cost for operation and maintenance is approximately 7 billion NOK (1 billion USD).

Though the technical infrastructure is rather young, a marked deterioration in the pipeline system can be observed. Annual renewal and maintenance is not sufficient to halt this negative trend, and this is a major challenge. To counter this, information is needed about the system, its history and its users, as well as the appropriate tools to analyze the information.

## **Utility Management in Norway - History**

In the early 1980's Norwegian public utilities started using databases and GIS technology to support their everyday operations. During these 20+ years a number of lessons have been learned:

- Which parameters are **required** for planning, operation and maintenance
- Which parameters are **adequate** for planning, operation and maintenance
- How to use this information
- How GIS technology can increase the value of this information
- How to implement a suitable system in an organization

Today more than 90% of the Norwegian water and wastewater networks are documented and maintained using a common MapObjects based management system. Thus, the information is similarly structured and all municipalities are using the same abbreviation codes. This greatly enhances the possibilities to do research work and share both experience data and key-figures.

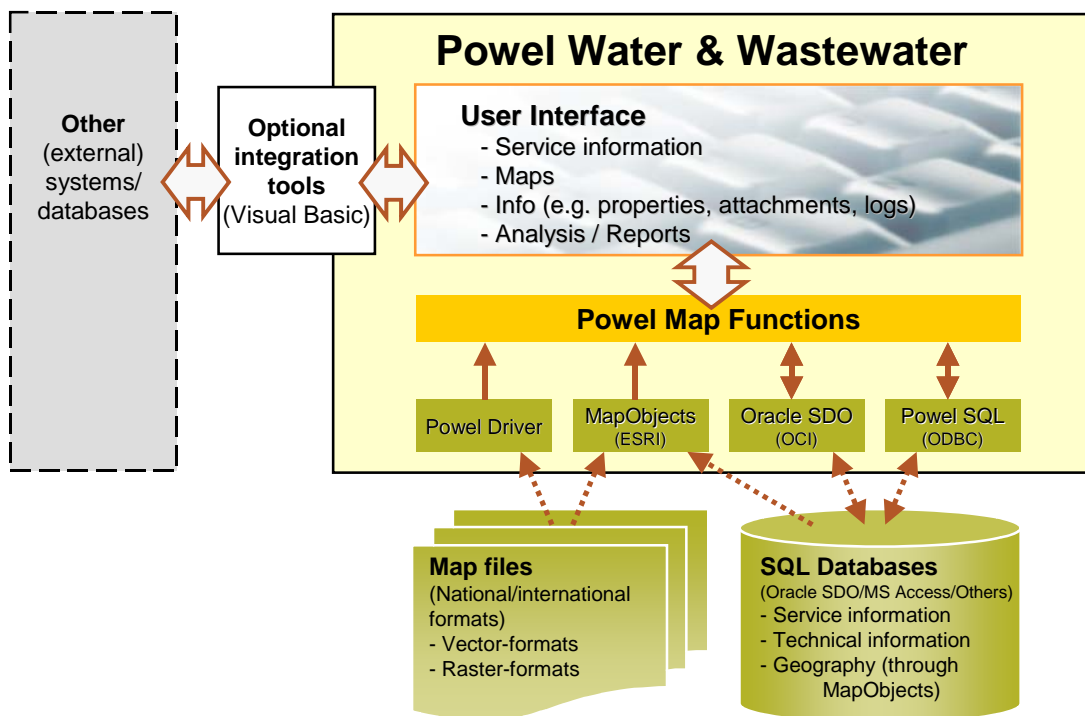
During these years mistakes have been made, lessons learned, and substantial progress has been made. From my point of view Norwegian utilities have succeeded because:

- There has always been a close collaboration between the research institutions, the end users and the commercial industry. A de-facto standard has been established.

- The focus has been on information and information gathering – NOT on computers and systems. It is understood that technology and systems are continuously developed, always with new technology becoming available “tomorrow”. The real problem was lack of information

### Technical solution

The Norwegian solution is a multi-user database application with integrated GIS functionality. All technical information is stored in SQL-databases and the system reads from different SQL-databases, other databases and files in order to use this information together with water and wastewater information. The GIS library MapObjects from ESRI is used to give the system a geospatial user interface.



### Integration with other sources and systems

In the major municipalities this Utility Management System is the default “Desk Top System” of all operatives. This is possible since the system has very strong mechanisms for integration with other data sources and software applications. This enables access to a lot of relevant information related to the water and wastewater network as well as its customers. Normally maps, cadastral information, drawing, documents and various other registers are made available through the system. Recently systems like SCADA and hydraulic calculation have been integrated with the Utility Management System.

All sensors included in a SCADA system can be made available through the utility management system, and different information produced by SCADA may

be displayed on the map at the location of actual sensor. The actual position (e.g. open or closed) of remotely controlled valves can also be shown.

In general these possibilities give the end-users access to relevant information very quickly and easily.

### **Information in focus**

During the first years there was an extreme focus on computers and functionality, but we soon realized that information is the most valuable part of a Utility Management System. The system is designed and developed to handle the basic information about the utilities, and the functionality supports the combination of this information together with almost any other available information in the organization. This may be digital maps, documents, drawings, cadastral information, information from SCADA systems etc.

To establish a Utility Management System we have divided the information into the following categories:

- As built information. The pipeline system is described as accurately as possible. It is more important to describe the hydraulic and technical attributes than the geographic accuracy. (During the first years there was an extreme focus on geographic accuracy)
- Historical information. This category comprises all repair work, maintenance, failures etc. From the as built information and the history we are able to describe the “As is Situation”.
- Service parameters. This category comprises all complaints etc. from consumers or customers. The trend is that this kind of information is becoming more important for priority of repairs and rehabilitation.

In Norway there is a comprehensive and very good cadastre or property information system. All buildings have a unique identification number and a building has one or many addresses and belongs to a property. All buildings, addresses and properties have co-ordinates and all persons in Norway belong to an address. This information is very useful data source for any Utility Management System.

The key factors for success are:

- Only store unique or original information and use software to derive conclusions.
- Store only information you are able to maintain
- Take care of historical information

- Use simple database structures; to build all relations into the database is impossible.
- Extensive use of standardized codes
- Do not try to enter all relevant information into a single system. A lot of adequate information is available through external sources; this must be utilized without converting.

### **Use of information for daily operations**

The major utilities have an updated database and this digital data is the only information source for daily operations. The traditional paper map is history. All engineers and operators have access to the database through the internal network or by use of laptops in the field. Examples of use are:

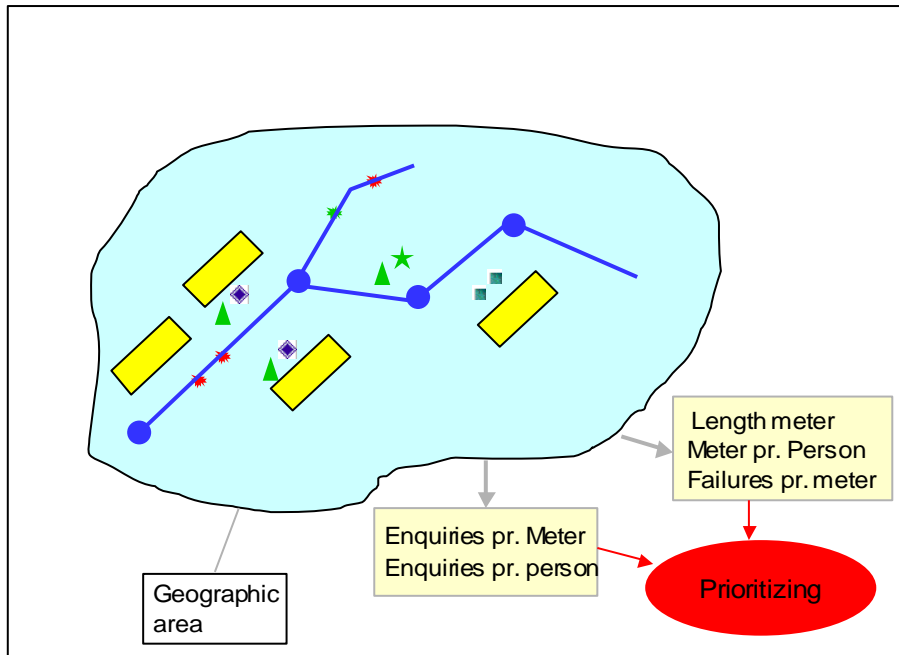
- Production of different thematic maps. There is a wide range of functionality to produce maps where both data from the water and wastewater database and external data are applied.
- Searching for details about a manhole, pipeline etc. Through the system you are able to find all details, drawings, documents or other related information.
- Find geographic locations
- Search for flow-directions, hydraulic connections in network and service lines
- Production of reports and work orders

For many years the utilities struggled to establish a proper database, but today all the required information is available. and both engineers and operators are requesting the information daily. The various users (engineers, service personnel and other operators) need the information every day, and they want it to be correct and updated. In this way, the motivation for updating is no problem. It essential that this kind of database is complete, and that the utility has well-functioning routines for continuous updating.

### **Analyzing information**

In the Utility Management System we find information related to an object (pipeline, valve, address, house etc) and information related only to geography or co-ordinates.

To do analysis and prioritizing we need to combine both kinds of information. To do this, GIS technology is essential. A normal approach is to establish scorecards for different regions or areas.



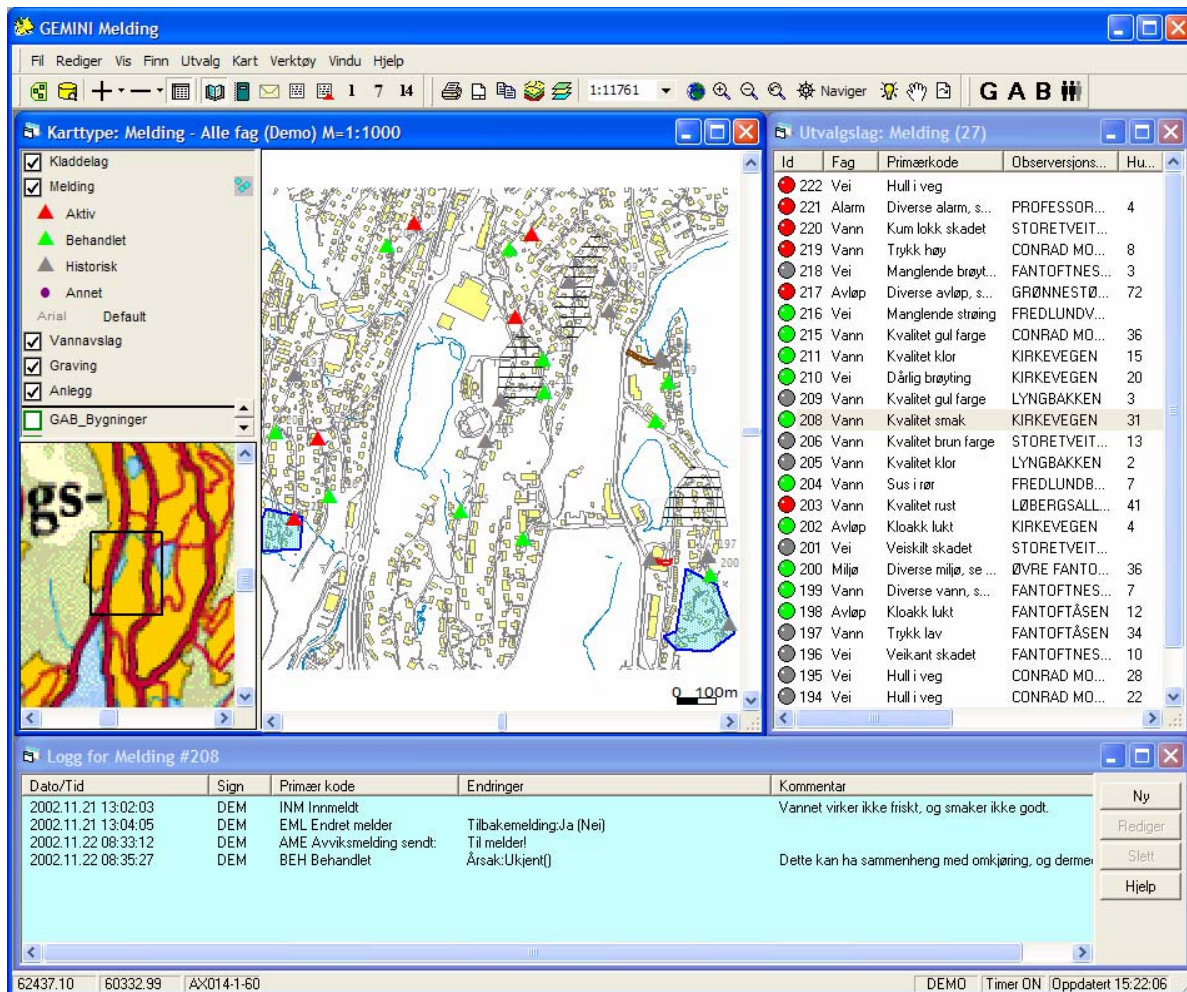
The figure above indicates the possibilities and the work process may be:

1. Draw the geographical boundaries of the area of interest (create a polygon)
2. Summarize the length of pipes (subdivided into different attributes or different pipes) and number of failures, repairs etc within the area
  - a. Calculate number of failures pr. meter
  - b. Calculate number of failures pr. 1000 persons
3. Summarize the number of enquiries or complaints
  - a. Calculate how many complains pr. 1000 persons
  - b. Calculate how many complaints pr. meter pipeline

By calculating key-figures for different attributes within each geographic area, you are able to set up a matrix for prioritizing maintenance / repair work.

### **Call-centre functionality**

A separate system enables those receiving enquiries from customers or the general public to quickly give a qualified answer. The screen may display an overview of all current and scheduled work, as well as all previous complaints or enquiries. Using maps, text and symbols, the display format can be tailored to organizations and user groups, and, depending on your function/role in the organization, you see a screen that supports your working situation.



The main principle is that all enquiries and events are linked to a map reference as a report. The map reference may be an address, a place or an object (e.g. a hydrant, lamppost or manhole). A log is generated for all reports, describing all the conditions that may be relevant to the current case, as well as other factors that are significant when several people are processing one case.

The report log provides documentation on what activities have been carried out. Over a period of time, the system also develops into a knowledge bank, which can be used when planning future work.

If, for example, the water is to be cut off in a particular area, you can draw the boundaries for that area on the screen and obtain a current address list of all parties effected (provided you have established a link to a population register/customer database). You can export this to external systems to organize automatic telephone alerts with pre-recorded messages.

All enquiries are registered in the database and the system forwards all the information to specialists and anyone with customer contact. The system

evolves into a knowledge bank, useful for planning future work. Problem areas can easily be identified and it is easier to prioritize the work that has to be implemented.

### **Experience from implementation in utilities**

To succeed, the Utility Management System must be an integrated system in the organization. We find the most successful implementations in utilities where priority is given to training, and most importantly: updating and maintaining information is performed as a part of the daily work – not as an activity or project outside the organization.

### **Conclusions**

Our main conclusions after 25 years of activity are:

- Focus must be on the information and not the technology
- Hydraulic information and crucial attributes are more important than geographic accuracy
- Maintain and update information as part of daily operations
- Think integration and utilizing relevant information available in the organization. The Utility Management System must not be an over-all system, but a part of a solution
- Establish simple database structures
- Thorough analysis is totally dependant on strong GIS functionality