QS5 Water Infrastructure Critical Component Anomaly Detection & Health Prediction Prototype

THE OPPORTUNITY

The digital transformation of critical water infrastructure is revolutionising how water is delivered. It has led to improvements in system efficiency, reductions in operating costs, and enabled more reliable and higher system flow rates, and greater flexibility for customers.

For large-scale, gravity-fed irrigation networks, this modernisation of infrastructure relies on 1000s of solar powered instruments and measurement devices to control and monitor flow. However, faults in these components can result in serious operational problems, including failure to deliver water to end users, and unmetered or lost water.

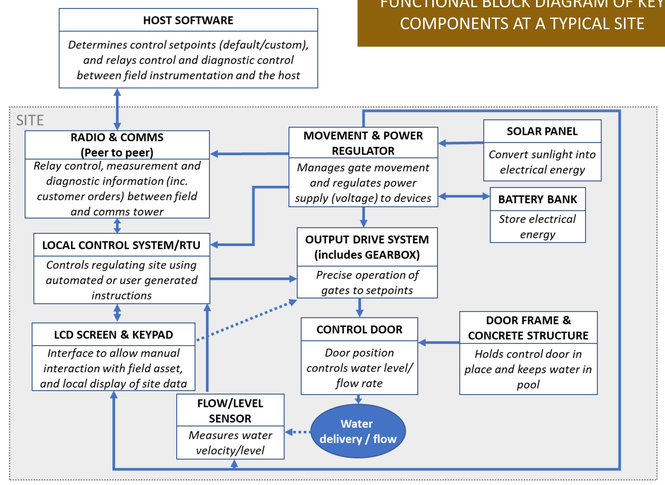
There is an immense amount of real-time data collected from the field devices that could be used to detect possible or imminent faults. This project involves developing prototype tools for early detection of failures of critical infrastructure components.

Making the most of data science involves organisational-wide changes – not just providing new algorithms and software, but also changing the way decisions are made, formalising how predictions are evaluated, and providing infrastructure and procedures to efficiently and safely integrate new data science capabilities into existing IT systems.

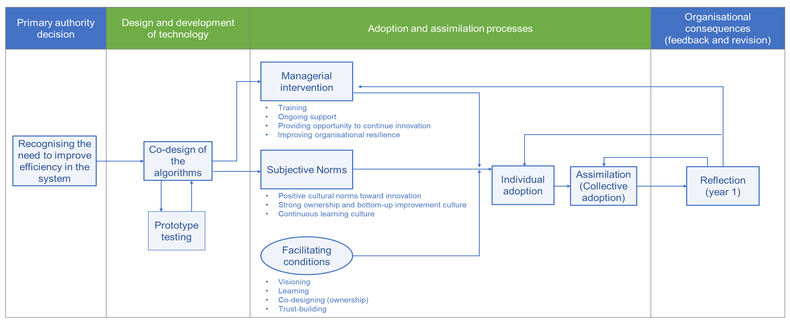
PROJECT SUMMARY

This project aims to support adoption and build capacity for anomaly detection, failure mode analysis, diagnosis, and predictive maintenance tools in order to improve water supply and delivery reliability, reduce maintenance costs, and improve data quality. Prototype tools targeted water level sensors and batteries, while building understanding of how these tools fit within a broader failure mode analysis and what deploying these tools involves in practice.

FUNCTIONAL BLOCK DIAGRAM OF KEY COMPONENTS AT A TYPICAL SITE



THEORETICAL ADOPTION FRAMEWORK



Three main parts of the project:

UNDERSTANDING FAILURES IN CRITICAL COMPONENTS

This involved understanding the problem, including how the main components of a typical site fit together, how failures in some components relate to others, and what data can be used to diagnose and predict failures. This research was centred around failure mode and effects analysis (FMEA), a process used to analyse failures of components in a system and their effects on system operations.

ANALYSIS OF ADOPTION PATHWAYS

Here we sought to understand how the new tools could be operationalised. Taking a broader view of adoption of innovation in organisations, the analysis examined the pathways for integration and utilisation of new technologies, including the adoption requirements and the implications for the workforce.

TRIALLING PROCESSES FOR CO-DESIGNING & OPERATIONALISING NEW PROTOTYPES

The intent of this work is to understand and trial different processes in prototyping and adoption, to understand what is required for the effective development and implementation of new tools. This will help identify the capacities needed to facilitate the transformation into digital agriculture across the MDB in the future.

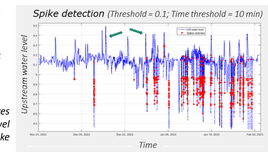
ANOMALY DETECTION PROTOTYPES

Examples of prototypes explored:

Spike detection tool

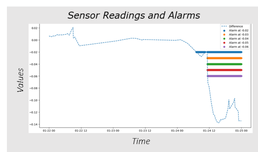
- *Detects significant fluctuations in water levels*

Green arrows = false spikes
Blue dots = U/S water level
Red dots = detected spike



Water level sensor blockage detection tool

- *Detects blockages in water level sensors based on deviations between sensors within the same pool*



Cumulative sum algorithm for batteries

- *Detects anomalies in battery voltage*

OUTCOMES

Prototype tools are being tested on live data within our partner organisations. These trials have demonstrated potential for a new 'tech accelerator' capability, with partnerships, procedures, infrastructure in place to support rapid testing of new data science capabilities, supporting the region's culture of continuous improvement.

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