THE PROBLEM WITH DATA

How data science can help local authorities manage their infrastructure.

Local authorities rely on their ability to make evidence-based decisions in order to effectively manage their infrastructure. This means decision-makers require access to the right information, at the right time and need to interpret it in the right way.

Useful information disconnected from the decision-making process can result in lost opportunities, reduced performance or erroneous actions. Too much data, on the other hand, or data that is not presented in an easily-interpreted format, can significantly impede the decision-making process.

The exploding volume of raw data is a pressing issue for many organisations. According to the McKinsey Institute, 90 percent of the world's data has been created in the past two years.

As the volume of data continues to grow exponentially, organisations need access to increasingly specialised skills in order to extract operational insights. And this has led to the emergence of data science.

Unlocking insights hidden within data, big or small, is the focus of the relatively new discipline of data science. Data scientists require a blend of skills and experience that ranges across software engineering, statistics, business analytics and domain-specific knowledge. These skills are used to design and operate data analysis 'pipelines' that transform raw input and extract actionable results.

At international infrastructure engineering company MWH a team of data scientists uses four main insight 'extraction' techniques. These comprise:

- Visualisation – Graphical display of information to convey results clearly and effectively.
- Simulation – Modelling of real-world processes to examine the behaviour of a system.
- Prediction – Forecasts about the likelihood of events under any given scenarios.
- Optimisation – Identification of the best course of action from a range of alternatives, after consideration of operational criteria.

These techniques can be used individually, or in combination, to inform infrastructure management, or any other evidence-based business operation.

For most organisations, it is far easier to collect data than it is to appropriately examine, interrogate and interpret it. New Zealand local authorities are no exception. According to the Office of the Auditor-General's recent report *Water and Roads – Funding and Management Challenges*, most are not using the full functionality of their asset management information systems.

Moreover, the auditor-general's report highlighted the need for local authorities to lift their game when it comes to:

- having good information about the condition and performance of their assets;
- integrating that information with financial and service delivery decisions and risk management; and
- linking their spending on maintenance and renewals to an optimised decision-making approach.

Consequently, better integration and analysis of these data sets is required. This challenge falls directly under the remit of data science, meaning that the skills of data scientists will be increasingly utilised by local authorities in the future.

GETTING REAL

WEB-BASED VISUALISATION AND REPORTING

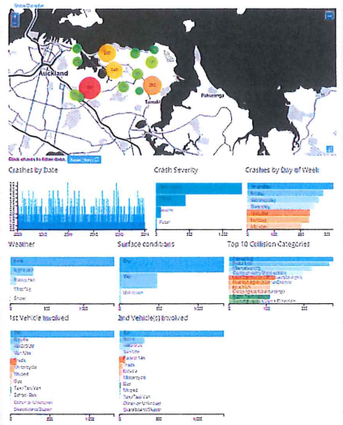
New Zealand's Crash Analysis System (CAS) is a specialised system maintained by the Ministry of Transport. Extensive training is required to fully utilise and extract data from within it. Consequently, few people are able to use CAS to its full potential. Additionally, the CAS data does not include information about the local road conditions that may contribute to each crash. Initially for internal use, MWH has developed an interactive web-based mapping tool to more easily query CAS data. This allows users to interactively drill down and explore crashes in an intuitive and widely-accessible manner. Users can also merge road surface condition data from another database.

Problem – How to unlock information contained in large related crash and road assets databases.

Solution – An interactive reporting tool that shows crash information spatially and allows results to be filtered against selected criteria.

Benefit – Improved efficiency. Easier access to – and interpretation of – 'buried' inter-related data sets.

Local area crash mapping - Auckland (sample)



PREDICTING ROAD SEAL REPLACEMENT RATES

There comes a time when assets such as roads need to be repaired or replaced. Consequently many organisations want to forecast their future replacement and repair costs based on historic failure rates. MWH determined survival profiles of different road surface materials for 11,000 kilometres of New Zealand's state highway network. The longevity of each material was established after considering factors such as traffic volume, proportion of heavy vehicles and region. With accurate survival curves to hand, it was straightforward to estimate how many times a particular surface material would need to be replaced over a five to 15 year planning horizon. This in turn allowed the cost-effectiveness of each material to be assessed against the others, given the differences in cost and anticipated replacement rates.

Problem – How to estimate future road surface replacement rates on the state highway network across a range of surface types and conditions.

Solution – Create statistical survival and replacement rate profiles by surface type and condition from a large dataset.

Benefit – Improved accuracy of asset life cycle estimates and increased confidence in replacement decisions.

This work received very positive feedback when presented to the National Surfacing Steering Group – a group comprising representatives from local authorities, NZTA, consultants and contractors across the country. This method is being considered for use as the standard means of calculating road surface survival. **LG**

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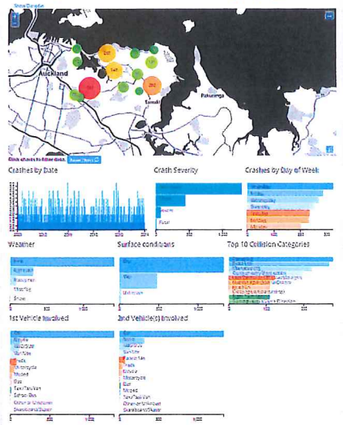

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