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Live Data for Live Models – System Summary

1 Abstract

The Sewer Risk Management website, v1.1 recommends that Sewerage Management Plans have a 25 year time horizon and that the impact of interventions should be monitored post construction. Therefore regular model updates are needed to enable accurate assessment and to identify any changes in risk. There is a step change possible from the current cycle of revisiting a DAP. Increasingly models are also required by external stakeholders for other purposes (SWMPs etc).

Proactive management of assets and issue identification is important to operators. This can be facilitated through the use of live telemetry such as ultrasonic depth monitors and internet linked flow monitors.

The potential next stage would be to link the models and the live data together to provide real time benefits to all parties with an interest in the operation of the network.

2 Introduction

The management of risk and the optimisation of systems is becoming a key part of water companies operational strategy. With the development of monitoring technologies connected remotely it is now possible to view how a system performs in real time. By combining this with other new technologies becoming available it will be possible to use this live data within hydraulic models and update the operational controls and modelling parameters automatically.

3 Data

Hydraulic models have always been very data intensive and were previously limited by the hardware capabilities as to how much detail could be included. Now however by using the latest technologies, for example clustering of simulations on remote server farms means that there are virtually no limits on the complexity of the model that can be constructed.

The availability of real time data and also the installation of permanent monitors in many catchments means that we are now collecting a different type of data that we can use in many more ways. The issue has now become how to manage and use all of the data that is available.

4 Operating in the Cloud

Traditionally models have been constructed locally on a users computer, and possibly backed up on a server. With the advent of widespread internet based computing, known as 'the cloud' it is possible to share, and control what people can see and do with the data. Cloud computing is beginning to enter the industry with StormScape's drainage design software being entirely web based.

By hosting the software in the Cloud, it can be accessed from anywhere without losing any power or functionality of the software. This is because all processing is carried out in the cloud and only the results are transferred to the user. Operational staff would be able to test scenarios from in the field, in order to identify the cause of an issue or to test the impact of a change to the operation of an asset or assets in the network.

5 The Live Modelling System

The system will act as an interface between stakeholders of the sewer system, the data that is collected from the system and the hydraulic models that represent the sewer network to enable real-time management of sewerage catchments and networks.

6 Who will use it and who will benefit from it?

The system could be made available for use by all parties that have an interest in the continued operation and risk management of the sewer network, see Figure 1 below for some examples. By making the sewer network operate more efficiently customers will benefit from better operation of the system and more effective use of investment.

Figure 1 – Potential System Users

Operations Staff: With the live sewer data they will be able to identify service issues much earlier when the live sewer data and the model predictions no longer match for example, due to a blockage or collapse in the system.

With rainfall forecasts simulated through the models flood locations can be predicted and operational regimes altered to free up capacity, or attend the expected flooding or pollution locations.

Stakeholders: These could be both internal or external people and organisations. Scenarios can be run on the models to test a whole range of options for example the models can quickly and easily identify the impact of new developments into the system. An external stakeholder could be a local authority investigating surface water management who is looking for volumes of flow entering their system from the water company surface water systems represented in the model. It will be important that a water company keeps control of the data and has a robust system for managing the liability of data accuracy.

Asset Planners: With a full set of up to date hydraulic models asset planners will be able to assess and compare risk across multiple catchments with greater confidence in the reliability of the models. By having all models available through a single access point it may be possible to run region wide scenarios such as the impact of reducing pump capacity to lower energy costs.

7 How would it work?

A decision support system will act as a host and interface between the user and the hydraulic models. Figure 2 outlines the system interactions. The user journey flows from left to right. Different users will be able to see different information, for example operational staff will see live sewer data whereas external stakeholders may have access limited to the models they have an interest in and may only view selected simulation results.

By using a modular approach to developing the system it is possible to set up specific 'Apps' for different types of user to have access to. By having control of what results and outputs different stakeholders can produce the water company can have greater confidence that their data is correctly used.

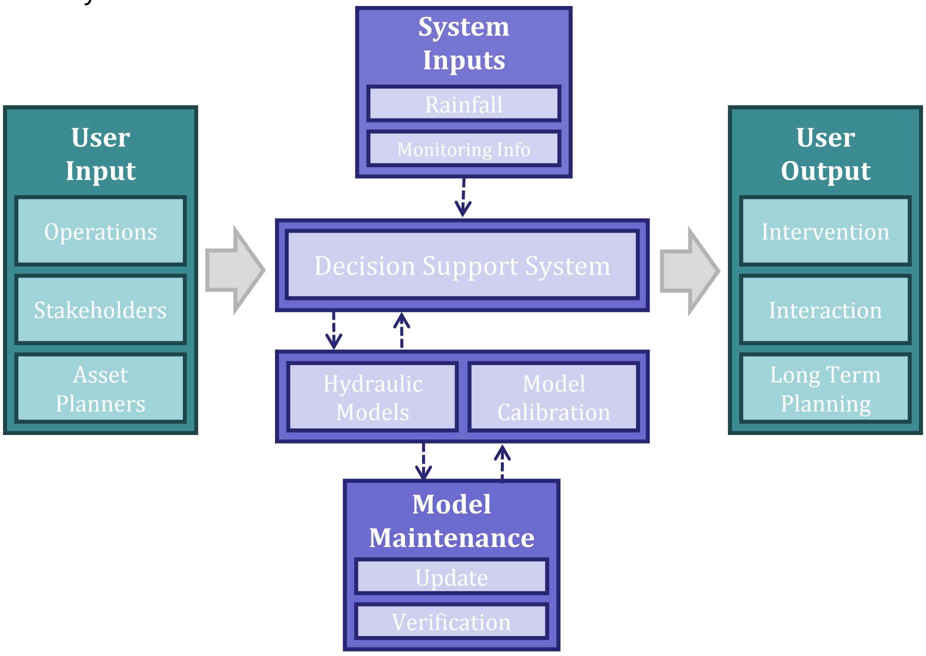

Figure 2 - System Schematic

The technical component of the system is contained in the central column of Figure 2. Live sewer data will be collected from raingauges (and/or radar), permanent flow monitors, ultrasonic depth sensors, pumping station, STW telemetry data or any other 'live' data source that is connected to the system. This will act as the 'observed data' for the models.

The observed data will be fed into the hydraulic models and simulated in real time. Where the model predictions do not fit the defined parameters the results will be assessed. The system for example could be trained using genetic algorithms to predict what the cause of the anomaly is, for example a blockage, a build up of silt or a sensor failure. If the analysis is unsuccessful this could trigger an alert for a manual assessment to be made to determine the cause of the failure.

Weather forecasts can be run through the model to predict the likelihood and location of flooding or pollution incidents. For large catchments this could allow proactive management of the system to free up capacity prior to a storm occurring, for example activating assist pumps to drain down the system, or closing penstocks to direct flows away from the area of concern.

By developing an understanding of how a system responds to specific types of rainfall, for example a long winter storm or a short intense summer storm it should be possible to provide an operational strategy. By having a suite of operational scenarios stored in the cloud and from the rainfall predictions the system could produce a risk matrix of a range of operational options and suggest the most effective response.

8 What are the challenges?

At this stage the system is a concept. Each of the components exist individually, and some have been linked, but not as an overall dynamic system. There are several challenges to be overcome for example linking the incoming data to the model efficiently.

The forecasting of potential incidents needs to be early and sufficiently accurate to allow operations time to proactively respond, they also need to be simulated quickly enough to allow the intervention scenarios to be tested.

The performance of complex models against long term data is currently not well understood, and there is limited confidence in their response to the more extreme events that are rarely captured in short term flow surveys. Until these rare events are captured by the long term monitors it will be difficult to have confidence in making operational decisions that could have a significant impact on the system.

While the system will be making use of features in readily available commercial software, there are challenges in setting up a working party as often software overlaps causing potential conflicts of interest between the potential partners.

9 What are the next steps?

At a practical level the concept needs to be proved by building a simple system linking a hydraulic model to a decision support system and allowing the system and users to run scenarios through the model.

The concept has been discussed with a number of software and related technology companies. There appear to be no showstoppers related to the technical connections, however agreeing a memorandum of understanding regarding the intellectual property rights and the potential commercial overlaps is taking more time.

10 Pilot Study

Thames Water have provided data for a catchment that has had long term monitors installed for several years. The catchment is a large complex London catchment that is influenced mainly by depth of rainfall, rather than intensity.

The initial pilot will aim to run the monitor data through the model and when an operational issue is predicted to run scenarios to minimise the risk.

This pilot is complementary to other initiatives that Thames Water are in the process of carrying out into real time analysis and control of catchments.