CHALLENGE 1: Leveraging existing data for leak detection and leak localisation

1. Aim

The specific aim is to make optimum use of all kinds of existing data sources, which are currently seeing insufficient use, in order to detect hidden leaks in the drinking water network and to determine the location of the leak as quickly and accurately as possible.

2. Current approach and limitations

Leak detection

In Flanders, we use the classical division into recording areas (DMA = District Metered Areas) using flow rate meters that allow for the drinking water supplied to be monitored accurately per area. Intelligent algorithms are already being implemented to monitor these areas for any calamities. Where the analysis indicates that a calamity is occurring in an area, a leak detection team should be dispatched to the site to trace the leak. Acoustic detection techniques are mainly used for this.

Limitations of the approach are:

- Reliability: can the increased consumption within an area be put down to a leak or to a different cause? Our data on the water consumption of household customers, industrial customers, the fire brigade, network flushing, etc. (although this is expected to improve with the roll-out of the digital water meter) remains non-existent, or at most limited.
- Accuracy:
    - the information on the size of the leak(s) is only on the extent and dependent upon the water consumption dynamics in the area. The larger the average fluctuation in water consumption throughout the day, the less sensitive the current software is. A calamity, then, will only be picked up when it is sufficiently large.
    - In order to trace smaller leaks, the present strategy is to create far smaller recording areas. This requires capital-intensive investments. That is beyond the scope of this challenge.
- Time: It remains necessary to go and trace the calamity in the area. In the case of a large area, this will still take much time with techniques that also have limits as to accuracy.
- Limited input: the data sources currently in use are limited to the inflow and outflow rates, sometimes accompanied by pressure measurements.

Leak localisation

There is no leak localisation based on existing data: There is only the knowledge that there is a leak somewhere in the recording area. A leak detector will make an assessment of a sub-area (when there is a major leak) based on the network in the GIS and the changes observed in the flow rate data. Next, the sub-area / the entire recording area will be investigated for leaks on-location. Acoustic and non-acoustic techniques will be used here in accordance with the situation.

Limitations of the approach are:

- Time-intensive: it takes days to investigate an entire recording area this way (depending on the size of the area).
- Techniques are limited in range and accuracy. The chance of successful detection is determined in line with the size of the leak, its location, type of material, subsoil, technician's knowledge, etc.

3. Desired solution

The provider will desire the use of available data sources, or make use of these in a creative manner, to offer the drinking water companies the ability to detect and find a leak more quickly. It is for the provider to identify the necessary data sources and to determine their added value. We are looking specifically at data sources beyond flow rate and pressure at the level of a recording area here.
It is not the case that this data source already needs to be available now. What is important here, though, is the economic aspect. Installing further measurement sensors in the drinking water network will of course lead to greater accuracy, but this is a capital-intensive and time-consuming investment, meaning it is not preferred.
An algorithm will need to use a combination of data sources (public/private, data already available / yet to be obtained) to give the end user as much information about the water leak (size, location) as possible. The more accurate it is, the quicker the leak will be found and repaired.

The technicians from the leak detection department will ultimately need to verify the locations. The end result should therefore be a dashboard that is easy to consult and interpret.

4. Specific preconditions

Open to innovative approaches within the legal limits in Belgium.

We are aiming for a communal solution with several drinking water companies. But every drinking water company has its own IT environment and specific setup for data flows. The proposed solution must be capable of platform-independent deployment, or as a component of a data flow by making use of clearly defined APIs.

The standardisation of the data flows is beyond the scope of this challenge. This means that the proposed solution must be able to handle data flows that vary in temporal discretisation, presence of outliers, missing data, etc.

No consumption data at the level of connections will be shared in this challenge. The proposed solution may suggest a suitable data flow for including anonymous consumption data in leak localisation. Nor will any use be made of digital meter data, but the proposed solution may contain this as a future possibility. If this is included, then GDPR regulations and anonymity of any data shared must be taken into account.

An agreement will be concluded for the sharing and use of the data available. The data shared will remain the property of the respective drinking water companies and can only be used for this challenge.

5. **Knowledge and solutions already available on the market**
   Techniques for accelerating the detection and localisation of leaks already exist. We use DMA zoning and algorithms for reporting calamities.
   There are some self-developed algorithms available in Flanders, but there is also an ongoing collaboration with Hydroware and Suez, although this is limited to flow rate analysis. As regards algorithms focusing on flow rates and water pressures, there are a range of global players who can provide these.

   However, it is the next step that the drinking water companies want to focus on, i.e. algorithms that draw upon more varied data sources to localise the leak to the street level, irrespective of the size of the leak. This is not yet possible as of today.

6. **Why do the existing (partial) solutions not fully meet our needs?**
   The existing solutions focus on flow rates (and ad-hoc pressure monitoring). They are not able to monitor small leaks as a calamity, nor can they provide for rapid leak localisation.