

# Improved transparency with digital twins of urban drainage systems

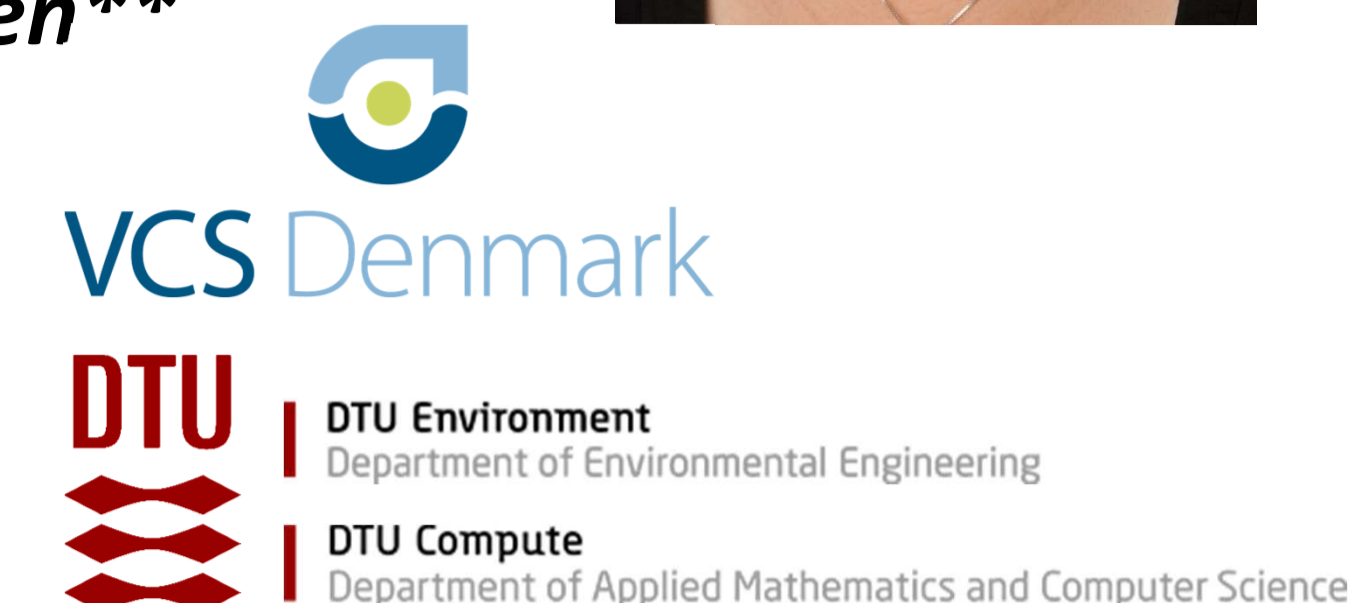


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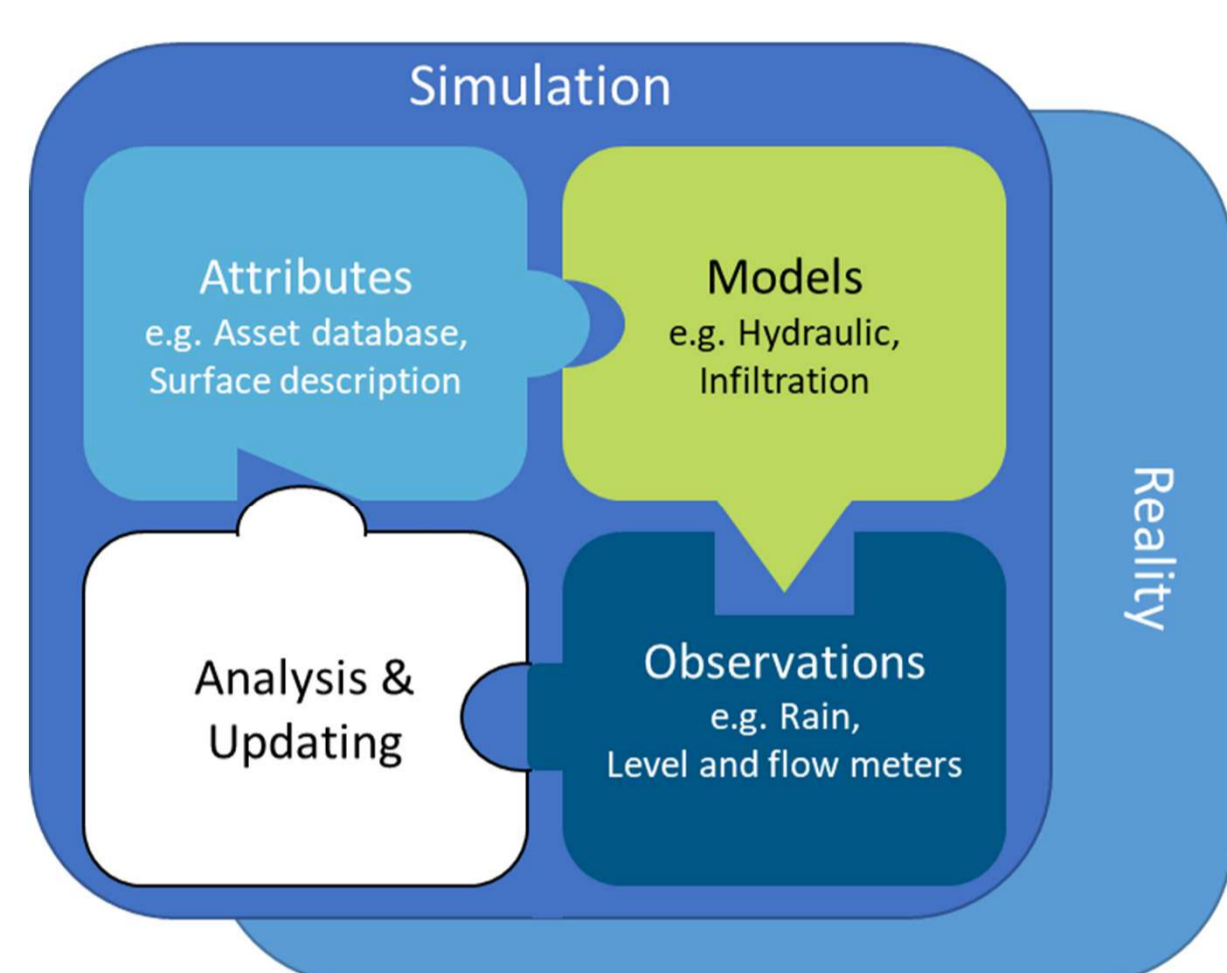
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## Introduction



(Pedersen et al., 2021)

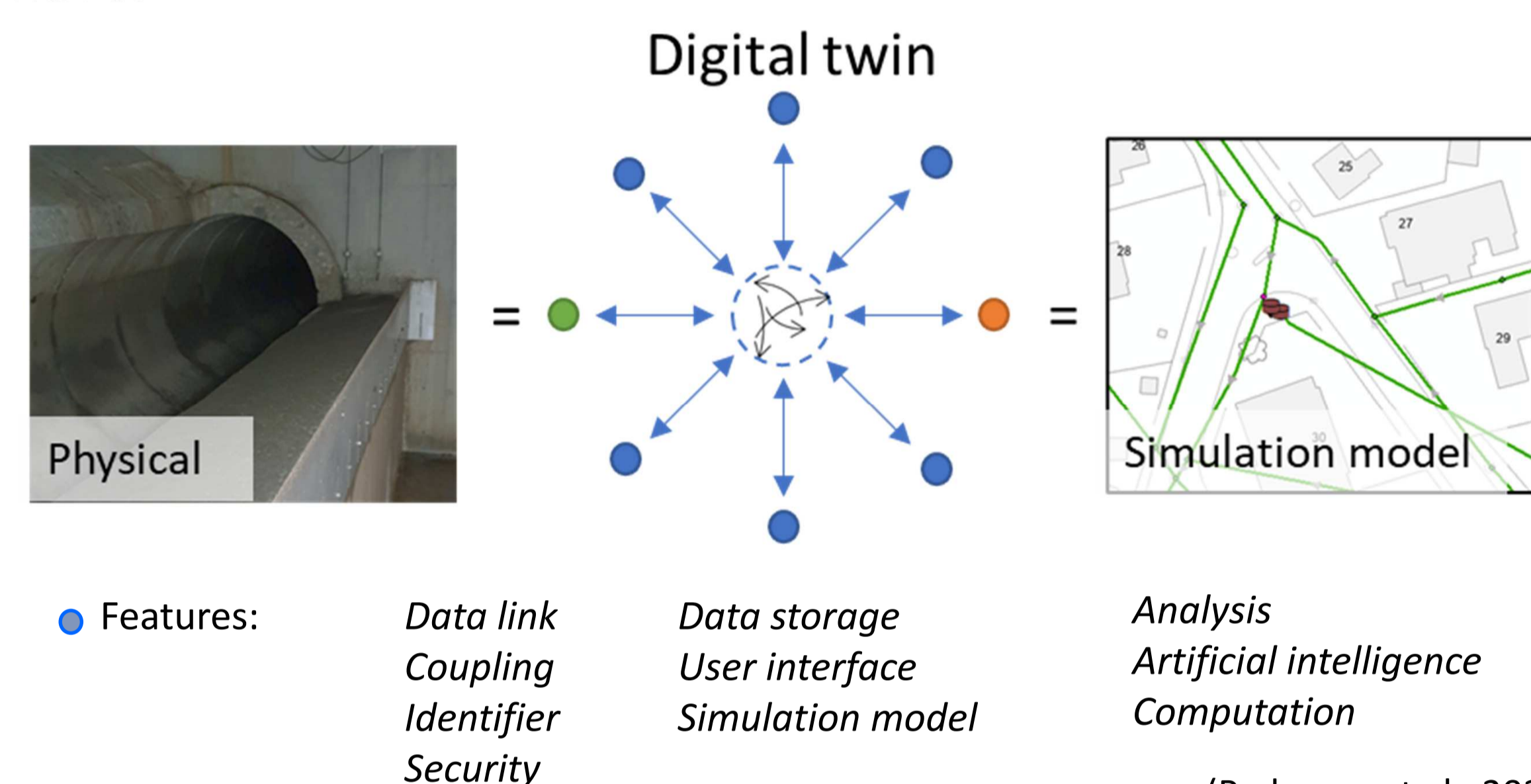
Figure 1: Puzzle of the elements.

For many years, the utility company VCS Denmark has tried to replicate the urban drainage system with models. Although more systematic and structured processes for model updating have been incorporated, reality did not always replicate in the models. The concept of digital twins seems to be assembling the puzzle pieces. With the increasing number of sensors applied in the digital twin, there is a need for a more systematic approach to validation both in terms of handling different models and in diagnosing errors in the current models.

A digital twin consists of different features as illustrated in Figure 2.

## Methodology

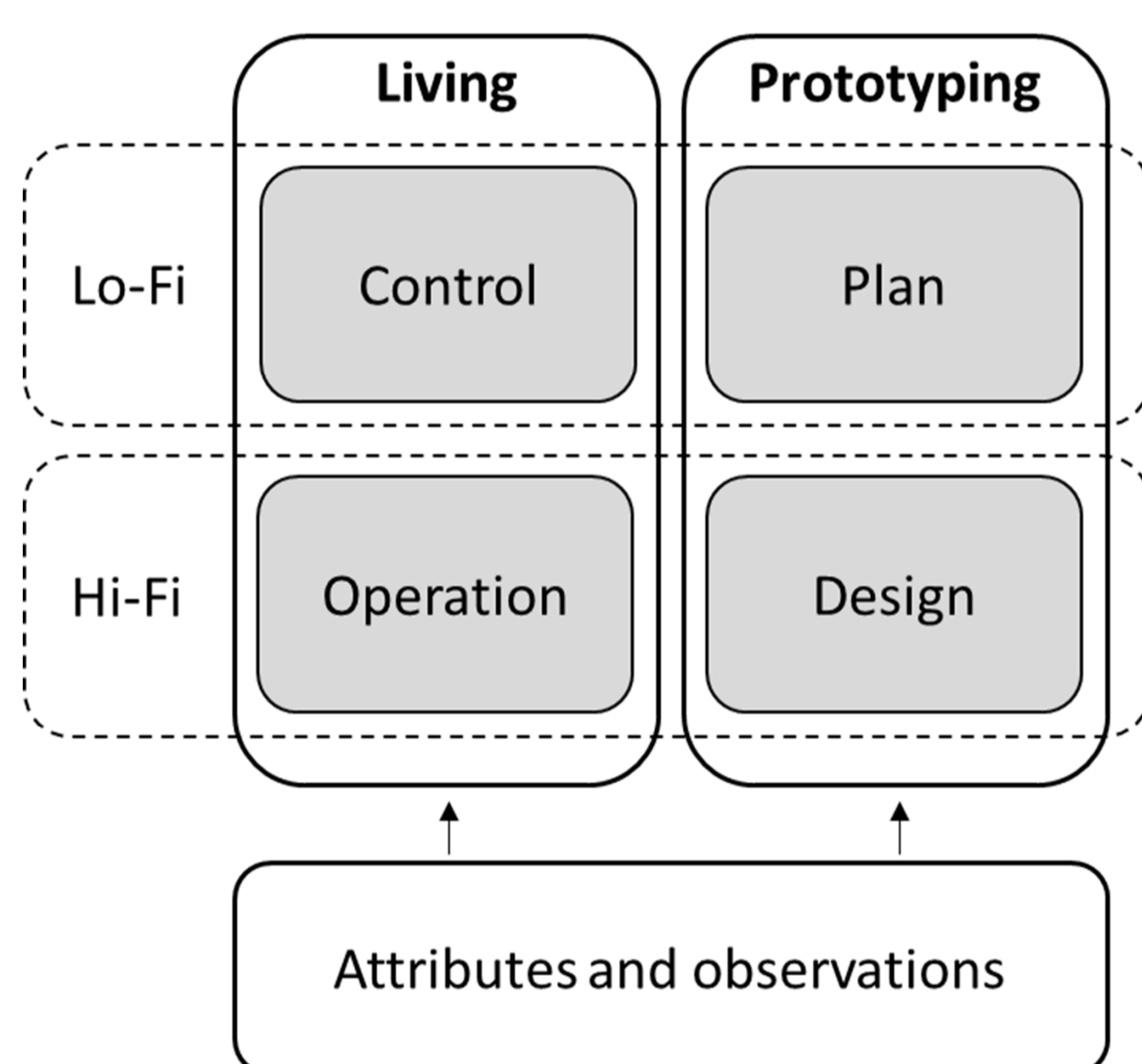
To understand what purposes a digital twin in an urban drainage system should include, personnel of a utility company were interviewed. The responses were used to identify the different characteristics that a digital twin may have.



(Pedersen et al., 2021)

Figure 2: Features of a digital twin.

## Results & Discussion



(Pedersen et al., 2021)

Figure 3: Simulation models in digital twins.

The feature simulation model can be several models to give different characteristics to digital twins as indicated by Figure 3. Depending on the purpose of the digital twin, different types of simulation models can be used. Living digital twins refer to a detailed operation model and more simple control model, and prototyping digital twins refer to design and planning models.

By distinguishing between the different digital twins we are able to accommodate different needs in the utility, as some needs for a digital twin are e.g., predictive maintenance, while others are in better design models.

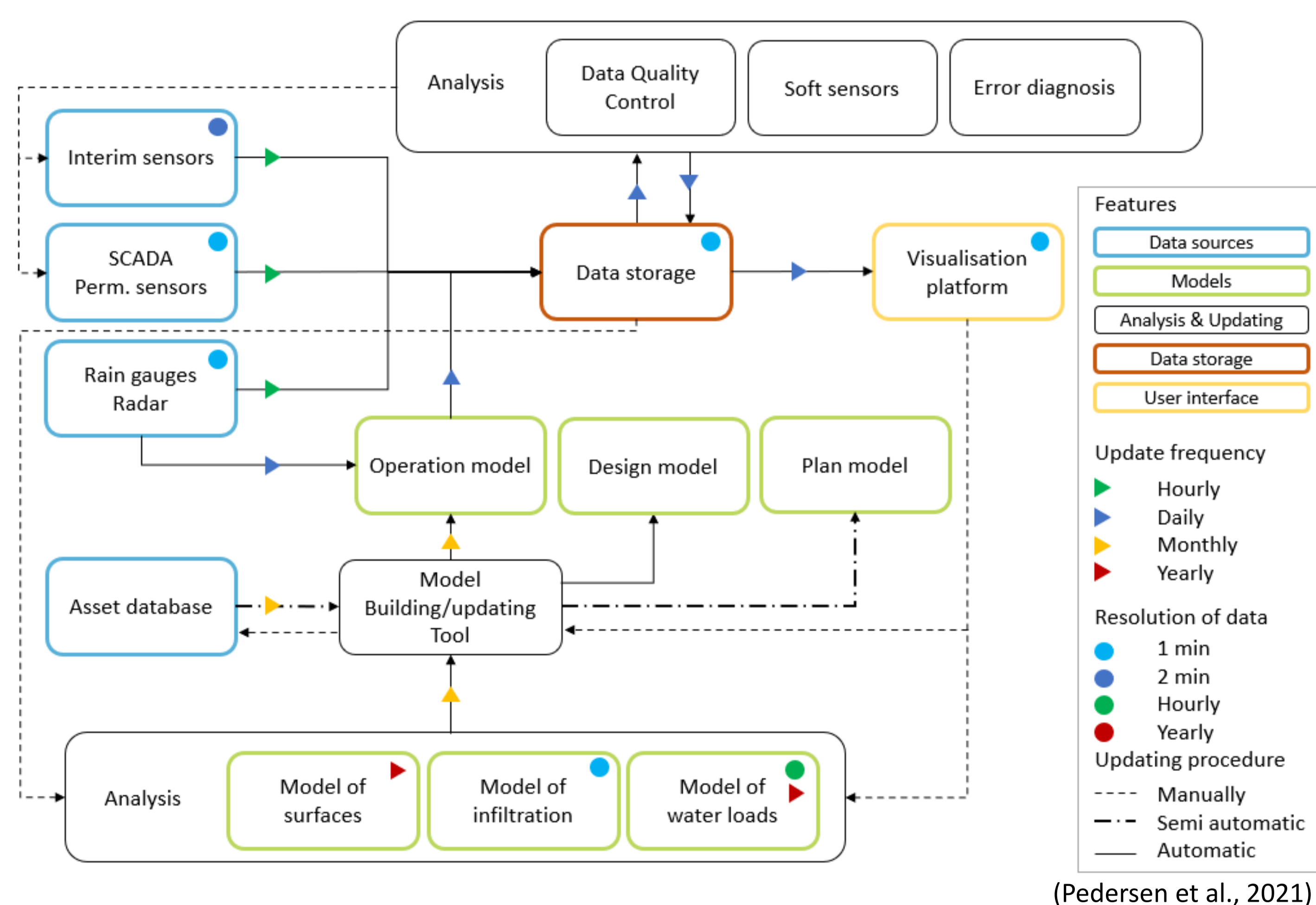
In the utility company VCS Denmark, the workflow has been identified for the digital twin, as seen in Figure 4, where the models are based on and continuously updated from the asset database. Different models, as indicated by Figure 3, can be extracted from the Model Building/Updating tool while currently only the operation model is in the loop for further analysis in the digital twin environment.

Observations and model results are gathered in a data storage, where we can deliver results to a visualization platform, which provides a simple graphical overview of the system and the model's performance related to the error diagnosis tool, which is being developed.

Ongoing work is currently done to improve the error diagnosis and thereby provide tools to automatically and systematically find errors in your model. But also to set up a digital twin environment in a flexible and robust way that can easily incorporate new and innovative digital twin features.

## Conclusions

With the current digital twin setup, we are closer to creating the required transparency for the digital twin and in particular the simulation models behind it. There is still a massive amount of work to be done to gain trust in a digital twin, but the journey has begun. With the concept of digital twins, we gain increased knowledge about our system as well as a structured approach with instant feedback from the digital twin setup.



(Pedersen et al., 2021)

Figure 4: Workflow of the current digital twin (DT) environment in VCS with different features

Pedersen, A. N., Borup, M., Brink-Kjær, A., Christiansen, L. E., & Mikkelsen, P. S. (2021). Living and Prototyping Digital Twins for Urban Water Systems: Towards Multi-Purpose Value Creation Using Models and Sensors. *Water*, 13(5), 592. <https://doi.org/10.3390/w13050592>