THE NZ PIPE DATA PORTAL - MAXIMISING THE VALUE OF OUR 3 WATERS DATA

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ABSTRACT

This paper outlines the current state of the NZ Pipe Data Portal being developed as a part of the Quake Centre's Building Innovation Partnership (BIP) programme. In addition, the paper will outline the proposed programme for benchmarking data and large-scale analytics.

BIP is an applied research programme, co-funded by the Quake Centre's Industry Partners and MBIE's Partnership fund. The purpose of the programme is to assist the infrastructure sector in improving coordination and control, quality cost and risk through the increased use of digital engineering. Fundamental to this is standardising and utilising data. To this end, BIP is creating a NZ Pipe Data Portal to realise the value of data from 3 water utilities from around the country. This development is on the back of a proof-of-concept pipe portal developed with the help of Christchurch City Council, Tauranga District Council and Auckland Council Healthy Waters.

The purpose of the Portal is to:

- Provide a larger dataset for councils that normally would have limited data for any asset performance analytics
- Provide an opportunity to benchmark network performance to other peer councils
- Provide a platform for testing and implementing asset data standards
- Provide a platform for mapping councils' data to a national standard
- Provide a benchmarking service for councils to analyse and compare their data quality and coverage
- Federate large data sets that can be analysed to improve the models for characteristics such as
    - The economic lives of pipes
    - Performance of pipes versus ground condition
    - The risk of pipe failure versus condition

The Portal will not be a database in itself, rather it will be a tool for linking with councils' systems and federating large data sets on the fly as required allowing analysis and visualisation of the data.

KEYWORDS

Asset Data Standards, Data Quality, Pipe Portal, Analytics

1   INTRODUCTION

1.1   VALUING DATA

Data are essential to good asset management decision-making and are particularly so for managing assets such as pipes where monitoring of the assets' condition and performance can be expensive, difficult and sometimes not possible. The value of this data is not sometimes recognised and in particular, the value that can be realised when data is managed well and shared appropriately. Fundamental to good data management is the need for data standards that define what data are collected, the metadata that is needed to correctly identify the data and understand its provenance and in what format the data should be stored. This paper describes the place of a National Pipe Data Portal in helping realise the value in NZ's pipe data.

1.2   BUILDING INNOVATION PARTNERSHIP (BIP)

The UC Quake Centre is a dynamic partnership between the New Zealand Government, the Universities of Canterbury and Auckland, and several leading industry groups, all working together in the engineering sector to

provide world-class knowledge, research and solutions for built infrastructure resilience. Through its Building Innovation Partnership (BIP) programme the Centre is working with NZ's 3 Waters sector to develop data-driven, industry-ready answers to pressing infrastructure questions. More information on BIP is available through the website: https://bipnz.org.nz/.

1.3   PURPOSE OF THE BUILDING INNOVATION PARTNERSHIP (BIP)

BIP's purpose is to support transformation in NZ's building industry so that it leads the world in digital design and construction methods, integrated asset management, material and manufacturing technologies and resilient construction systems.

Outcomes include:

- New digital design and construction methods and information-sharing processes that improve design and construction efficiencies
- More resilient and sustainable buildings and horizontal infrastructure
- Digital construction methods used by leading small-medium as well as large building firms
- Commercial exploitation of infrastructure management systems, digital building professional services and new seismically resilient construction products
- Digital consenting and integrated asset management methods used by local government
- Better informed clients and a smarter, more productive and more competitive building industry

Whilst BIP works across both horizontal and vertical infrastructure, the Partnership has one theme delivering an integrated programme of work for 3 Waters. This aims to implement more effective, efficient and equitable processes in investment planning, procurement, design, construction, maintenance, repair and renewal of 3 Waters assets.

2   THE NZ PIPE DATA PORTAL

2.1   PURPOSE OF PIPE DATA PORTAL

The National Pipe Data Portal is a central piece of work in Theme 1 of the BIP programme of work focused on better decision making for 3 Waters asset management. This body of work aims to deliver a number of benefits to the 3 Waters sector and beyond. These include:

- Providing a platform for developing, testing and implementing national data standards
- Developing the process for sharing data for a range of uses including:
    - Standard design templates
    - Standard as-built capture and ingestion
    - Benchmarking data quality
    - Large scale analysis of pipe characteristics
    - Models for useful life of pipes and risk of failure
    - Local, regional and national valuation
- Coordinated planning with other utilities
- Integrating with other datasets to form a National Digital Infrastructure Model (NDIM)

2.2   PROOF OF CONCEPT

A proof of concept pipe data portal was created by students from the Masters of Applied Data Science from the University of Canterbury. The students mapped stormwater pipe data from Auckland Healthy Waters, Christchurch City Council and Tauranga City Council to a single draft national data standard. Data quality checks were applied to the data and reports delivered to the respective councils. These data were then federated into a single view with some basic analyses were applied to the single federated dataset. A range of data manipulation and assessment tools were applied and the data federated using Nextspace's Bruce platform. This exercise proved that both the concept and the technology were fit for purpose.

To move to the next step, BIP has begun to rebuild the pipe portal looking at all underground 3 Waters assets associated with the pipe network, namely pipes, fittings and chambers.

2.3   CURRENT DEVELOPMENTS

A fundamental principle of the pipe data portal is that the data belongs to the asset owners who are the best people to manage their data. Likewise, the best home for the data is in the asset owners' asset management systems. Therefore the purpose of the portal is to provide a view of those data in a suitable format and not to create another, separate database. To this end, the portal needs to create a dynamic link to local authorities' data and map those data to the national standard and create a dynamic federated view. To create this system, a number of activities are underway including:

- A Code of Practice (CoP) has been developed for as-builts for pipe, chamber and fittings with the assistance of a range of local councils, consultants, contractors and manufacturers. The CoP is a machine readable, minimum viable data standard for 3 water pipes chambers and fittings. In the first instance this CoP covers as-built data. Over time it will be expanded to include valuation, O&M, failure analysis, etc. The CoP can be found here: https://bipnz.org.nz/3-waters-asset-data-standards/
- A small team is engaging with a number of councils and mapping their data to the CoP.
- Dynamic links are being created using Web Feature Services (WFS) and the Web Map Services (WMS) feeds from councils' data.
- Automated data quality tools are being integrated into the data workflow.
- The data is being federated and visualised via the Bruce platform
- Access to the federated data is via a secure login.

2.4   DATA QUALITY

The quality of the data is central to the value of the data. A fundamental measure of the data is how well it can be mapped to the CoP. Automated tools are being developed to both dynamically map the data and provide a quality assessment. This quality assessment has a number of uses. These include:

- Providing an opportunity to benchmark data against the CoP and other councils' data
- Informing a council on areas where value can be obtained by improving the data or collecting more data
- Informing a data quality improvement process
- Providing users of the data a confidence measure when analysing or combining the data across a range of uses.

The concept of the data quality tool was based on the Roading Efficiency Group's (REG), that has seen significant data improvements across the transport sector.

2.5   USE CASES

As well as data quality improvement, the use cases for the pipe data portal are varied and these will only become wider as more data is shared and problems and opportunities are identified. Below are some of the initial use cases that BIP is working on.

2.5.1   USEFUL LIFE OF PIPES

Many councils only have a relatively small number of critical pipes which may be of different ages and materials and in quite varied ground conditions. This does not give a large enough sample size provide a statistically significant assessment of the pipes' useful lives. By creating large, national data sets, the pipe portal will allow large scale analytics to narrow down the models for the useful life of the pipe. This will decrease uncertainty and provide a significant improvement in predicting renewals profiles and the associated costs. It will also allow for investigating a wider range of variables that impact on pipe lives.

2.5.2   RISK OF FAILURE

As with the useful life of pipes, large data sets combined with other data such as geotechnical, water table and operations data will allow much better analysis of the risk of failure of any underground pipe asset. This will allow proactive risk management to reduce the number of potential catastrophic failures.

2.5.3   REPORTING

With a standardised dynamic link to a central data viewer, it opens up the opportunity to create automated reporting of performance if this is required. This will open up opportunities for regional and national performance reporting. It is feasible that reports such as the National Performance Review (NPR) could be delivered with significantly less effort and greater accuracy.

2.5.4   COORDINATION AND FORWARD WORKS

The use of standardised data within the portal allows integration with other systems such as a forward works viewer. This a tool in which future planned work can be logged and coordinated with other utilities. It also provides the opportunity to aggregate up individuals into programmes of work with different degrees of certainty. This is then the basis of a 'pipeline of future work' which will allow some contractor certainty and also facilitates reporting to national bodies such a the Infrastructure Commission for their works pipeline.

2.5.5   NATIONAL DIGITAL INFRASTRUCTURE MODEL

The pipe data portal is an essential element in the development of a National Digital Infrastructure Model (NDIM). The NDIM is, in itself a component of a national digital twin. A digital twin is a high-fidelity representation of the real-world that looks like, behaves like and is connected to the real world, to improve understanding for decision making. (Witherden, 2017). A national digital twin is not a single entity. Rather, based on the particular need, it is a way of viewing disparate data sets in a unified manner. This will allow significantly improved planning, management and decision-making of all our infrastructure in a coordinated and effective manner. This will allow us to look at our data in many different ways: geospatially, economically, environmentally, culturally, operationally, etc. (Infrastructure New Zealand, 2020)

The first digital twin use case that is being explored with the portal is one being developed to investigate the impacts of urban flood on a community and its associated infrastructure.

2.5.6   TRACKING DISEASE

The pipe data portal is currently being explored as a vehicle for understanding the geographical spread and community prevalence of pathogens such as Covid-19. By sampling wastewater and tracing the pipe network, it is possible that the extent of any future flare-up of the disease may be able to be understood and managed, informing the public health response before the contagion can spread too widely.

3   CONCLUSIONS

The National Pipe Data Portal is one of the central pillars of the Building Innovation Partnership's focus on improved investment decision-making for 3 Waters Networks. It is a tool to enable data standardisation, data sharing, and large scale analytics. It also creates the opportunity for much wider data integration across and range of utilities and other organisations of importance to the community.

The portal is currently under active development, and as such, new use cases are explored as the need and the opportunity arises. One such use case is tracking of Covid-19 in the sewerage system. Another use case is developing improved models for assessing the impact of floods on urban areas, including the impacts on related infrastructure such as road, electricity and telecommunications.

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