

Finding leakages or predicting the weakest pipes?

European countries face substantial non-revenue-water (NRW) ratios of up to even more than 50%. Water scarcity is an upcoming challenge everywhere, even in countries that considered themselves to be 'wet', like the Netherlands. For uninterrupted supply of drinking water and water for industries, the reduction of NRW is a widely embraced objective. Other drivers to reduce NRW are the ambition to save energy and chemicals in water production, the international benchmark and the general sustainability awareness that spilling drinking water is societally increasingly unacceptable.

Replacing pipes with the highest risk

This paper describes an additional approach to reduce the NRW-ratio. Spatial Insight wants to support drinking water utilities in identifying and replacing the pipes that are likely to become tomorrow's leakages. By applying different mathematical methods on historic failure data and asset data, the groups of pipes with the highest risk of not contributing to the performance of the network can be identified. Proactive replacement of these groups of pipes will be the optimal and accountable way to reduce non-revenue-water with the available CAPEX budget.

Data driven asset management

Data driven asset management aims to facilitate optimal and accountable decision making in pipe replacement. Experiences in The Netherlands indicate that utilities that embrace data driven asset management manage to increase the performance of their networks and have a more efficient pipe rehabilitation process than before.

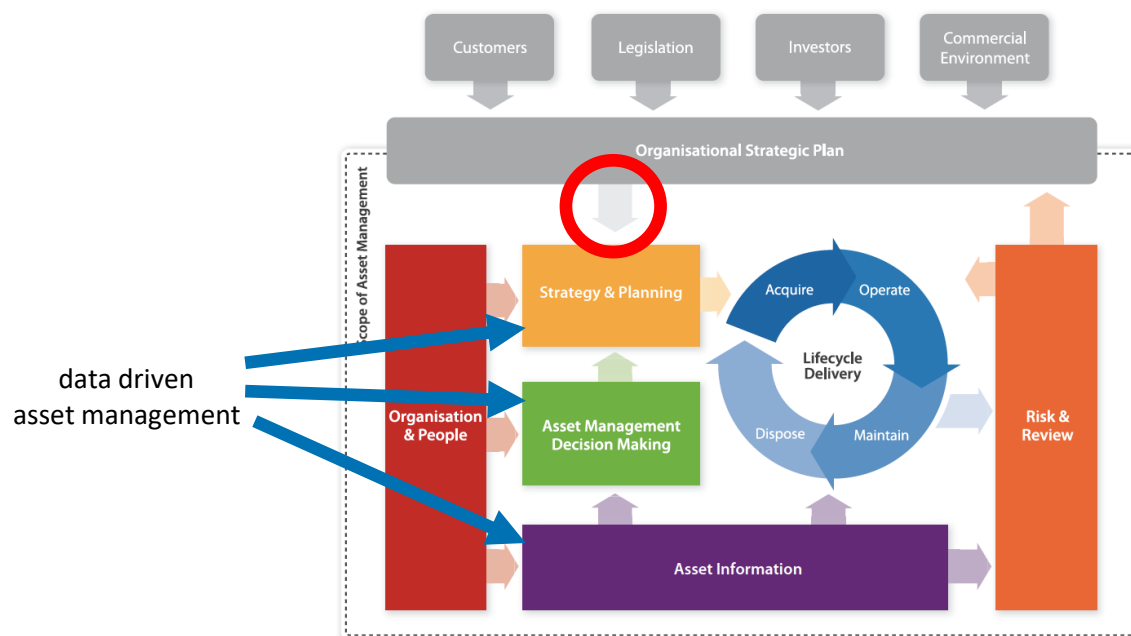


Figure 1. Data driven asset management taps into the international ISO55001 framework.

Asset management is more than pipe replacement, more than inspecting, more than financials, and more than data. Asset management is a company-wide philosophy that intends to optimize the output or performance of the assets that an organisation manages, in this case a water distribution network.

Typically, the objective of a drinking water distribution network is delivering water with sufficient quality and pressure to clients at any time, at minimal OPEX and CAPEX. From maintenance crew up to board level, from engineers to financials, from data to spades, an integral approach is required to get to the optimal results.

The data driven asset management approach that Spatial Insight proposes is contributing to 'strategy & planning', 'asset management decision making' and 'asset information', as defined within the international ISO 55001 standard, see Figure 1.

Asset management maturity

Data driven asset management aims to enable utilities to the actions needed for optimal performance of the network. The following asset management maturity model is proposed to define a logical step-by-step approach to get there.

1. Knowing what your assets are
2. Knowing what happens in the network
3. Knowing how the network performs
4. Understanding how the network will perform
5. Taking the exact actions required for optimal performance

Typically, utilities know where the pipes in the network are, and most often store that data in a database. The database often contain information about the geometry of the pipes, the diameter, length, material, and year of construction. When you know what your assets are, the next step is understanding what is happening in the network. Measurements give insight in flows, pressures and water quality at specific points, but also in the condition of a pipe. Hydraulic modelling allows understanding the flows and pressures in the complete network. The performance of the network can be defined in terms of number of leakages, non-revenue water, customer minutes lost, etc. When a baseline has been set and the performance mechanisms are understood, modelling can be done to predict the performance of the network in different scenarios. For example, one can calculate the number of leakages for different annual pipe replacement ratios. Finally, when the future performance can be calculated, the exact actions can be taken to get to the desired level of performance of the network. An action may be the replacement of a group of pipes, or the decrease of annual investment in the network, etc.

Lego bricks

The data driven asset management approach proposed by Spatial Insight has been set-up as building blocks, see Figure 2. The basis of the calculation is integrated and standardized data, including asset data, failure data, and possibly other (open) data from the environment of the network, eg. settling or traffic data, data about vulnerable or critical clients or data about other critical infrastructure. Lacking structured or integrated data does not mean modelling is useless. We believe that by starting modelling, even with incomplete data, the motivation to invest in more and/or better data will naturally increase: a business case starts to grow organically.

Modelling starts by applying SI-Regression, the method to find the relation between age and failure frequency for each pipe material. Knowing the most likely chance of failure of each individual pipe is essential, though not sufficient for optimal decisions.

Pipes of the same material same diameter and same age may leak much more frequent in one location compared to another. This may be because of a bad contractor, bad production batch, local soil conditions, etc. SI-Cluster is the algorithm that groups pipes with similar characteristics, thus taking local unknown factors of failure into account. By clustering pipes with a comparable contribution to not realizing the asset management objective, bigger size projects are defined, allowing spreading mobilisation costs of pipe replacement over a bigger length of replaced pipes.

Now it's time to take the effect of failure into account. SI-Rehab is a risk model that multiplies the chance and risk of failure. Domain knowledge is a crucial part of weighing the different aspects in chances and effects: drowning a hospital will be worse than flooding a meadow, but is flushing away a rail track not even worse? SI-Rehab has been designed for the Dutch context and situations and can be tailored to local conditions by a local consultant and the experts from the client.

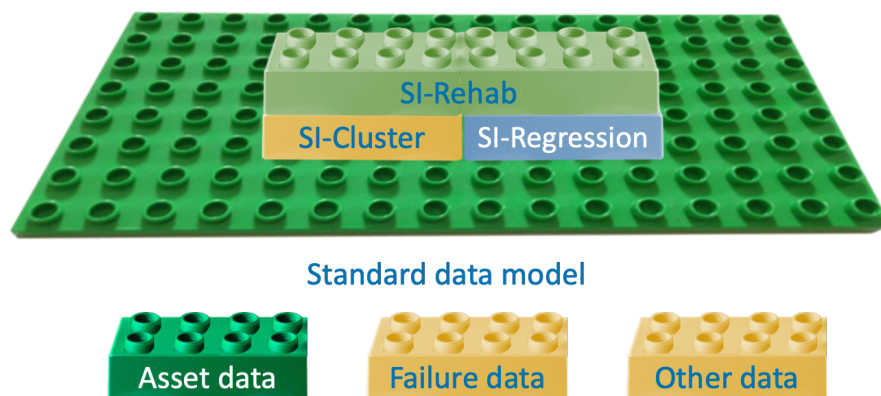


Figure 2. Building up data driven asset management.

Finally, BestNet is the tool that four Dutch drinking water utilities apply to combine different pipe rehabilitation scenarios, compare the impact of different pipe replacement scenarios, and create the portfolio of pipes that need to be replaced.

Conclusion

Data driven asset management changes utilities from fire fighters into traffic controllers. Spatial Insight has developed a methodology that focuses on the prevention of leakages, rather than identifying and fixing existing leakages. Utilities are invited to join forces and deep dive into data driven asset management for optimal and accountable decisions.